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1835

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ERRATUM.

Page 184. Note [2]. Lines 1 and 4. For *Gecarcinus ruricola* read *Grapsus ruricola*.

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TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY.

I. *On the* M'horr Antelope. *By* E. T. Bennett, *Esq., F.L.S., Sec. Z.S.*

Communicated January 8, 1833.

PLINY appears, with one exception, to be the only author of antiquity who distinguishes the *Dama* of the classical ages by any tangible characters; and even his slight notices are confined to its transmarine origin[1], and the forward curvature of its horns[2]. In other writers the word, although of frequent occurrence, is accompanied only by vague epithets, indicative for the most part of gentleness, timidity, and velocity. Thus we have in Horace[3] the epithet "pavidæ"; in Virgil[4], "timidi"; in Martial, "molles[5], imbelles[6]"; in Seneca[7], "veloces"; and in Columella[8], "velocissimæ";—all applied to the *Damæ*, which appear, from the constant references made to them about that period, to have been well known at Rome in the times of the earlier Cæsars. The exception above noticed occurs in the fragment of the Halieuticon, generally ascribed to Ovid and at all events written by a contemporary author, and merely determines the animal to have had a fawn-coloured back, and to have been an object of the chase[9]. In this latter particular the writer, whoever he may have been, is confirmed by Virgil[10] and Columella[11]. It seems scarcely probable that an animal so well known, and com-

[1] "Sunt et damæ, et pygargi, et strepsicerotes, multaque alia haud dissimilia—hæc transmarini situs mittunt." Lib. viii. cap. 53.

[2] "Cornua—in rupicapris in dorsum adunca, damis in adversum." Lib. xi. cap. 37.

[3] Carm. lib. i. Od. 2. [4] Ecl. 8, 28; and Georg. lib. iii. 539. [5] Epig. lib. iv. 35.

[6] Epig. lib. xiii. 91. [7] Hippol. 61. [8] De Re Rust. (ed. Schn.) lib. vii. cap. 12.

[9] "Altera pars fidens pedibus dat terga sequenti:
Ut pavidi Lepores, ut fulvo tergore Damæ
Et capto fugiens Cervus sine fine timore."—Hal. (ed. Gesn.) p. 4.

[10] Georg. lib. iii. 410. [11] loc. cit.

monly applied to such a purpose, could have been of foreign origin and brought from beyond the seas; and it is therefore natural to conclude that most, if not all, of the last-mentioned writers refer to a different animal from that of Pliny, and probably to our own Fallow-deer, the name of which, in almost every language of modern Europe, is evidently derived from the same root with the Latin *Dama*. If this supposition be admitted, the name of *Dama* can no longer be regarded as improperly applied to the Fallow-deer, merely because Pliny has thought fit to transfer it to an exotic animal, and to adopt for the European species the name of *Platyceros*, given to it by the more scientific Greeks.

The first attempt to identify the "Dama Plinii" in modern times was made by our learned countryman John Caius, who communicated to Conrad Gesner[1] the drawing of an animal which he suspected to be the same with that of Pliny. In a letter to Gesner, he states that an English friend of his had assured him that such animals were found in the northern parts of Britain. Buffon[2] conjectures the figure in question to be that of a Goat, with the horns accidentally curved forwards; but the resemblance of the horns to those of the animal described by himself under the name of *Nanguer*, raises a doubt upon this point, and at least excuses Caius and Gesner for regarding it as the *Dama* of Pliny, of which this form of horns is the most clearly distinctive mark. In a subsequent communication Caius writes that he had since learned from his friend that the animal was indeed found in the North of Britain, but that it had been introduced; and that he had seen it in the possession of a nobleman, to whom it had been presented. I have heard, he adds, from some, that it is a native of Spain. From all this it is evident that the locality from whence it was derived was by no means positively determined; and an inspection of the figure will show, that notwithstanding the addition of a beard and the length of its hair, as well as the comparative shortness of the legs and neck, it is far from impossible that it was rudely sketched from an Antelope, rather than from a Goat. It is further stated to have been "colore Dorcadis," of the colour of the roebuck, a very unusual colour for a goat.

In 1764 Buffon[3] published, as his ninth species of Gazelle, the figure and description of an animal brought from Senegal, where Adanson stated that it was named *Nangueur*, or *Nanguer*. This animal agreed so well with the principal character assigned by Pliny to his *Dama*, that Buffon did not hesitate to regard it as identical; and Pallas[4] adopted the idea in his Monograph of the genus *Antilope*, published three years afterwards, in which the *Nanguer* was introduced under the name of *Antilope Dama*, which it has ever since retained. Pallas states that he had only seen the head and horns; and adds, on what authority it is therefore difficult to conjecture, that the female is equally furnished with horns.

[1] Gesner, Quadr. (ed. 1620.) p. 306.
[2] Hist. Nat. tom. xii. p. 214.
[3] Hist. Nat. tom. xii. p. 213. pl. xxxiv. the animal; and pl. xxxii. f. 3. the horn.
[4] Spic. Zool. fasc. i. p. 8.

No other original observations were made upon this subject until the year 1824, when M. Lichtenstein read before the Royal Academy at Berlin a Memoir on the *Antelopes* of North Africa, which was published in 1826. In this paper he described and figured the male, female, and young of a species of *Antelope* transmitted from Nubia by MM. Ehrenberg and Hemprich, which he believed, notwithstanding the extent of geographical range thus indicated, to be identical with the *Nanguer* of Senegal. In the MS. notes of these distinguished travellers, the native name of *Addra* is applied to the animal in question. Figures of the adult and young, evidently of the same species, have since been given, with the same scientific and native name, in M. Rüppell's Zoological Atlas, from specimens obtained in Kordofan. These specimens were observed in the Frankfort Museum by Colonel Hamilton Smith, who described them in Mr. Griffith's edition of Cuvier's "Animal Kingdom," under the name of *Antilope ruficollis*, which seems to have been originally attached to them in that collection.

On comparing the figures and descriptions contained in the works referred to with each other, and with two living specimens and an imperfect skin of an *Antelope*,—for which the Society are indebted to the active exertions of Mr. Drummond Hay, His Majesty's Consul-General at Tangier, and of Mr. Willshire, Vice-Consul at Mogadore, and which were brought from the territories of the Sheikh of Wednoon (twelve days' journey inland from the latter place),—I have been led to the conclusion, not only that the Society's animals differ from that of Buffon, but also that those of MM. Lichtenstein and Rüppell are sufficiently distinct from both to be regarded as a different race. Whether the variations which I am about to point out may be considered important enough to constitute of these animals three distinct species; or whether they may be regarded as indicative only of the existence of so many local races in one and the same species,—may possibly remain a question, until we can have the opportunity of consulting Senegalese specimens of the *Nanguer*, which appears no longer to exist in any European Museum, together with specimens, if any such should be found, of similar animals from intermediate localities. At present I am disposed to consider them as three species, to be provisionally adopted (like those which have been formed from animals intimately allied to the Gazelle, *Antilope Dorcas*, Pall.) until further investigation shall lead to a more perfect understanding of the subject. With the view of furnishing the means of comparison between the Society's animals, which were transmitted under the native name of *M'horr*, and those published by other authors, I proceed to give a detailed description of the former, taken chiefly from the individual which has lately died at the Society's Gardens, and which, except in one or two trifling particulars to be hereafter noticed, agrees in all respects with that which still survives.

The form of the *M'horr* is light and elegant; its neck is long and slender; its tail is of moderate length; its limbs are extremely slender and delicate; and its hoofs are short, pointed, and form a rather acute angle at their anterior margin. The head tapers uniformly, with a face moderately prolonged, suborbital sinuses of small extent, and its naked muzzle limited to a narrow border round the nostrils, which is prolonged in a middle line as far as the margin of the upper lip. The horns are black, imbedded at their base in long hair, and marked, in this individual, with eight complete, rather distinct, well defined rings, and one or two incomplete ones, which occupy about two thirds of their entire length, the remainder towards the points being perfectly smooth and shining. They rise upwards from the head, and pass backwards, and a little outwards to a short distance beyond the termination of the rings, from which point they form a strong curve forwards, and thus bring the upper and smooth part to a right angle with the rest of the horn, and with the line of profile. Their extreme point is nearly straight. In the living individual, which is evidently an older animal, the number of rings is eleven; the base of the horns rises more abruptly from the head, and the proportionate length of the annulated and smooth portions corresponds with the greater development of the former.

The colour of the upper parts is a deep fulvous or dull bay, which extends about two thirds down the sides, where it terminates abruptly in the white of the belly. It is continued along the middle of the back to within a short distance of the tail, and is rounded posteriorly. From the hinder part of the sides the deep colour is continued in a broad and somewhat triangular patch upon the haunches, whence it proceeds in a narrowing stripe down the middle of the outside of the legs as far as the hock, on which it extends rather broadly backwards, and below which the stripe crosses obliquely and gradually towards the front of the limb, terminating a short distance above the hoofs, and occupying at its termination the anterior outer part of the fetlock. Throughout this course the separation of the fulvous colour from the pure white immediately adjoining it, is strongly defined.

At the shoulders, in the individual under description, the deep upper colour terminates below abruptly; but above the knees on the outer surface of the fore legs a faint stripe is seen gradually deepening downwards to the colour of the upper surface. It crosses below the knees towards the front, and terminates above the hoofs like the stripe on the hinder legs. In the imperfect skin before mentioned, and in the living individual, the stripe is lengthened upwards so as nearly to join the dark upper colour, with which it is united by a streak of a fainter hue.

The brush below the knees is well marked, and rather large. It occupies the front of the leg, is bounded exteriorly by the deep colour, and is surrounded in the rest of its circumference by white; the whole of the hairs directed towards its centre are white. They are rigid and erect, and much longer than the adjoining hairs.

The deep fulvous colour of the upper surface extends over the whole neck both above and below, and becomes fainter on the head, passing up the cheeks and fading away under the eyes; between the ears and behind the horns it is tinged with blackish or iron-grey. This grey occurs again in front of the horns, where it is slightly intermingled with rufous, and is continued in a broad stripe down the middle line of the face to the muzzle; the middle of this streak has more white than its extremities, the white being slightly tinged with fawn. In the larger individual the median stripe is dark at its upper part only, the lower part having merely a few black hairs intermingled with the white. On either side, this darker middle streak is bounded by a nearly white but somewhat fawn-coloured streak, proceeding from above the eye to the muzzle. From the inner canthus of the eye a deep grey streak, bordering the last, passes to the angle of the mouth; at its upper part, adjoining the small suborbital sinus, it is nearly black. The same black colour occurs in a corresponding spot above and behind the eye. Immediately adjoining the eye, and surrounding the under lid and outer canthus, is a patch of white; and a large patch of white occurs also under the base of the ear, extending backwards, and being separated in front from that of the hinder part of the eye by the intervention of rather pale rufous proceeding from the cheeks to just behind the base of the horns. The hairs of the base and tips of the ears in front, of their edges, and of two longitudinal lines within them, are white. The outside of the ears is fulvous, with a mixture of blackish, which is considerably increased towards the tips, where the colour is nearly black.

The whole of the lower parts of the sides and under surface, with the inner, the hinder, and the anterior surfaces of the limbs, are pure white. The white of the hinder part of the posterior limbs extends upwards for about four inches above the tail, including the tail and the whole rump, and is prolonged forwards on each haunch in a broad streak about five inches in length. The long hairs of the tip of the tail are alone fulvous, intermingled with black. The lips and lower jaw, extending to the upper part of the throat, are white. A remarkable white patch is seated about half way down in front of the neck; its form is that of a crescent placed transversely.

The hair on the body is of moderate length, adpressed, and firm. That of the face and legs is shorter, and equally adpressed. At the base of the horns in front it is much longer, tufted, and somewhat erect. The under part and sides of the tail are naked; the hairs of its outer surface are erect and short, except close to the tip, where they gradually lengthen, forming a tuft projecting backwards, and nearly two inches in length.

The measurements are as follow:—

	Ft.	In.
Length, along the line of the back, from the tip of the nose to the base of the tail	4	2
Length from the tip of the nose to the inner canthus		6
Length from the tip of the nose to the base of the horn		7
Length of the tail (exclusive of the hair)		7
Height to the tip of the horn	3	0
Height at the shoulder	2	6
Height at the loins	2	8
Length of the horn along its curve anteriorly		9½

	In.
Length of the horn in a straight line	7½
Distance between the tips of the horns	5¾
Circumference of the horn at its base	5⅛

The survivor, being the older animal, is some inches taller, and its other measurements greater in proportion; but these cannot be obtained with accuracy during life[1]. Both individuals are males; but the female, as appears by a note of Mr. Willshire's, is equally furnished with horns.

The distinction between the three animals, the *Nanguer* of Buffon, the *Addra* of M. Lichtenstein and of M. Rüppell, and the *M'horr* of the Society's Gardens, is to be found chiefly in the distribution of their colours. The horns of the *Nanguer*, as figured by Buffon, appear intermediate in form between those of the young *Addra* and the *M'horr*, having no more than six rings, rising almost in a straight direction from the head to the point of curvature forwards, and measuring only six or seven inches in length. But the supposition that this is an intermediate state of the same animal, is contradicted by the colouring, the dorsal fawn in the *Nanguer* extending along the back and sides nearly as far backwards and downwards as in the *M'horr*, while in the young, as well as in the adult *Addra*, it gradually becomes narrower and fainter as it passes backwards from the lower part of the neck, leaving not merely the haunches and the crupper, but also the far greater part of the sides, white. This is equally the case in the young male with the horns scarcely protruded beyond the commencement of the rings, and in the adult with eighteen or nineteen rings to the horn; and is still more decided in the female, where the deeper colour is even more circumscribed in extent. In the specimens represented in M. Rüppell's work, there is also figured and described a short longitudinal fawn-coloured streak on the haunches, which is not met with in M. Lichtenstein's figures, and is equally wanting both in the *Nanguer* and in the *M'horr*. In the former of these the haunches are wholly unmarked, the dorsal colour being cut off posteriorly in nearly a straight line, extending from the back downwards; while in the latter, as we have seen, they are nearly covered by a broad somewhat triangular patch continued from the sides, extending down the hinder legs, and bounded above by a white streak, which is continuous with the white of the crupper.

How far local circumstances may operate in producing more or less permanent, and more or less extensive, variations of colour, I will not attempt to decide: but the perfect coincidence in markings of the young and adult *Addra*, male and female, as figured in

[1] This animal having since died, I am enabled to add its measurements, as follows:—Length, as above, 5 feet 1 inch; from the tip of the nose to the inner canthus of the eye, 6¼ inches; from the tip of the nose to the base of the horn, 7½ inches; of the tail (exclusive of the hair), 8 inches. Height to the tip of the horn, 4 feet 5½ inches; at the shoulder, 2 feet 11 inches; at the loins, 3 feet 1 inch. The length of the horn along its curvature anteriorly is 12 inches; and taken in a straight line from base to tip, 9½ inches; the distance between the tips of the horns, 4 inches; and the circumference of the horn at its base, 6½ inches.

the Berlin Transactions, and in the work of M. Rüppell, appears to me to furnish the most convincing proof that neither the *Nanguer* nor the *M'horr* can possibly represent intermediate stages of the same animal. I therefore consider myself fully justified in assigning the following differential names and characters to each. I have not retained for either of them the name of *Dama*, because, as far as the essential character goes, it seems to be equally applicable to all. Perhaps, however, on strict principles of nomenclature, it ought to have been retained for Buffon's animal, to which, as a trivial name, it was unquestionably first applied.

Genus ANTILOPE, *Pall.*

Sectio, DAMÆ. Cornua reflexa, annulata; versus apicem insigniter procurva, lævia. Collum elongatum, maculâ mediâ anticâ transversâ albâ.

ANTILOPE MHORR.

Ant. obscurè badia; facie albidâ, vittis tribus griseis; prymnâ lineâque latâ utrinque inde antrorsum ductâ, caudâ, ventre, artubusque internè anticè posticèque albis; coloribus abruptis.

Hab. in Africæ Occidentalis ditione Wednoon.

ANTILOPE NANGUER.

Ant. suprà fulva; infrà, prymnâ, clunibusque totis albis.

Nanguer, *Buff.*, *Hist. Nat.* xii. *p.* 213. *pl.* xxxii. *f.* 3. & *pl.* xxxiv.

Antilope Dama, *Pall.*, *Spic. Zool.* 1. *p.* 8.

Hab. in Senegaliâ.

ANTILOPE ADDRA.

Ant. collo dorsoque medio dilutè fulvis; infrà, prymnâ, dorso posteriore, lateribusque albis.

Antilope Dama, *Licht.*, *in Abhandl. Akad. Berl. für* 1824. *p.* 226. *Tabulæ duæ.*—*Cretzschm.*, *in Rüpp. Afrika, Atlas Zool. pp.* 39. & 43. *tt.* 14. & 16.—*Ehr.*, *Symb. Phys.*, *Mamm. t.* 6. (♂, ♀, adulti juvenesque)[1].

[1] The plate of Ehrenberg above referred to, as containing figures of the Nubian species, was published, I believe, in 1829; but the illustrative text, which bears date in August 1832, did not reach this country until after the reading of the present paper. In it the learned author expresses his doubts of the correctness of the Plinian synonym as applied either to the *Addra* or the *Nanguer*; and considers the word *Dama*, as used by other classical writers, to be a common appellation of all cervine beasts of chase. He is of opinion that the species of *Antelopes* are circumscribed within very narrow limits; and for this reason, as well as on account of the shorter and thicker neck, and much shorter horns of the Senegalese animal, he seems inclined to regard the *Dama* of Eastern and Western Africa as distinct, but does not venture on changing the received denomination. Of the *M'horr* he had no knowledge. The particulars of the habits of the *Addra*, as observed by himself in the territory of Dongola, to which it would appear to be almost confined; and the descriptions and minute admeasurements of the adult male, its skeleton, the female, and the young of both sexes, render this a highly valuable addition to our stock of information relative to the Eastern animal.

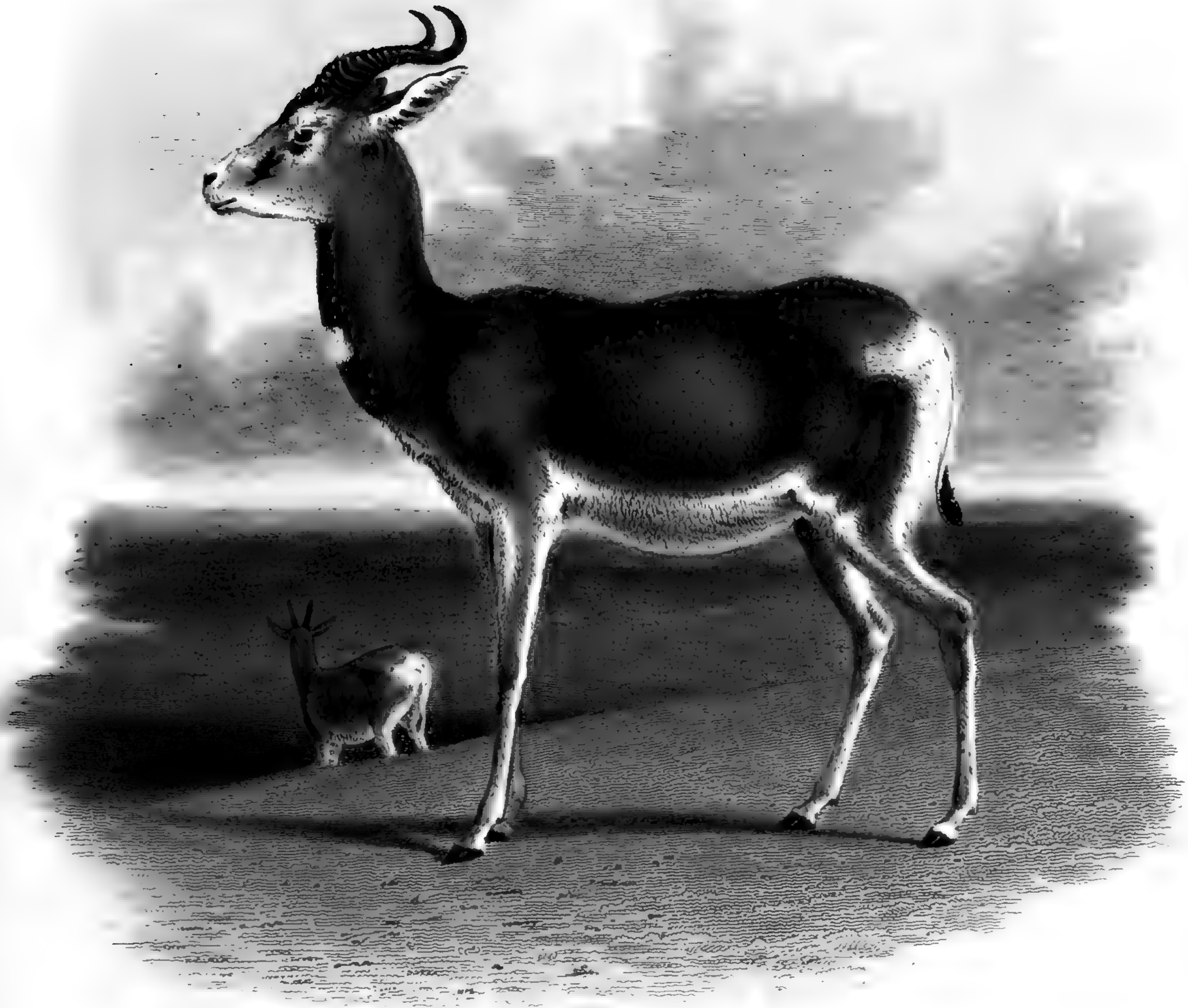
Antilope ruficollis, Cretzschm.; *Ham. Smith in Griffith's Anim. Kingd.* iv. *p.* 205. & v. *sp.* 822.
Hab. in Nubiâ et Kordofan.

The *M'horr* is regarded in the kingdom of Marocco as an exceedingly rare animal, and Mr. Willshire states that the one earliest obtained by him was the first individual of the race which had been seen in Mogadore. It is highly esteemed, according to Mr. Drummond Hay, on account of its producing the bezoars, so precious in oriental medicine, and which are known in Marocco as the Baid-al-Mhorr, or Eggs of the M'horr. Mr. Hay conjectures that Baid-Mhorr may possibly be the source whence, rather than from the Persian Pazahar, the name of Bezoar has sprung. It is pretended that two of these calculous concretions are met with in the intestines of every individual of the race; but none were found in that which died in the Society's collection, and which, as is stated by Mr. Spooner and Mr. Langstaff, who examined it after death, agreed in its visceral anatomy with the *Antelopes* in general. Mr. Spooner's notes of this examination are published in the Proceedings of the Society.

PLATE I.

ANTILOPE MHORR.

Trans. Zool. Soc. Vol. 1. Pl. 4 p.



Antilope Mhorr

Hills, del.

II. *On the Nervous System of* Beroë Pileus, *Lam., and on the Structure of its Cilia. By* ROBERT E. GRANT, *M.D., F.R.S. Ed., L.S., G.S., Z.S., &c., Professor of Comparative Anatomy and Zoology in the University of London.*

Communicated January 8, 1833.

IN the month of September last I obtained on the coast of Sheppey, in the Thames, a specimen of the *globular Beroë, Beroë Pileus*, Lam., a species which has been observed occasionally on the coasts of England and Scotland, and which I had once before met with on the coast of Staffa. It constitutes the genus *Pleurobrachia* of Dr. Fleming, and the *Eucharis* of Péron and M. Blainville. I found this little animal floating with myriads of minute *Equoreæ* and other *Medusaria* in the harbour of Sheerness. The boatmen, who seemed to be familiar with it under the name of the spawn of the Sea-egg (*Echinus*), which it somewhat resembles in its globular and ribbed form, assured me that often in hot and calm weather they swarm, with the little *Medusæ*, in such numbers as to cover the surface of the water in all this part of the estuary of the Thames. The animal has a regular oval form, with its longest diameter, from the mouth to the *anus*, about six lines, and its breadth about four lines. The general texture of the body is quite transparent and colourless. The eight equidistant bands which support the *cilia*, extend along the surface from the margins of the mouth to the *anus*, and appear more firm in their texture and less transparent, than the rest of the body. There are four prominent membranous lobes placed around the mouth, which the animal can retract at pleasure. The mouth and *œsophagus* are wide; and the latter continues so to the stomach, which extends to the centre of the body. The intestine continues straight, equal, and narrow, from the stomach to the *anus*, which has a prominent circular margin. The digestive organs contained no perceptible food, but Fabricius has often observed minute *Crustacea* in that cavity. The ovaries consisted of two lengthened clusters of small spherical gemmules, of a lively crimson-red colour, extending along the sides of the intestine and stomach. Their bright red colour contrasted beautifully with the glassy transparency of the general texture of the animal; and I have generally observed that the lively hues presented by the *Acalepha*, depend on the bright opaque colours of their reproductive gemmules, which are often red, sometimes yellow, or brown, or purple. The two *tentacula* are remarkable in this species of *Beroë* for their complex structure, and their peculiar movements. They extend from two curved tubes placed near the sides of the stomach, which pass obliquely downwards and outwards to terminate between two of the bands at some distance above the mouth. They are about four times the length of the animal, and consist of two thin white filaments, round, and tapering to a very fine extremity. Along their whole course they present minute equidistant filaments, extending from their lower margin, which coil themselves up in a spiral manner, and adhere close to the *tentacula* when they are about to be withdrawn into their sheaths or tubes. These tubes have a sigmoid form, and are shut and somewhat dilated at their upper extremity. The *tentacula* seem to be spirally twisted in them when withdrawn. The *tentacula* are often thrown out from the tubes to their full extent by one impulse, and the slow uncoiling of the slender serpentine filaments from their margin is then very beautiful; when coiled up, they appeared like very minute tubercles along the side of the *tentaculum*. The animal often poised its body in the water, without moving the *cilia*, by extending these minute filaments to the bottom of the vessel. I observed that both the *Beroë* and the *Equoreæ* were inconvenienced by each other's presence, and less free in the extension of their delicate *tentacula*, until they were put into separate vessels.

At a short distance above the mouth I could perceive a double transverse filament of a milky white colour, like that of the abdominal nerves of the *Pectinaria* and other transparent animals, which formed a continuous circle round the body. In the middle of the space, however, between each of the bands of *cilia*, these cords presented a small knot or *ganglion*, so that there were eight *ganglia* in the course of this ring. From each of these *ganglia* two nerves on each side passed to the adjoining band, and a larger filament from each *ganglion* could be traced upwards in the middle of the transparent space between the bands to beyond the middle of the body. In the course of these longitudinal middle filaments two or three smaller *ganglia* could be observed, from which filaments were directed inwards to the *viscera*. These filaments and *ganglia* were situated near the surface of the body; and from their general appearance and their mode of distribution, there can be little doubt that they constitute the nervous system of this animal. This arrangement of the nervous system is analogous to that of *Holothuria* and *Asterias* among the *Echinoderma*, in the circular disposition of the central filaments and *ganglia*, and in the regular radiation of nerves from that circle. All the movements of the *Beroë* are of a lively character; its *tentacula* and the lips of the mouth appear to be exquisitely sensible; the animal frequently contracts its body longitudinally or transversely by a sudden impulse, and when it is at rest the slightest agitation of the vessel containing it, causes it to commence instantaneously the rapid vibration of its *cilia*. The *Rotiferous animalcules* are found to possess a complex nervous system, consisting of cerebral and œsophageal *ganglia* and longitudinal nervous filaments, and even the *Polygastric animalcules* possess organs of vision. I am inclined therefore to believe, that although nerves have not hitherto been shown in the *Acalepha*, they will be found even in the simpler forms of *Medusæ*, which I have shown elsewhere to be affected by light, as well as *Actiniæ*, *Hydræ*, and *Furcocercæ*.

The *cilia* of this *Beroë* are the largest I have yet met with in any animal. These singular minute vibratile organs perform important functions in the simpler forms of animals, and in the embryo condition of more elevated classes. They are the organs of motion and of respiration in the *Polygastrica* and *Rotifera*. They are the instruments of respiration, and produce the currents to the mouths of the *polypi* of *Zoophytes*. They are the organs of locomotion of the reproductive gemmules of *Poriferous* and *Polypiferous animals*, and probably produce the currents through the pores of the former class. They are important parts of the respiratory apparatus of adult *Conchifera*, and I have shown them to be the organs of locomotion in the embryos of *naked* and *testaceous Gasteropods*. They constitute the organs of locomotion and of respiration in several genera of *Acalepha* allied to the *Beroë*, of which M. Blainville has formed a family thence called *Ciliogrades*.

These minute hair-like organs are variously disposed on the surface of animals according to the object of their motions, whether for respiration, progressive motion, or obtaining food. They move with great regularity and velocity, and they occur so numerous on a single animal, that I have calculated about four hundred millions of them on a single *Flustra foliacea*. The *cilia* are generally organs so minute, that with the aid of the microscope we can only discover their outward form, their position, and the direction of their motions, their intimate structure entirely escaping observation. They appear like flat tapering filaments prolonged from the homogeneous cellular tissue of the body to which they are attached. The magnitude, however, of these organs in the *Beroë*, and the transparency of the parts around them, enabled me to perceive that in this animal they are not single fibres, but consist of several straight short transparent filaments placed parallel to each other in a single row, and connected together by the skin of the animal, like the rays supporting the fins of a fish. These fins are of the same breadth with the bands to which they are attached, and they extend from the mouth to the *anus*, there being about forty on each band. Viewed with the aid of a lens, the parallel fibres appear like transparent tubes, sometimes a little detached from each other at their free extremities by injury done to the connecting membrane, and at these parts the isolated spines projected stiffly outwards. Where the fins were quite entire, the membrane connected the tubular rays to their extremity, where the fin presented a slightly rounded outline. Dr. Fleming observed in *Beroë ovatus* water moving in vessels along the middle of the bands to which the *cilia* are attached; and M. Audouin has observed that in the closely allied genus *Idya*, the water is sent into the *cilia*, which he considers as respiratory organs. The animals can change the direction of the currents of water in the vessels, and also the direction of the motions of the *cilia*. When the *cilia* are in active vibration, the motion appears like the continued undulations of a fluid along the surface of each band. This structure cannot be observed in the minuter forms of the *cilia* in other classes; but from the similarity of their arrangement, and their mode of action, it is probable that the structure is similar. The *cilia* of *Trichoda patula*, Müll., a minute animalcule, are disposed in longitudinal series from the mouth to the *anus*, precisely as in the *Beroës*. It does not appear probable that the regular and rapid vibrations of these very minute organs in the lowest forms of animal organization, depend on volition directed at once to thousands of millions of muscles. When the *tentaculum* of a *Flustra* is cut off from the *polypus*, I have observed it swim like a straight worm, or a *Vorticella*, through the water by the action of the *cilia* still continuing; and it was observed by Fabricius, that when the *Beroë* is broken to pieces these continue to live, and to swim about by the action of the *cilia* still kept up. The tubular feet which project from the *ambulacra* of the *Asterias*, rise and sink in constant succession by the entrance and exit of water sent into them by vessels destined for that office. The same mechanism is observed in *Echinus* and in *Holothuria*, (the forms of which, as well as the arrangement of the feet, closely resemble those of the *Beroë*,) and the tubular *tentacula* of *Actinia* rise by the injection of water into them from their base. It appears therefore highly probable that the motions of the *cilia* of the *Beroë* are intimately connected with the streams passing along the bands; and should the rapid vibrations of these singular organs in the lowest animals depend on the undulations of water conveyed through elastic tubes along their bases, one of the most remarkable phenomena of animal motion, though one of the most frequent, will lose much of its present marvellous character, and prove another instance of the striking similarity of the phenomena of the simplest organic beings to those which occur in the inorganic world.

PLATE II.

Fig. 1. BEROË PILEUS, *Lam.* (twice the natural size).

III. *Observations on the Laws which appear to influence the Assumption and Changes of Plumage in Birds.* *By* WILLIAM YARRELL, *Esq., F.L.S. & Z.S.*

Communicated February 26, and April 23, 1833.

THE changes of plumage observable in birds at certain seasons, have of late years occupied much of the attention of ornithologists; and among others of our own countrymen, we are greatly indebted to the late Colonel Montagu for a long series of observations, by which the difficulties of tracing specific identity in many instances were successfully cleared up, and various periodical appearances distinguished and described.

These interesting changes have their origin in various causes, and are produced by different means: some are the effect of age, others of sex, season, or disease; sometimes they are produced by moulting, or discharging the old feathers and obtaining new ones, but more frequently by one or other of two different processes.

Before, however, proceeding to explain the manner in which changes are otherwise produced in the plumage of birds, it may be considered necessary to say a few words on the feathers themselves.

The bulb or pulp, which is the foundation of each feather, has its origin in a gland or follicle of the skin; and as the pulp lengthens, this gland or follicle is itself absorbed. The pulp still lengthening becomes invested on its outer surface with several concentric layers of condensed cellular membrane, from which the shaft, the filaments of both lateral webs, the colouring matter and the horny quill are severally produced; but anatomists appear to differ a little in opinion as to the exact manner in which the growth of the various parts takes place. The pulp, which nearly fills the barrel of the quill while the feather is forming, is connected with the body of the bird by an aperture at that end of the quill which is fixed in the skin, through which aperture or *umbilicus* a portion of the pulp is extended. The whole of the pulp, within as well as without the quill, is the only part of the feather which appears to be vascular, and the large feathers of the wing may be injected, while growing, from the humeral artery; but the feathers once perfected, the injection can no longer be sent even into the pulp. The membranes of which it was composed, the former *nidus* of vessels now obliterated, dry up, contract, and ultimately separating transversely into funnel-shaped portions, (which remain in the barrel of each quill,) are well known by the familiar term of pith.

A perfect feather presents many points of interest, if we consider its various parts, form, colour, strength, lightness, durability, and the peculiar manner in which the fibres of the web lock in with each other to afford continuity of surface. The accessory plume also requires to be noticed. This is usually a small downy tuft, which not only assumes a very different character in the feathers of different species, but is even very dissimilar in the feathers of different parts of the body of the same bird. The accessory plume is situated at the distal end of the quill, at the aperture through which the shaft and its lateral fibres have passed out, and at the central point from which the two lines of the web begin to diverge. In the strong feathers peculiar to the wings and tail, it remains a small tuft of down, as at first mentioned; but in the feathers of the body in the *Hawks*, *Grouse*, *Ducks*, *Gulls*, and some others, it is to be found of all sizes, augmented in some species to the full extent of the feather from which it emanates. The four species of *Struthious* birds afford remarkable instances of the variety that occurs in this accessory plume, even in subjects so closely allied; and the rich Menagerie of the Society enables me to speak of them from personal examination upon living specimens. In the *Ostrich* the feathers have no accessory plume. In the *Rhea* there is a tuft of down. In the *Emu* the accessory plume is augmented to the full size of the principal shaft and web, and the feather of this bird is constantly and correctly represented as having two plumes on one quill. In the *Cassowary*, besides the double shafts and webs from a single quill, as in the *Emu*, there is still an accessory plume, thus forming three distinct parts; and a feather so constructed is figured by M. Guérin in his 'Iconographie du Règne Animal'. (Oiseaux, pl. 48.)

In young birds the first feathers are preceded in their passage through the skin by filaments of down; but after the first plumage, at the regular period of moulting, each old feather is the pioneer (*gubernaculum*) of that which is to follow. If the shaft of a principal feather becomes broken off, the bird ejects the stump with difficulty; a certain portion of shaft appears to be necessary to enable the bird to get rid of the feather. Though perfectly able to throw off the old feather if entire, it seems unable to cast off the smaller but mutilated portion, and no new feather comes through the skin, the orifice being occupied. Inflammation of the vessels in the part of the bird, and increased adhesion of the stump, are the consequences; and whether these portions of the feathers are allowed to remain, or too many of them drawn out at the same time, disease and some risk to life are the result;—in the first instance from continued irritation, in the second from too great and sudden a demand upon the vital powers of the animal. The natural moult proceeds by degrees, and the large quill-feathers of the wings and tail are generally shed by pairs.

The state of the plumage in birds, like that of the productions of the cuticle in other animals, man not excepted, is in general a good criterion by which to judge of the health of the body.

The principal peculiarities of the feather thus briefly premised, it may be added that the time required to obtain that state of plumage which is considered characteristic of the adult bird, varies according to the species from one year to five; and that several birds build nests, and rear young, before they attain their adult plumage.

Baron Cuvier has stated, that when the adult female bird differs from the male in the colour of her plumage, the young birds of both sexes, in their first feathers, resemble the female; the young males afterwards putting forth the colours that indicate their sex. When the adult male and female are of the same colour, the young then have a plumage peculiar to themselves. To these laws which appear to govern the assumption of plumage in young birds, and of the first of which (to select in illustration examples the most familiar among land and water birds,) the various *Pheasants* and *Ducks* may be named; and of the second, the *Partridges* and *Gulls*; a third law may be added: whenever adult birds assume a plumage during the breeding season decidedly different in colour from that which they bear in the winter, the young birds have a plumage intermediate in the general tone of its colour compared with the two periodical states of the parent birds, and bearing also indications of the colours to be afterwards attained at either period.

There are three modes by which changes in the appearance of the plumage of birds are produced:—

By the feather itself becoming altered in colour.

By the bird's obtaining a certain number of new feathers without shedding any of the old ones; and

By an entire or partial moulting, at which old feathers are thrown off, and new ones produced in their places.

The first two of these changes are observed in adult birds at the end of spring, indicating the approach of the breeding season; the third change is partial in spring, and entire in autumn. That the colours of the plumage are more brilliant during the breeding season is well known; and ichthyologists have observed that the scales of fishes become brighter as the season for spawning approaches.

A fourth mode may be noticed, though its effects are limited. It is observable in spring, as the breeding season approaches, by the wearing off of the lengthened lighter-coloured tips of the barbs of the feathers on the body, by which the brighter tints of the plumage underneath are exposed, as has been noticed by Sir William Jardine and Mr. Blyth. The effect is most conspicuous in the *Buntings*, *Finches*, and *Warblers*.

Young birds of the year in various species, after the autumn moult, continue through the winter to assume, by degrees, the more intense colours characteristic of adults, without changing the feather. This colour commences generally at that part of the web nearest the body of the bird, and gradually extends outwards till it pervades the whole feather.

In many birds the spring change is common to both sexes, as in the species of the genera *Limosa*, *Tringa*, *Totanus*, *Phalaropus*, &c. In others the males only are affected. The rapidity of this assumption of vivid and particular colours previously to the breeding season bears a relation to the sexual vigour of the birds; and one of the great objects of existence being accomplished in the reproduction of the species, the plumage almost immediately indicates the commencement of a return to the colours peculiar to winter.

The most conspicuous changes of plumage appear to be coincident with an altering or altered state of the sexual organs.

The perfection and beauty of a recently acquired plumage compared with its appearance as the time of moulting approaches, when the sources by which it has been formed and nourished are about to be directed to the production of new feathers:

The power possessed by many birds, particularly the *Ducks*, of resisting while alive the constant action of water, which power is lost after death:

The fading of the more delicate tints of the plumage soon after life is extinct, as in the *Goosander* and others: and the varieties occasionally seen, generally young and weak birds, which, as they increase in health and strength, and obtain in consequence natural secretions, put forth by degrees the plumage common to the species,—are additional proofs that feathers are influenced by constitutional power, and their colour affected as the secretions alter under constitutional changes. The remarkable alteration observed in some females, particularly among the *Gallinaceous* birds, when from disease, age, or other cause, they are deprived of the influence of the perfect sexual organ, and assume in consequence the appearance of the male, is a striking example of an alteration in the colour of the feather produced by a constitutional change and its influence.

Montagu was unwilling to believe that the feathers themselves changed colour, as he states in the Introduction to his 'Ornithological Dictionary'; and it is certainly difficult to understand how this is so constantly effected in the web of the feather, where no vascularity can be shown to exist even when the part is growing: but the fact is certain; it has been confirmed by the repeated observations of the Rev. Mr. Whitear and Mr. Youell (Linn. Trans., vol. xii. p. 524.); and of this fact further proof will be adduced in the course of this paper.

Several birds examined in April were changing the colour of some parts of their plumage from that which is peculiar to winter, to that of the breeding season. Many of the old feathers obtained at the preceding autumn moult still retained the colours they had borne through the winter; others were changing; and some had entirely assumed the colours peculiar to the breeding season, bearing precisely the same tints and markings as some new spring feathers, the webs of which were only in part exposed.

This change of colour was particularly noticed among the scapulars, tertials and wing-coverts of the *black* and *barred-tailed Godwits*, the worn state of the edges of the webs and tips of these feathers leaving no doubt of their being old ones. On the breasts of several *golden Plovers*, some of the feathers were entirely white, the colour peculiar to all the feathers of that part of the bird in winter; some were entirely black, being the colour assumed at the breeding season; while others bore almost every possible proportion of well-defined black and white on the same feathers; from which it appears that the same cause of particular colour in new feathers can also partially or entirely change the colour of old ones.

In the paper in the Linnean Transactions before referred to, Mr. Whitear, after detailing various instances of the change of colour in the feathers of birds during the early part of the year, (a change which has also been observed in the *black* and *barred-tailed Godwits*, the *Knot*, *Dunlin*, *grey* and *golden Plovers*, *Mallard*, *black-headed Gull*, and others,) adds the following paragraph. "If the feathers of a live bird, apparently beginning to change, were marked by fastening a piece of silk to them, notching them, or otherwise, and it was observed that the first colour of the feather gradually disappeared, while the new colour extended itself more and more, till the feather had assumed that exhibited by the perfect bird, the fact would be established beyond contradiction." This experiment I have performed, with the exact result which had been anticipated.

A *Herring Gull* (at the Society's Gardens), in its third year, was examined at Christmas last. Several tertial feathers were found to have their basal halves blue-grey, the other parts mottled with brown. Two notches were made with scissors on the webs of these feathers, intended to refer to the two colours then present. Some other feathers were wholly mottled with brown, and were marked with one notch. This bird was re-examined in April. The tertial feathers, which, when marked, were of two colours, were now entirely blue-grey; one was tipped with white. The other feathers, which, when marked, were wholly mottled, were now for two thirds pure white, the terminal third alone retaining the mottled brown.

The particulars which now follow are from the notes of James Hunt, one of the Keepers, made at the Gardens of the Zoological Society in the Regent's Park during the seasons of 1831, 1832 and 1833, but principally in 1832, and will be found to confirm, as far as they go, the views here taken.

Black-tailed Godwit.—*Limosa melanura*, Leisl.

Black markings began to appear on the feathers of the lower part of the breast and belly of this bird on the 24th of February 1833. Three days afterwards the feathers on the upper part of the head, neck and breast, began to change colour from dusky brown to red. On the 29th the scapulars, wing-coverts and tertials, began also to change their colour. By the 29th of April the bird had arrived at the full colour of the breeding plumage. The change that has been going on in this bird since the 24th of February, is absolutely an alteration of colour, and not produced by moulting, as I examined the bird day by day. The change commences at the base of each feather, and the tip is the last part that alters in colour.

Ruff.—*Tringa pugnax*, Linn.

The moulting of the *Ruff* commenced on the head and neck about the 29th of March 1832; the feathers on the body were not thrown off; the head and neck were left destitute of plumage, but the feathers of the body remained in a perfect state. The new ruff and head feathers appeared almost immediately, and were perfected by the 4th of May. This bird began to shed his ruff feathers on the 8th of June, and by the 6th of July he had lost them all.

The feathers that formed the ruff round the neck of this same bird in the spring of 1831 were ash-coloured; but the feathers that ornamented the same part during the spring of 1832 were decidedly black.

MANDARIN DUCK.—*Anas galericulata*, Linn.

The male bird commenced moulting off his breeding plumage about the 24th of May, and by the 3rd of July he so much resembled the female in the colour of his plumage, that it was a matter of some difficulty to distinguish them unless by a close inspection. He remained in this state until the 22nd of August, when he began to shed the feathers which were to be replaced by others of a more brilliant colour, and on the 25th of September he appeared in his perfect breeding plumage. In this last moulting the bird did not shed all his feathers, as in the spring,—but only those that gave place to new ones of a more brilliant colour. The wing and tail primaries, and the plainer feathers, were those produced in spring.

SUMMER DUCK.—*Anas Sponsa*, Linn. *Dendronessa Sponsa*, Swainson.

The male of this species began to moult off his breeding plumage about the 14th of June, and by the 29th of July his feathers differed but little in colour from those of the female. He remained in this state until the 24th of August, when he began to shed those feathers whose places were to be occupied by others of a more brilliant colour, and on the 27th of September he was in full plumage. The wing and tail primaries, and some plain feathers, remained as in spring. A brood of *Summer Ducks* was hatched on the 17th of July, and by the 18th of September the young birds had completed their first feathers. They then commenced a partial moulting, and by the 14th of November were in as perfect a state of plumage as the parent birds.

CORMORANT.—*Carbo Cormoranus*, Meyer.

Some white feathers on the side of the head and neck began to appear on the 4th of January 1832, and arrived at their greatest perfection by the 26th of February. They remained in this state till the 2nd of April, when they began gradually to disappear, and by the 12th of May were wholly lost, having been fifty three days arriving at perfection, thirty six days stationary, and forty days disappearing,—making together a period of eighteen weeks three days. These feathers are new ones, much longer than the black feathers of the same part, rounded in form, and in some degree resembling bristles. Some white feathers began to appear on the thighs of the same bird on the 25th of January, and the patch was completed in five weeks. These white feathers began to disappear about the 16th of June, and by the 20th of July were almost entirely gone. A young *Cormorant* brought to the Garden in the summer of 1830, did not go through any change during the summer of 1832.

HERRING GULL.—*Larus argentatus*, Brunn. LESSER BLACK-BACKED GULL.—*Larus fuscus*, Id.

The change of colour in the plumage of these *Gulls* commenced about the 14th of February, and from that time there has been a constant change of colour going on in the feathers. The moulting of these birds does not appear to expedite the change of colour. The new feathers have much the same hue as those that have been shed.

LAUGHING GULL.—*Larus ridibundus*, Linn.

The feathers on the head of this *Gull* began to change colour from white to black on the 11th of March. It was a change of colour, and not an act of moulting; no feather was shed, and the change was completed in four or five days. The plumage remained in this state as to colour till the 19th of July, a period of eighteen weeks and five days, when the black feathers were moulted, and the new feathers came white. The autumn moult lasted seven weeks.

IV. *On the Structure and Characters of* Loligopsis, *and Account of a New Species* (Lol. guttata, *Grant*) *from the Indian Seas. By* Robert E. Grant, *M.D., F.R.S. Ed., L.S., G.S., Z.S., &c., Professor of Comparative Anatomy and Zoology in the University of London.*

Communicated February 12, and July 23, 1833.

No specimen of the *Loligopsis* of Lamarck appears to have been hitherto brought to Europe, and few naturalists are at present willing to admit the existence of this genus. Cuvier only mentions it in his 'Règne Animal' (tom. iii. p. 14.) as a genus founded on drawings, which he considered of little authenticity, and makes no allusion to it in his Memoirs on the Anatomy of the *Mollusca*. M. Blainville (Malacologie, p. 367. note) rejects the genera *Loligopsis* of Lamarck and *Leachia* of M. Le Sueur, from their being founded on imperfect observations and figures, and from their affecting to present on the same animals the caudal fin of a *Loligo* along with only eight arms around the head, as in the *Octopus*. He regards such a combination of characters on the same individual as very doubtful. M. Férussac is of opinion that in the present uncertainty of naturalists regarding the *Loligopsis*, the species might be referred to the genus *Cranchia*, which is a *Decapod* with caudal fins. Lamarck, however, founded his genus *Loligopsis* on a drawing of a *Cephalopod* observed by Péron and Le Sueur in the South Sea, which had only eight equal arms around the head along with the caudal *appendices* of a *Loligo*; that species he denominated *Lol. Peronii* (An. s. Vert., tom. vii. p. 659.). M. Le Sueur has founded a new genus *Leachia* on a drawing made by M. Petit from a similar *Octopod* with caudal *appendices*, obtained from the South Pacific (Journ. of the Acad. of Nat. Sci. of Philadelphia, vol. ii. Part I. p. 90.). As the *Loligopsis* of Lamarck, and the *Leachia* of M. Le Sueur, differ only in the length of the arms, M. Rang (Hist. des Mollusques, p. 87.) has very properly rejected this generic distinction, and regarded the two terms as synonyms; the *Leachia cyclura* of M. Le Sueur forms therefore a second species of *Loligopsis* in M. Rang's use of the term, and the species I have now to describe forms a third of the same genus.

All the *Naked Cephalopods* are *Octopods*, the disk which produces these feet by its division never producing a greater number than eight; but in many genera two retractile pedunculated *tentacula* are developed, and extend from within this outer subdivided disk, and generally between the first and second anterior arms on each side, which has given rise to the division termed *Decapoda* in this class. The *tentacula*, however, never assume the form of the other feet. The peculiarity of the *Loligopsis* is therefore not the want of any of the usual eight feet, but the want or imperfect development of the *tentacula*, which are the most mutable of the parts around the mouth, assuming various forms, and being sometimes entirely wanting. They are present in *Loligo*, absent in *Octopus*; and in the animal which forms the subject of this communication, they are perceptible only in a rudimentary state. The *Cephalopods* present differences of structure so remarkable as to render it impossible, in the present state of our acquaintance with them, to determine what characters even of an external nature are incompatible with each other, or necessarily concomitant.

The *Cephalopod* represented in the accompanying drawings (Plate II. figg. 2. & seq.) was taken in the Indian Ocean by my late intelligent pupil Mr. Cotton, Surgeon in the Honourable East India Company's service, and was sent to me along with many other interesting marine animals collected by him during his second voyage to India. It has the lengthened tapering form of body, the eight sessile arms, and the circular caudal *appendix* of the other two known species of *Loligopsis*; but it differs from them in the comparative length of the different arms,—a character by which they also differ from each other. The *Loligopsis Peronii*, according to Lamarck, has the eight arms of equal length; the *Lol. cyclura*, according to M. Le Sueur, has the upper and the inferior pair of arms, nearly of equal length; and in the *Lol. guttata* the upper pair of arms are at least a third shorter and smaller than any of the other pairs. The whole length of the present species, from the point of the longest arms to the end of the tail, is four inches and three quarters; the specimen of M. Le Sueur measured five inches and a half; and that of Lamarck was like a small *Sepiola*, that is, about two inches long: so that this singular type is probably confined to small *Cephalopods*, and has thus escaped more general observation. Independently, however, of its external peculiarities, it presents modifications of internal structure hitherto met with in no other *Naked Cephalopods*, and which serve to connect the latter forms with the *Testaceous*.

Externally this animal[1] has much resemblance to a young individual of the common *Loligo sagittata* deprived of its long *tentacula*. It has the same lengthened tapering form of the body, short cephalic arms, dark brown spotted surface, and rounded terminal fin. Every part of the surface, from the point of the arms to the extremity of the tail, is closely covered with dark brown spots, chiefly of two sizes; the larger are minute angular patches of irregular form, and the smaller are very minute dark points, filling up the interstices between the polygonal patches. These spots extend into the interior of the mantle, and cover closely the surface of the four separate lobes of the liver. There are several large, round, and very obvious patches of the same deep brown colour on the caudal half of the trunk, which have a somewhat symmetrical arrangement; eleven of these are seen on the dorsal surface, and nine on the ventral. It is not probable that these large circular spots will be found identical in number and arrangement in other species, although from their size and symmetrical order they may be constant in this; I have therefore taken the trivial name of the present species from

[1] Plate II. figg. 2. & 3.

this marked external character. M. Le Sueur has represented his species as covered with numerous, small, narrow, transverse patches. The head is short, and projects much transversely from the great size and almost pedunculated form of the eyes. The arms, eight in number, are comparatively short and strong, and the disk from which they originate is separated externally by a deep *sulcus* from the rest of the head. The suckers are very small, few in number, with short peduncles, and are placed alternately on all the arms. The posterior or upper pair of arms are by much the smallest; they measure five lines in length, and have about fourteen suckers on each. The second pair is equal to the inferior or front pair; they measure eight lines, and have about thirty suckers on each. The third or outer pair are longer, and much stronger than the other arms, and may compensate for the want of *tentacula*; they are an inch and a quarter in length, and have each thirty-two small suckers. The third pair of arms are those generally most developed in the *Naked Cephalopods.* At the base of this large pair, and between them and the front or inferior pair of arms, is seen on each side a small cylindrical tubercle, occupying the usual position of the *tentacula* of other genera, and destitute of suckers. These rudimentary *tentacula,* about a line in length, of equal size, and rounded at their extremity, present no appearance of laceration. If this animal agreed in structure or characters with any other known genus of *Cephalopods* possessing *tentacula,* it might be imagined that in the present instance the *tentacula* had been early and simultaneously cut off, and were now being reproduced. Neither Lamarck nor M. Le Sueur notices these minute tubercles at the outside of the inferior pair of arms.

The mouth is closed externally by a corrugated outer lip[1], which sends out a muscular band to the base of each arm, and the usual circular fimbriated lip within this immediately invests the two small dark brown horny mandibles. The exposed brown portion of the mandibles is very short; they have sharp cutting margins, and the lower extends over the point of the upper mandible. The eyes[2] are very prominent, and the lens projects through a circular fold of the skin, which is spotted to the margin, and passes transparent over the lens. Around the lens the sclerotic has a singular tuberculated appearance, presenting seven round projecting eminences of a shining silvery lustre, like so many smaller lenses placed around two thirds of the eye-ball, and leaving only the posterior third of the circumference free. The rest of the eye-ball has a beautiful deep purple colour. The peduncle of the eye, into which the optic nerve enters as a long round cord coming from the distant supra-œsophageal *ganglion,* is like a smaller eye-ball placed behind the larger exterior. The surface of this posterior rounded peduncle of each eye has a deep brown colour, and is composed of fibres directed forwards to the base of the eye-ball. The same appearance is slightly represented in the figure of *Lol. cyclura* of M. Le Sueur, as seen from behind. The funnel extends far forward from the sac; it is wide, with loose *parietes,* but possesses no trace of the internal valvular fold[3] which we observe in *Loligo, Sepia,* and *Sepiola.*

[1] Fig. 5. [2] Fig. 6. [3] See fig. 4. where it is represented laid open.

The *parietes* of the mantle are remarkably thin and loose, excepting where they are supported by the dorsal transparent *lamina*, and by two thin cartilaginous *laminæ*, extending half way down the sides of the mantle. The dorsal *lamina*[1] is thin, transparent, convex externally, carinated along its middle, narrowest about the middle of the trunk, expanded laterally on the caudal half of the trunk in which the *viscera* are lodged, and tapers gradually to a narrow point as it passes along the middle of the circular caudal fin, to the lower extremity of which it extends. The two lateral thin *laminæ* present here an appearance anomalous in *Cephalopods*; they extend longitudinally from the free edge of the mantle, where the valvular expanded base of the *syphon* is attached internally, to about half way to the tail. They are placed rather towards the ventral surface of the mantle, so that the warty projections which they send out are seen in the front view of the animal. To the eye these lateral *laminæ* are almost imperceptible; but they are obvious to the feel, from the stiffness they produce along their course. Each of these *laminæ* sends out twelve or thirteen conical tubercles[2] about a line in diameter at their base, which extend to the distance of a line beyond the general surface of the mantle. Between each of these twelve large transparent cartilaginous warty tubercles, there are three minute projecting parts of the same substance, the middle one of these three being larger than the others, so that the whole of this line of the mantle presents a continuous row of hard rough conical prominences, the use of which in an animal otherwise sufficiently provided with organs of progressive motion, it is not easy to conceive. When we look through the mantle from the inside along the line of these tubercles, it appears, from the transparency of the cartilaginous substance composing them, as if there were twelve circular openings on each side; the tubercles, however, are quite solid, and have a very rough warty external termination. From their connexion with the lateral *laminæ* and their regular position, they can scarcely be considered as analogous to the dorsal general cutaneous roughness of some other *Octopods*. The head of the animal is supported behind by its close attachment to the upper expanded termination of the dorsal *lamina*. The sac containing the *viscera* tapers from the middle, where it is widest, to the beginning of the tail, and continues very narrow along the inferior surface to the extreme point of this nearly circular caudal *appendix*. The length of the tail is about a sixth of the whole length of the animal; it consists of two semicircular fins, extending laterally from the posterior termination of the body. These fins are attached to the dorsal surface; they are supported by the tapering portion of the dorsal *lamina* throughout their whole extent; and by following that *lamina* to its extremity, they are drawn a little out so as to terminate the body in an obtuse point.

The *viscera* occupy but a small part of the cavity of the mantle, and are placed far back in that cavity, the *branchiæ* themselves not extending forwards beyond the middle of the sac. The *parietes* of the lower part of the *œsophagus* are thin, loose, transparent, and with internal longitudinal slight *plicæ* of the mucous coat. The *œsophagus*[3] narrows

[1] Fig. 2. [2] Fig. 3. [3] Fig. 7.

before entering the first stomach or gizzard. The gizzard has a rounded form, with strong muscular coats; it is placed near the bottom of the cavity of the mantle, in close connexion with the upper surface of the *ovarium*, and as usual to the right of the spiral stomach. The second or spiral stomach is here larger than the first, of an ovoidal form, extending horizontally to the left side, marked internally with spiral folds, but having only a minute portion of its left extremity twisted in a spiral manner, like the spire of a *Haliotis*[1]. It opens by a wide orifice from the first stomach, and receives the termination of the hepatic ducts from the four divisions of the liver. The pancreatic glands surrounding the hepatic ducts have here a ramified form, with long wide branching ducts, each extreme ramification terminating in a separate small glandular vesicle. The termination of the united hepatic and pancreatic ducts in this large spiral or second stomach, is protected, as usual, by two prominent lips, between which it enters obliquely, and these valvular lips extend tapering to beyond the pyloric extremity of the stomach. The subdivided form of the stomach is common to the *Cephalopods*, with many other *Molluscous animals*, and the stomach is the part into which the hepatic ducts open in all these classes. But in the *Cephalopods* these ducts open also partially into the *duodenum*, as in the *Vertebrata*, by the valvular lips at the termination of these ducts extending from the spiral stomach into that intestine to near the *anus*. The intestine passes up in front of the space between the lobes of the liver, and over the ventral surface of the large ink bag. The liver is divided into four principal lobes, as in *Nautilus*, which are quite separate from each other; and the ink bag, which is large and situate close to the *anus*, is placed above and between the upper two lobes. The lobules which compose these four distinct portions of the liver are not, however, detached from each other as in the *Testaceous Cephalopod*. The high situation, the great size, and the shortness of the duct, of the ink gland, agree with those of *Sepiola*, another small and delicate genus of *Cephalopoda*. The alæform membranous *appendix* attached to each side of the *anus* is about two lines long, and the *anus* opens by a transverse slit between two prominent semicircular lips, situate at a great distance below the *syphon*. The branchial arteries, or subdivisions of the *venæ cavæ*, pass to the auricles between the two lobes of the liver on each side, and just before entering these lateral hearts, they are surrounded by a spherical cluster of vesicles[2], like those which open into these vessels in *Nautilus*. The branchial auricles, however, are not absent, as in *Nautilus*; they are of great size, nearly spherical, with firm *parietes*, and are entirely destitute of those singular *appendices* usually found attached to these muscular sacs in the *Naked Cephalopods*. The *branchiæ* are single on each side, and the smallest in proportion I have yet met with, each measuring only two lines in length. They have the usual pectinated structure, with the artery running along the connecting ligament on the dorsal surface, and the vein, which is here re-

[1] Fig. 7.

[2] Fig. 8.

markably wide, running along the free margin of each gill to the systemic ventricle. There are twenty two *laminæ* in each *branchia*, which are, as usual, largest in the middle of the gill, and become gradually smaller towards both ends. The systemic ventricle is very muscular, though not larger than one of the branchial auricles; it has a lengthened fusiform shape, with an aortal trunk from each end. The branchial veins enter it on each side near its upper and broader extremity, where the anterior or ventral *aorta* arises; the dorsal *aorta* passes up to the head behind the lobes of the liver. On the large dorsal or posterior *aorta* there is a distinct bulbous enlargement, as in *Nautilus*. This is probably the commencement of the *bulbus arteriosus*, which in higher classes of animals allows the *aorta* to be divided during the development of the vascular system, into the great pulmonic and systemic trunks. The great systemic ventricle is extended nearly in a longitudinal direction, and not, as usual, transversely. The two branchial veins[1] form slight bulbous enlargements before they enter near its upper and more dilated part; and the anterior or smaller *aorta*, going to be distributed chiefly on the anterior *parietes* of the mantle, has also a slight enlargement at its origin from this rounded extremity of the ventricle. The large dorsal *aorta*, coming from the inferior narrow *apex* of the ventricle, passes first downwards and backwards to gain the dorsal surface of the mantle, then runs upwards, behind the liver and *œsophagus*, along the middle of the back, between two large nervous cords, to the head, giving off numerous branches in every part of its course. These two large parallel nervous cords[2] descending along the middle of the back, like the two columns of the spinal marrow of *Vertebrata*, arise from the two great *ganglia* placed close together at the upper and back part of the mantle, and can be traced downwards, preserving their parallelism, and giving off numerous nerves in their course, to the base of the mantle below the organs of generation. They take their course along the middle of the dorsal *lamina*.

The specimen was a female, and the developed condition of the *ovaria* and *ova* showed that, though a small animal, it had arrived at maturity. The ovarial sac[3], closely attached to the base of the stomachs, though filled with completely developed *ova*, occupied but a minute portion of the capacious cavity of the mantle; all the *viscera* together did not occupy nearly a quarter of this cavity. The *ova*[4], of a pyriform shape and nearly of the same size, hanging in dense clusters which distend their sac, are attached by their tapering end, and exhibit a darker-coloured opaque central yolk surrounded by a thinner and more transparent fluid. The capsule of each *ovum* does not present the white opaque reticulate markings so common in the larger *Cephalopods*; and the usual large glands of the oviducts appear to be wanting.

This little animal constitutes a new form in the class of *Cephalopoda*, a highly interesting group, connecting, by obvious characters, the simple structure of *Gasteropods*

[1] Fig. 8. [2] Figg. 5. 6. [3] Figg. 4. 5. [4] Figg. 9. 10.

and *Pteropods* with the more elevated forms of *Vertebrata.* It possesses characters hitherto known only in the *Testaceous Cephalopods,* with others common in the *Naked* species; and it establishes on unequivocal characters the existence of a genus hitherto regarded as doubtful. The structure of its eyes is not less remarkable than the condition of the *tentacula,* and the great development of its longitudinal dorsal nerves. In the smallness of the space occupied by the *viscera* in its capacious mantle, it more resembles a *Clio* among the *Pteropods* than the ordinary forms of this class. No other *Cephalopod* has yet presented a spiral stomach like that of *Loligopsis,* or similar tubercles on the mantle; and the form and mode of termination of the pancreatic and hepatic ducts in a capacious undivided stomach are also peculiar. In its *fasciculus* of vesicles on each branchial artery, the want of *appendix* to the branchial auricles, the structure and position of its systemic ventricle, and the origin and distribution of its arterial trunks, it differs from any known form of *Naked* or *Testaceous Cephalopods,* though partaking of the characters of both.

EXPLANATION OF THE FIGURES OF *LOLIGOPSIS GUTTATA.*

PLATE II.

Fig. 2. Entire animal, back view, natural size.

Fig. 3. Entire animal, front view, natural size.

Fig. 4. Front view of the digestive and other abdominal *viscera.* *a. œsophagus*; *b.* gizzard; *c.* spiral stomach; *d. anus*; *e. e. e. e.* lobes of the liver; *f.* ink gland; *g. ovarium*; *h. h.* inner surface of the lateral tubercles; *k. syphon* laid open; *l. l.* rudimentary *tentacula.*

Fig. 5. Front view of the nervous and vascular systems *in situ.* *a.* œsophageal *ganglia*; *b.* great dorsal *ganglia*; *c.* great dorsal nerves; *d. vena cava*; *e.* its vesicles; *f. f.* branchial hearts preceded each by a cluster of vesicles; *g. g.* hepatic ducts; *h.* pancreatic glands.

Fig. 6. Nervous system, and organs of vision. *a.* supra-œsophageal or cerebral *ganglion*; *b.* sub-œsophageal *ganglion*; *c.* optic nerve; *d.* peduncle of the eye; *e. e.* great dorsal nerves; *f. f.* their *ganglia.*

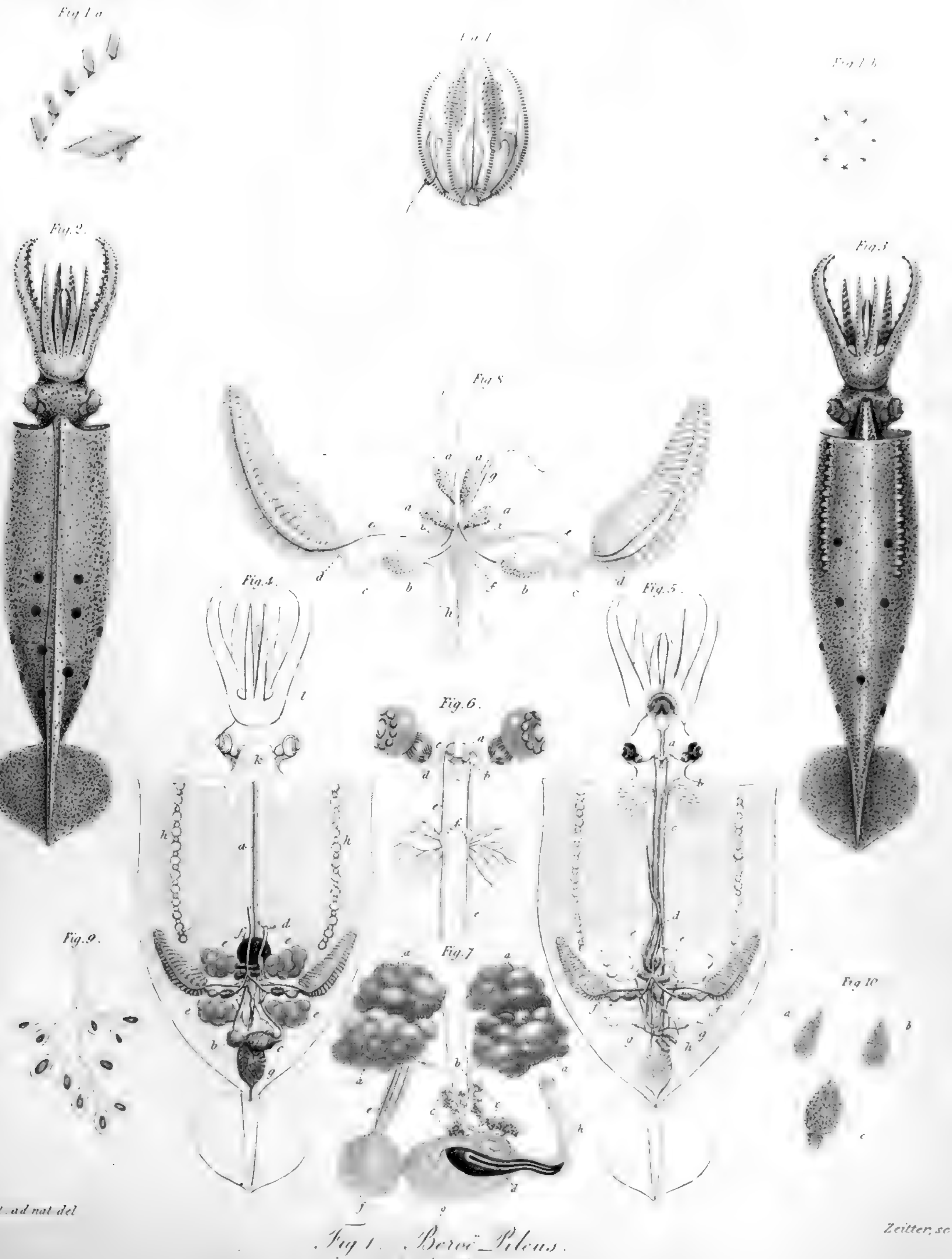
Fig. 7. Hepatic and pancreatic organs. *a. a. a. a.* four lobes of the liver; *b.* hepatic ducts; *c.* pancreatic glands; *d.* opening of the hepato-pancreatic duct; *e.* crop; *f.* gizzard; *g.* spiral stomach; *h.* intestine.

Fig. 8. Vascular system. *a. a. a. a.* vesicular bodies of the *vena cava* and branchial arteries; *b. b.* cluster of vesicles surrounding the entrance of the branchial arteries into the auricles; *c. c.* branchial auricles; *d. d.* branchial arteries; *e. e.* branchial veins; *f.* systemic ventricle; *g.* anterior or ventral *aorta* going to the anterior *parietes* of the

mantle; *h.* dorsal or ascending *aorta*; *i. i.* enlargements of the branchial veins at their entrance into the systemic ventricle.

Fig. 9. Cluster of *ova* attached by their peduncles, and containing each a central yolk.

Fig. 10. Structure of the *ovum* as seen through the microscope.



F. E. Grant. ad nat. del. Zeitter, sc.

Fig 1. Beroë Pileus.
1a do. cilia. 1b do. nerves.
Fig 2-10. Loligopsis guttata

V. *On the Characters and Description of a new Genus of* Carnivora, *called* Cynictis.

By W. Ogilby, *Esq., A.M., F.L.S., R. Ast. S., Z.S., &c.*

Communicated March 12, 1833.

THAT the work of Creation was originally complete and perfect in all its parts, that no hiatus existed among natural bodies, or, in other words, that no individual stood completely apart from surrounding groups, but that all were connected by a uniform gradation of intermediate forms and characters, is a law of natural history which every day's experience tends more strongly to confirm. It is true that, even at the present time, many instances might be brought forward in the animal kingdom, of insulated groups, apparently united by no connecting links; and many others, more particularly among the larger *Hoofed Quadrupeds*, in which we have no reason to suppose that any such connecting links exist in the actual state of things: but in the one case we have daily opportunities of verifying the general law by the discovery and introduction of new animals from remote and unexplored regions; and in the other, the combined researches of modern zoology and geology have brought to light numerous genera and species, long since swept from the surface of the earth by various convulsions of nature and the consequent changes produced in the physical character of the globe, which fill up the chasms that would otherwise appear among the forms and characters of existing animals.

The little animal which forms the subject of the present memoir, affords a striking illustration of the truth of these reflections. It forms, in truth, the type of a genus which connects the family of the *Civets* with that of the *Dogs*, in all their most essential characters; participating with the one in its organs of mastication, and with the other in those of locomotion, and consequently ranging, with the *Proteles* of M. Isidore Geoffroy-St.-Hilaire, as a second genus intermediate between these two groups. The *Proteles*, however, partakes, in some degree, of the characters of the *Hyænas*; the present animal, as we shall presently demonstrate more at large, is more immediately interposed between the *Dogs* and *Ichneumons*, to the latter of which it bears a pretty close resemblance in external form and appearance. The name *Cynictis*, by which I propose to distinguish this genus, is intended to express the double relation which it bears, on the one hand to the *Dogs*, and to the *Viverræ* generally on the other. The legs are high, and completely digitigrade; the toes long, and well separated from one another; the claws long, curved, and moderately sharp, like those of the kindred genera *Herpestes* and *Ryzæna*; the forms of the head and body are likewise similar; but in the number of its toes the *Cynictis* is intermediate between these two genera, there being five toes on the fore feet, and four only on the hind, a combination not found in any other genus of the *Viverra* family except the *Proteles*. The thumb, or inner toe of the fore feet, is placed considerably above the line of the other toes, as in the *Dogs* and other completely *Digitigrade Quadrupeds*, and does not touch the ground when the animal stands or walks; the hind heel is very much elevated, and, as well as the *metatarsus*, completely covered with hair, the under part of the toes alone being naked and of a black colour. This part of the foot is divided into separate little pads or tubercles; and there is a large one on the inner surface of the fore feet, considerably above the others, which does not come in contact with the ground in ordinary progression, but which, from its elastic nature, probably serves in this animal, as well as in the *Dogs*, *Cats*, &c., to break the fall in jumping, and other violent actions. In other respects, there is nothing remarkable to be observed about the feet, except that the claws are long and moderately curved, very much compressed at the base, but broader towards the point, and hollowed or scooped out beneath like a spoon, so as to adapt them admirably to the purpose of burrowing beneath the soil. In their entire form and structure, the organs of locomotion are thus in most respects perfectly similar to those of *Herpestes*, only that they are more completely digitigrade, in which character, as well as in the number of the toes, the *Cynictis* is more analogous to the *Dog* than to any genus of the *Viverra* family.

But it is in the characters of its dental system that this new genus most closely approximates to the *Civets*, and by which its situation in the system of nature is determined to be in contiguity with that family. The following formula expresses the number and arrangement of the teeth according to the plan followed by M. F. Cuvier in 'Les Dents des Mammifères'.

38 Teeth	20 Superior	6 Incisors.	
		2 Canines.	
		12 Molars.	6 False.
			2 Carnassiers.
			4 Tuberculous.
	18 Inferior	6 Incisors.	
		2 Canines.	
		10 Molars.	6 False.
			2 Carnassiers.
			2 Tuberculous.

The incisors present nothing remarkable. They are small, equal, and arranged in a regular straight line; those of the under jaw are in contact with the corresponding canine, those of the upper separated from it by a vacant space, which, in the reciprocal position of the jaws, is occupied by the lower canine. The canines themselves are sensibly flattened on the sides, with an obscure cutting edge behind; those of the upper jaw are nearly straight, those of the lower slightly hooked backwards. The first false molar of the upper jaw is very minute, and in contact both with the canine and with the following false molar: it is a simple, irregularly conical rudiment, with a single root. The second is also of a conical form, with a large pointed lobe in the centre, and a small rudimentary lobe on each side of it: the third is about the same size as the second, and in all respects similar, excepting that it has a large additional lobe on its inner surface, which adds considerably to its breadth, and at once distinguishes it from all the other teeth. Next in succession follows the carnassier, which is as long as the second and third false molars together. In its general form it resembles the third false molar, consisting of a large trenchant lobe in the centre, with a smaller one on each side, and a blunt tuberculous lobe of considerable dimensions on its inner surface. The lateral lobes, however, are here much more developed than those of the false molars; the posterior one, in particular, occupies nearly half the entire length of the tooth, and from its blunt, flattened form, appears to belong more properly to the tuberculous than to the carnivorous part of the dentition; and the internal lobe, which exhibits the same general characters, is likewise very large, and runs for a considerable way into the palate. A section of the whole tooth would form an obtuse-angled triangle, of which the anterior lobe would occupy the obtuse angle, and the interior and posterior lobes, the two acute angles respectively. The first tuberculous tooth is nearly half the length of the carnassier; but its breadth, or dimensions measuring from the outer surface of the jaw inwards, is nearly three times that length: it is perfectly flat on the crown, from the effects of long use, but appears to have originally consisted of two distinct tubercles, one on the outer, the other on the inner surface, separated from one another by a deep depression. The second tuberculous tooth is, as to form, in all respects similar to the first, but is little more than half its size.

In the under jaw the lateral incisors are separated from the canines by a vacant space, which receives the upper canine in the reciprocal position of the jaws. The three false molars are of the normal form of these teeth in general, resembling the second false molar of the upper jaw, but rather larger and more developed, and differing from one another in having the lateral lobes successively more distinctly separated from the central, scarcely apparent in the first, but large and well-developed in the third. This latter tooth wants the interior tuberculous lobe of its corresponding analogue above, because the narrowness of the under jaw does not permit any development in that direction; there seems to be, nevertheless, a faint indication of it on the inner side of the posterior lateral lobe, almost in contact with the carnassier. The carnassier, also, owing to the same cause, is of a form essentially different from that of the upper jaw. It is a long and tolerably thick tooth, with a deep transverse depression in the middle, and a small furrow on the interior of the first half. This first part appears to have originally consisted of three small but distinct tubercles, one on the outside and two within, separated by the small furrow already mentioned. The heel of the tooth consists of a single large, flat tubercle, which, in the reciprocal position of the jaws, is opposed to the first superior tuberculous tooth: there is no interior tubercle, as in the upper carnassier, owing to the restraint imposed upon the development of the lower teeth in this direction by the comparative narrowness of the under jaw. The single tuberculous tooth is likewise influenced by the same cause. Its greatest dimensions are in a longitudinal direction, and it appears equally to have consisted originally of two tubercles, separated from one another by a transverse depression: in other respects it resembles the superior tuberculous teeth.

In their reciprocal position the crowns are not directly opposed to one another, as in herbivorous animals; but those of the lower jaw pass on both sides within those of the upper, the tubercles of the one corresponding regularly to the depressions of the other, and thus forming an admirable instrument for cutting, which acts precisely upon the principle of a pair of scissors. The incisor and tuberculous teeth alone have their crowns in contact with one another, and for this purpose the latter teeth are situated considerably within the line of the other molars. The last tuberculous tooth of the upper jaw fits into the depression of its lower analogue, and the first, as has been already observed, into the depression which separates the tuberculous heel of the lower carnassier from the anterior lobes. The skull from which this description was taken being that of a very old animal, the sharp trenchant edges of the teeth were completely worn away, leaving the lobes universally of a blunt, tuberculous form, and often rendering it a matter of some difficulty to trace their original characters.

This system of dentition is, in most respects, extremely similar to that which is common to the *Viverræ* in general, and particularly to the genus *Herpestes*, from which the *Cynictis* differs principally in the absence of the rudimentary false molar of the lower jaw, in having that of the upper jaw in contact with the canine, and in a few other circumstances of very minor importance when compared with the general characters of the organization. From the *Ryzæna* or *Suricate*, on the other hand, the dental system of the *Cynictis* differs in the presence of the superior rudimentary false molar, being thus directly intermediate, in point of dentition, between this genus and the *Herpestes*; and it is not a little singular that it should bear precisely the same relation to both these genera in the form and number of its toes. The *Herpestes* have rudimentary false molars both in the upper and under jaws, and five toes both before and behind; the *Cynictis* has rudimentary false molars only in the upper jaw, five toes on the fore, and only four on the hind feet; the *Ryzæna* has no rudimentary false molars in either jaw, and four toes only, as well on the anterior as on the posterior extremities. These traits of zoological character strongly point out the true natural relations of all these animals, and demonstrate the relative positions which they occupy in the system of nature. With the single exception of the *Proteles*, there is no other known genus of the *Viverra* family which possesses the same number of toes and complete digitigrade extremities which form so prominent a character in the *Cynictis*. Here, however, all analogy ceases between these two genera. It is true that we are at present ignorant of the adult characters of the dentition of the *Proteles*; when we become better acquainted with this important part of its organization, we may perhaps discover additional points of relation between it and the present genus; but in all its most striking external characters it is completely different, and seems to occupy an intermediate station between the *Dogs*, the *Civets*, and the *Hyænas*.

In addition to these characters, the *Cynictis* may be readily distinguished by its external form and appearance from all conterminous genera. It has a short head, contracted suddenly in front of the eyes, and forming a small naked muzzle, divided by a longitudinal furrow; the ears are short and elliptical, naked inside, and directed forwards; the body long and slender; the tail bushy, and two thirds of the length of the body, and the whole external form and appearance not unlike that of a *Ferret* or *Ichneumon*. The temporal *fossæ* are separated from the orbits by a complete rim of bone.

I propose to distinguish the animal which has given rise to these observations, by the specific name of *Cynictis Steedmannii*, in compliment to Mr. Steedman, to whose enterprise we are indebted for our knowledge of this unique species. The following are the principal dimensions of this animal, taken from the skin, and measured along the curvatures.

	Ft.	In.
Length of the head from the muzzle to the root of the ear		$2\frac{1}{4}$
Length of the ear		$\frac{3}{4}$
Breadth of the ear		$1\frac{3}{4}$
Length of the body from the muzzle to the root of the tail	1	6
Length of the tail	1	0
Height at the shoulder		7
Height at the croup		$7\frac{1}{2}$

The hair is of a moderately fine quality, much like that of a *Dog*, smooth and close on the body, long and bushy on the tail. The general colour, as well as the whole external appearance of the animal, is precisely that of a small *Fox*, bright red over the entire body, head and extremities, deep and uniform on the back, but mixed with silvery grey on the cheeks, neck, sides and tail, arising from a mixture of hairs tipt with grey, and dispersed through the fur of these parts. The breast, belly and legs, are unmixed red; and the tail, which precisely resembles the brush of a *Fox*, is covered with long bushy hairs of a sandy red colour at the roots, dark brown in the centre, and grey at the points: the last two inches at the tip of the tail are uniform dirty white. The hairs of the body are not annulated as in the *Herpestes* and *Suricate*, and they are altogether of a finer and more furry quality. The external form and appearance of this animal have been already compared to those of the *Ferret* and *Egyptian Ichneumon*; but it probably stands higher on the legs than either of these species, being more completely digitigrade; and its head is shorter and less pointed. The specimen here described was procured in the neighbourhood of Uytenhage, on the borders of Caffraria.

In consulting the works of travellers through the Colony of the Cape of Good Hope, I have been able to find but two notices which seem clearly to refer to this animal; one by Dr. Sparrman, the other by Mr. Barrow. The first of these authors, in the English translation of his Travels, vol. ii. p. 184, has the following passage. "Two other small animals, which probably likewise belong to the *Viverra* genus, I had only a hasty glimpse of in this Colony. The one we saw, and gave chase to between the two Fish Rivers, made its escape from us, however, by running into a hole under ground, and seemed to be somewhat less than a cat, though longer in proportion. The colour of it was a bright red." It is true that this passage records no observation by which we can, with certainty, refer the animal to which it alludes to the *Cynictis Steedmannii*, but the size, colour and habitat are so perfectly similar in both cases, as to render their identity extremely probable. In the following extract, however, from Barrow's Travels, vol. i. p. 185, the characters are fully reported. "Upon those parched plains" (those of Camdebo on the eastern confines of the Colony,) "are also found several species of a small quadruped which burrows in the ground, and which is known to the colonists under the general name of *Meer-kat*. They are mostly of the genus of animals to which zoologists have given the name of *Viverra*. An eagle, making a stoop at one of these, close to where we were passing, missed his prey; and both fell a sacrifice, one to the gun, the other to the dogs. Both the bird and quadruped appeared to be undescribed species ...... The *Viverra* was wholly of a bright chestnut colour; the tail shaded with black hairs, bushy, straight, and white at the extremity; ears short and round; on the fore feet five, and on the hind four toes; the body and tail each one foot long."

There can be no doubt of the animal to which this description refers,—a description more minute and accurate than we generally find in the works of travellers. It agrees in every point with the species which forms the subject of the present memoir, except, perhaps, in the reported dimensions of the tail and body: but this difference most probably arises from the age or sex of the specimens, or from the measures of Mr. Barrow being taken in a straight line, whilst mine followed the different curvatures of the head, neck, and body. The name *Meer-kat*, by which it appears that this animal is known to the colonists, signifies a monkey, and is of very general acceptation in South Africa, being applied indifferently to the present species, the *Cape Herpestes*, *Ground Squirrels*, and various other small burrowing animals.

Both the passages here quoted confirm the burrowing habits of the *Cynictis Steedmannii*, which I had already inferred from the form of the claws.

PLATE III.

Cynictis Steedmannii.

Fig. 1. *Cranium* seen laterally.
2. *Cranium* seen from above.
3. One half of the upper jaw seen from below.
4. One half of the lower jaw seen from above.

F. Lear, del.

Cynictis Steedmannii.

Zeitter, sc.

VI. *On the* Chinchillidæ, *a Family of* Herbivorous Rodentia, *and on a new Genus referrible to it. By* E. T. Bennett, *Esq. F.L.S., Sec. Z.S.*

Communicated May 14, 1833.

In the well-defined division of the purely *Herbivorous Rodentia*, characterized by the want of distinct roots to their molar teeth, which are continually growing by the addition of fresh matter to their base as their crown is worn away by attrition, the little family which I propose to designate *Chinchillidæ* is deserving of peculiar attention. This family (which may at once be distinguished by its teeth, consisting of either two or three parallel and ribband-like bony *lamellæ*, each surrounded by its own proper coat of enamel, and connected to its neighbour by the intervention of cortical substance alone,) consists at present of two genera, both established within the last five years, *Lagostomus* and *Chinchilla*. Of the former, one species only, the *Viscacha* of the plains of Buenos Ayres, has been described. Of the latter, besides the *Chinchilla*, long popularly known for the extreme fineness and beauty of its fur, and of late scientifically described by various writers, there appears to exist a second species, the mutilated skins of which have not yet afforded sufficient materials for its complete definition. To these I have now to add a third genus; which I have no hesitation in regarding as new to science, although, if my conjecture as to the origin of the animal be correct, it has been repeatedly noticed by travellers for a period of nearly three hundred years.

In describing, after D'Azara, the *Viscacha* of the Pampas of Buenos Ayres and Paraguay, M. Desmarest[1] refers to an unpublished drawing by Feuillée of a *Viscacha* observed by that author in Peru, and suggests the probability of its belonging to a distinct species. A careful comparison of the scattered notices published by travellers and naturalists of the *Viscachas* of the Eastern and Western sides of the Andes, had long since led me to form a similar opinion as to their distinctness. This opinion was fully confirmed on the acquisition by the Society, in the month of June last, of a living animal, obviously nearly allied to the *Viscacha* of Buenos Ayres, but possessing the distinguishing peculiarities of the Peruvian species; and which consequently, although no information could be obtained as to its native country, I did not hesitate to refer to that obscure but highly interesting form. At the next Meeting of the Committee of Science and Correspondence I made some remarks on its affinities, pointing out various external characters by which it was distinguished from both *Chinchilla* and *Lagostomus*, the only two genera with which it appears to come into immediate contact; and intimated my intention of establishing on it, whenever its death might furnish the oppor-

[1] Mammalogie, p. 360, note.

tunity of examining its teeth and internal organs, a new genus, which, from the peculiarly lengthened form of its ears, I proposed to call *Lagotis;* dedicating its specific name to the memory of the illustrious Cuvier, whose loss the world of science was just then called on to deplore. The name of *Lagotis Cuvieri* was therefore placed upon the cage in which the little animal was confined, together with the English synonym of the *long-eared Viscacha;* and the opportunity being now afforded of redeeming my pledge, I propose to lay before the Society a full description of this new genus, including its internal anatomy and the peculiarities of its bony skeleton. To this description I shall add a comparison of its form and structure with both *Chinchilla* and *Lagostomus*, which the materials now and heretofore at my disposal enable me to make in some degree complete.

Before entering, however, into this more purely technical part of my subject, it may not be uninteresting to take a review of the history of the two *Viscachas*, which appear to have been long since indicated in the writings of South American travellers, although one (the *Lagostomus*) was first characterized only five years ago, and the other has remained until the present moment entirely unknown to science. In another place I have given the history of the conterminous genus *Chinchilla* up to the year 1829; but the progress of science has added, in the brief period that has since elapsed, several valuable notices of that animal also, which, in order to make my account of the family more complete, I shall enumerate in their proper place.

The earliest notice of the Peruvian *Viscacha* which I have met with, is contained in Pedro de Cieça's 'Chronica del Peru'[1]. An English version of this book was published so late as the year 1709, under the title of 'The seventeen years Travels of Peter de Cieza through the mighty Kingdom of Peru'; and from this the following account of the *Viscacha* is extracted. The original Spanish will be found in a note below. "There is another sort of creature they call Viscacha, about the bigness and resembling a hare, but that it has a long tail like a fox; these breed in stony places and among rocks, and many of them are shot with guns and cross-bows, and taken by the Indians in gins [with the lasso], they being good to eat after hanging to tender; and of their hair or wool the Indians make large mantles, cloaks, or blankets, as soft as silk, and very valuable[2]."

Father Joseph de Acosta, who wrote in 1590, also mentions the *Viscacha* of Peru as an animal resembling a hare, but larger, which was hunted and eaten[3]. He is followed

[1] Anv. 1554. fol. 268 v.—Robertson mentions an edition published at Seville in 1533; but I have seen none earlier than that quoted above.

[2] "Ay otro genero de animal que llaman Viscacha del tamaño de una liebre y de la forma, salvo que tienen la cola larga como raposa: crian en pedregales y entre rocas, y muchas matan con ballestas y arcabuzes, y los Indios con lazos: son buenas para comer como esten manidas: y aun de los pelos o lana de estas Viscachas hazen los Indios mantes grandes, tan blandas como se fuessen de seda: y son muy preciadas."

[3] "Otros animalejos llaman Vizcachas, que son a manera de liebres, aunque mayores, y tambien las caçan y comen."—*Historia Natural y Moral de las Indias, Sevilla* 1590. p. 288.

by the Inca Garcilasso de la Vega, whose 'Commentarios Reales' were published at Lisbon in 1609, and who describes the *Viscacha* as a kind of rabbit, with a long tail like that of a cat, inhabiting desert places covered with snow. In the time of the Inca monarchs, and for many years afterwards, he says, the natives were in the habit of spinning its wool for the preparation of their robes of finer texture, such as were worn only by the nobles. Its colour he describes as a light brown mixed with ash-grey; it is soft and smooth, and was held in great estimation[1]. The greater part of this account is almost literally copied by De Laet, in 1633[2].

My next authority is Nieremberg, whose very brief notice of the *Viscacha*[3] is evidently copied from Garcilasso, with a glance perhaps at Acosta or Cieça. He adds, moreover, a figure (how obtained is not stated) which, though rude, is by no means a despicable representation of the animal. It has long narrow pointed ears, and a bushy tail; its habit giving the idea of the head and body of a rabbit, with the tail of a fox retroverted over the back like that of a squirrel.

From this period the Peruvian *Viscacha* seems to have remained unnoticed for nearly a century, when it was again observed by Feuillée[4], who saw specimens of it domesticated in the houses at Lima. He speaks of it as a kind of rabbit, usually inhabiting the colder parts of the country, of a mouse colour, with a very soft fur, a long tail turned upwards, and the ears and moustaches of the European rabbit, from which it does not differ in size, while its sitting posture is also similar. In his Preface he mentions his intention of figuring the animal, but he has neglected to do so. We learn, however, from M. Desmarest[5], that his original drawing still exists, in the possession of M. Huzard.

[1] "Otra differencia de conejos ay que llaman Vizcacha, tienen cola larga como gato, crianse en los desiertos donde aya nieve, y no les vale que alla van a matarlos. En tiempo de los Reyes Incas, y muchos años depues (que a un yo lo alcance) approvechavan el pelo de la Vizcacha, y lo hilavan de por si, para variar de colores la ropa fina que texian. El color que tiene es pardo claro, color de ceniza, y el es de suyo blando y suave, era cosa muy estimada entre los Indios, no se echava sino en la ropa de los nobles." Part I. fol. 216.

[2] "Habent et aliam speciem cuniculorum, quam vocant Vizcacha, cauda oblonga instar felis, generantur in solitudinibus nivalibus. Sub imperio *Yncarum* atque adeo postea, villos illorum ducebant in fila, quibus pannos nobiles intertexebant elegantiæ gratiâ, sunt enim colore pardo diluto vel cinereo, blandique et tenues."—*Descriptio Indiæ Occidentalis, Lugd.* 1633, p. 407.

[3] Viscachæ contra dicuntur cuniculi genus, quod feles imitetur prolixitate caudæ. Amant nives, quos ibi etiam inquirit gula. Pilus olim gratus, in pretio et usu."—*Historia Naturæ, Antv.* 1635, p. 161.

[4] "Les *Viscachos* sont une espèce de Lapins sauvages, qui gitent ordinairement dans les lieux froids. J'en vis dans des maisons de Lima, qu'on avait familiarisêz; leur poil gris de souris est fort doux: ils ont la queue assez longue, retroussée par dessus, les oreilles et la barbe comme celles de nos lapins, ils s'accroupissent comme eux, et n'en diffèrent pas en grosseur. Durant le règne des Incas on se servoit du poil des *Viscachos* pour diversifier les couleurs des laines les plus fines: les Indiens en faisoient alors un si grand cas, qu'ils ne les emploioient qu'aux étoffes dont les gens de la prémière qualité s'habilloient."—*Journal des Observations Physiques*, &c. tom. iii. (1725.) p. 32–3.

[5] loc. cit.

In the year 1772, the celebrated traveller Antonio de Ulloa published his 'Noticias Americanas'[1], which contain a very particular account of the little animal in question. As this is perhaps the best history that has been given of its habits and manners, and as the book itself is scarce and little known, I have here translated it entire from the original Spanish, which, as in other cases, I subjoin in a note below[2]. "Taking the place of the rabbit, which is wanting in Peru, there is another kind of animal called Viscacha, which is not found in Quito. In form and in the colour of its fur it is similar to the rabbit; but differs from it in having a long tail furnished with tufted hair (like that of the squirrels), which is very thin towards the root, but thick and long as it approaches the tip. It does not carry its tail turned over the head like the squirrels, but stretched out, as it were, in a horizontal direction: its joints are slender and scaly. These animals conceal themselves in holes of the rocks, in which they make their retreats, not forming burrows in the earth like rabbits. Here they congregate in considerable numbers, and are mostly seen in a sitting posture, but not eating: they feed on the herbs and shrubs that grow among the same rocks, and are very active. Their means of escape do not consist in the velocity of their flight, but in the promptitude with which they run to the shelter of their holes. This they commonly do when wounded, for which reason the mode of killing them is by shooting them in the head, as if they receive the charge in any other part, although much injured, they do not fail to go and die in the interior of their burrows. They have this peculiarity, that as soon as they die their hair falls off; and on this account, although it is softer and somewhat longer and finer than that of the rabbit, the skin cannot be made use of for common purposes. The flesh is white, but not well flavoured; being especially distasteful at certain seasons, when it is altogether repugnant to the palate."

The *Journal de Physique* for 1779[3], contains numerous translated extracts from an anonymous Italian work on the Natural History of Chili, sometimes attributed to the

[1] Madrid, 1772.

[2] "En correspondiencia de los *Conejos* que faltan en el Peru hay otra casta de animales, que llaman *Viscachas*, de que el reyno de Quito carece enteramente: son en la figura y en el color del pelo lo mismo que el *Conejo*, y se diferiencian de el en que tienen rabo largo, poblado de pelo esponjoso, al modo de las Ardillas: acia el nascimiento es muy ralo, y acia la punta espeso y largo: no lo trahen buelto acia la cabeza como la Ardilla, sino tendido quasi orizontalmente: las articulaciones so menudas y escamosas. Se esconden en los agugeros de las peñas, y en ellos tienen sus madrigueras, no haciendolas en la tierra como los *Conejos*: alli estan juntas muchas, y lo mas del tempo se les vé sentadas sin comer: se alimentan de las yerbecillas, y de los arbustos que se crian entre las mismas peñas: son de mucha viveza; su escapada no la tienen en la carrera, sino en la prontitud di buscar la concabidad, y meterse en ella: de ordinario lo executan quando se sienten heridas, y por esto el modo de matarlas es tirandolas á la cabeza, pues aunque reciban el golpe en otra parte, y les hagan mucho daño, no dexan de ir á morir a lo interior de la madriguera. Tienen la particularidad de que luego que mueren se les cae el pelo, y por esta razon, aunque es mas suave, y algo mas largo y fino que el del *Conejo*, no se pueden aprovechar sus pieles para los usos communes. La carne es blanca, pero no de buen gusto, por ser fastidiosa, con particularidad en ciertos tiempos, en los que del todo repugna." p. 130–1.

[3] Vol. xiv. p. 478–9.

Abbé Vidauré, the original of which I have not at present an opportunity of consulting. In these the *Viscacha* of the western slope of the Andes is again described as having the size and nearly the shape of a large rabbit, but with shorter legs. Its fur is said to be soft, and of a mixed grey and black colour; while its tail, which is like that of a fox, is furnished with bristles so rigid as to resemble spines. By agitating this tail it defends itself from its enemies. Its flesh is good to eat. It lives in burrows which it forms for itself; and passes the night in carrying to the opening of its hole whatever it finds in the adjacent country, insomuch that if a traveller loses any thing, he has only to look for it at the entry of the burrows of the Viscachas, where he is almost sure to recover it[1]. This account is in several particulars apocryphal, as well as dissimilar from those of previous writers; and it will be seen, on comparing it with the notices to be hereafter quoted of the *Lagostomus*, that the author has confounded the habits of the eastern and western species, the former alone being actuated by that mania for collecting every thing within its reach, which he has apparently transferred to the latter. It may therefore be doubtful, notwithstanding the locality assigned, to which of these animals the notice in question actually refers.

The same may also be said of the notice of the *Viscacha* by the Abbé Molina, whose work, originally published in 1782 and reprinted with considerable alterations in 1810, contains a similar account, evidently copied in some of its parts from the preceding. He describes the animal as resembling the hare in its head, ears, muzzle, moustaches, dentition, toes, mode of eating, and upright posture in sitting; while it approaches the squirrel in colour, and in the form of its tail, which is long, curved upwards, clothed with long rough hair, and serves as a weapon of defence against its enemies. He speaks of the employment of its wool among the ancient Peruvians; and adds, that the Chilians use it at the present day in the manufacture of hats. Its burrows, according to the report of eye-witnesses, have two flats, communicating by a spiral staircase; in the lower it deposits its food, while it lives in the upper, which it seldom quits except at night. It collects round the mouth of its burrow whatever has been left behind or lost by travellers; and its flesh, which is white and tender, is preferred to that of the rabbit or the hare[2].

Two other brief notices, from the pens of modern English travellers, complete the

[1] "La Viscaque est de la grosseur et presque de la figure d'un grand Lapin, quoiqu'elle ait les jambes plus courtes. Son poil est doux et mêlé de gris et de noir. Sa queue, qui ressemble à celle du renard, est garnie de soies si dures qu'ils ressemblent à des épines. Il se defend de ses ennemis en agitant sa queue. Sa chair est bonne à manger. Il vit dans des terriers qu'il se forme. Il passe la nuit à porter à l'entrée de son trou tout ce qu'il trouve dans la campagne. Quand les voyageurs ont perdu quelque chose, ils vont la chercher à l'entrée des terriers des viscaques, et sont presque toujours sûrs de l'y trouver." p. 478–9.

[2] "La Viscaccia secondo i caratteri naturali deve formare un genere a parte tra gli Scojattoli e le Lepri. Ella si rassomiglia alla Lepre nella testa, nelle orecchie, nel muso, nei mustacchi, nella dentatura, nelle dita, ed anche nella maniera di mangiare, e nel tenersi diritta a sedere; del resto poi s' accosta allo Scojattolo nel colore e nella coda, che è assai langa, ripiegata in su, e vestita di lungo e ruvido pelo, colla quale si defende da'

history of this interesting animal, which has hitherto found no place in the works of systematic writers. The first of these occurs in Schmidtmeyer's 'Travels into Chile'[1], and adds nothing but the name of Peruvian Hare to the account of Garcilasso. The other is contained in Stevenson's 'Narrative of Twenty Years' Residence in South America'[2], where the author, in enumerating the animals of the provinces of Huailas, Caxatambo, Conchucos, and Huamalies in Peru, speaks of the *Viscacha* as inhabiting the higher ranges of the mountains, and feeding principally on the moss which is nearest to perpetual snow. He states that it is easily domesticated, and the heat of the valleys does not seem prejudicial to its health; and adds, like some of the previous authorities, but in contradiction to others, that its flesh "is very savoury, and is considered a great delicacy". His description of the animal, together with the account which he gives of the uses to which its wool was once applied, are wholly taken from Garcilasso.

It is singular that the *Viscacha* of the plains, the peculiar habits of which render it so striking an object to travellers over the Pampas of Buenos Ayres and the interior provinces east of the Andes, should have escaped mention until a much later period than that of the mountains of Peru. Indeed the earliest notice that I have found of its existence is of later date than any which I have quoted for the Peruvian animal, with the exception of those of the two last-named travellers. This is contained in Dobrizhoffer's curious History of the Abipones[3], and is to the following effect[4]. "The Biscacha, called by the Abipones Neheláterek, is an animal resembling the hare, with a tail like a fox, and in colour mixed black and white: its hairs are very soft. It digs its

suoi nemici. Tutto l' altro pelo del suo corpo è fino, morbido, e atto benissimo a qualunque sorta di manifatture. I Peruani al tempo de'loro Imperatori gl' Inchi facevano delle belle stoffe con questo pelo. I Chilesi se ne servono oggigiorno nella fabbrica dei capelli. La Viscaccia si propaga come il coniglio, e abita sotterra nelle valle Andine in certe buche che scava nelle falde dei monti, ed anche nelle pianure adiacenti. Queste buche, per quanto mi hanno detto quelli che vi sono stati, hanno due piani, che comunicano tra loro per mezzo di una scala fatta presso a poco a chiocciola; nel piano d' abbasso ripone l' animale i viveri necessarj; nel superiore abita egli stesso, ne d' ordinario va fuori se non di notte tempo: allora col favore delle tenebre batte liberamente la campagna, e tutto quello che vi trova atto al suo cibo, o che vi si sia stato lasciato o perduto dai passaggieri, lo raccoglie e porta d' intorno alla bocca della sua tana. La sua carne, che è bianca e tenera, vien preferita dagli abitanti a quelle del coniglio e della lepre."—*Saggio sulla Storia Naturale del Chili, ed.* 2, *Bologna*, 1810, p. 254.

[1] London, 1824, p. 88. [2] London, 1825, vol. ii. p. 82. [3] Historia de Abiponibus, Viennæ, 1784.

[4] "Bestiam fœtidam ridicula sequitur Biscacha, Abiponibus Neheláterek, lepori propemodum similis, vulpis instar caudata, maculis tum nigris, tum candidis insignita. Ejus pili mollissimi. Per campos editioribus fere in locis specus tanto sibi fodit artificio ut imbribus nulla ex parte pateant. Hi in varia distinguuntur conclavia, cum plures eodem in loco familiæ soleant habitare. In terræ superficie plures itidem ad specum patent portæ. Ad has sole accumbente turmatim consident, ac, num quis adventantium strepitus unquam exaudiatur, auscultant diligenter. Quod si tranquilla omnia, nocte illustri pabulatum excurrunt, vicinisque agris stragem inferunt deplorandam. Nam tritico seu Europæo, seu Turcico magnopere inhiant. Alterutrum si presto sit, gramen fastidiunt. Hinc in campis desertis biscacharum stativa vix deprehendas, quæ iter agens quamprimum detexeris, ab Hispanorum coloniis te parum abesse, nil dubita. Illud mirabar sæpe, neque in Abiponum, neque Quaraniorum, etsi omni frugum genere consitis jam territoriis, Biscacham uspiam videri. Ad specus sui portas

burrows in the more elevated parts of the plains with so much art, that no aperture is left by which the rain can penetrate; and these burrows are divided into distinct settlements, numerous families inhabiting the same locality. On the surface of the ground are several entrances to the burrow, at which, towards sunset, they are seen seated in crowds, diligently listening for the sound of any person approaching. If every thing remains quiet, they seek their food in the obscurity of the night, and commit grievous devastation on the neighbouring fields, devouring both wheat and Indian corn with extreme avidity, and when either is to be had despising grass. For this reason the stations of the Biscachas are rarely to be seen in the desert plains, but indicate with certainty the near neighbourhood of the Spanish settlements. I have often wondered never to have seen the Biscacha in the territories either of the Abipones or the Guaranis, although well supplied with all kinds of crops. They daily heap up at the entrances of their burrow, dry bones, chips of wood, or whatever other refuse they may meet with; but for what purposes they collect such things it is impossible even to conjecture. The Spanish colonists sometimes amuse themselves with hunting them; pouring many buckets of water into their subterraneous retreats, until, to avoid drowning, the animals come forth into the plain, where, no means of escape being afforded them, they are killed with sticks. Their flesh, unless when very old, is not considered despicable, even by the Spaniards."

The Essay on the Natural History of the Province of Gran Chaco by the Abbé Jolis[1], appears to be so little known to naturalists, although containing much original and interesting information, that I do not remember ever to have seen it quoted. Its author, a Spaniard, dwelt for twelve years in South America, and made three journeys into the remote districts of the interior. His account of the *Biscacha*, in many particulars, resembles that of Dobrizhoffer, but differs so much in others, that it seems desirable, especially considering the rarity of the work, to translate it at length, at the risk of being a little tedious. "The Biscachas," he says, "resemble our hares, but have their bodies visibly somewhat curved and arched. They live in society in burrows under ground, which they form for themselves, excavating in all directions to the extent of a mile in circumference, with various exits, and separate retreats, in which the old live distinct from the younger. The soil in which these are usually made, is that which is hard and barren, and destitute of every thing, but with brushes at no great distance, and pasture of tender grass, roots, and the bark of trees. They collect around their retreats bones, dried leaves, and whatever they find in the neighbourhood. If any thing

ossa arida, lignorum segmenta, et quidquid quisquiliarum invenerint, congerunt quotidie. Sed quos demum in usus sibi reservent talia, nemo unus vel conjectura assequatur. Illarum venatione tempus fallunt aliquando Hispani ruricolæ. In earum subterranea latibula aquæ cantharos effundunt plurimos. Ne submergantur, in campum prosiliunt bestiæ, et nullius effugii opportunitate sibi relicta, stipitibus necantur. Illarum carnem, nisi admodum vetulæ sint, ne Hispani quidem aspernantur." Vol. i. p. 306–7.

[1] Saggio sulla Storia Naturale della Provincia del Gran Chaco, tom. i. Faenza, 1789.

is missing in their districts, it is to be found with certainty piled up in these situations the following day. As they are animals that avoid the light, having little power of vision, they are not to be seen in the day-time, unless at dawn, or towards evening after sunset. The night, and especially when the moon shines, is their proper time for seeking their food. Those among the Biscachas which are called Chinchillas, and which may be said to belong to the first species, inhabit only the mountains and cold situations: in size they are equal to a rabbit, and are clothed with a fine long fur. Their agility is surprising; they are seen leaping from rock to rock, as if they had the faculty of flight. The others indicated above inhabit the level country in warm situations. They are equal in size to the hare, and some are even larger; but their fur is rough, their tails are short, and their teeth and claws very strong. Fierce and courageous, they defend themselves with all their might against the dogs, and sometimes even attack the legs of the hunters. I shall speak," concludes the author, "in my travels, as a fitter place, of the three curious modes in which they are driven out of their retreats; that is to say, with water, with fire, and by rubbing sticks together[1]." These travels were never, I believe, published: the work, which was intended to consist of four volumes, having, as far as I am aware, stopped short at the conclusion of the first.

Jolis was followed, towards the latter end of the last century, by D'Azara, a French translation of whose work on the Quadrupeds of Paraguay was published in 1801. This book is so well known and so justly appreciated, that it is unnecessary to do more than refer to the excellent notice of the *Viscacha* contained in it[2], which for a long time furnished the only materials consulted by zoologists for the history of this curious animal. It agrees in most particulars with the accounts of Dobrizhoffer and Jolis, but

[1] "Le *Biscache* (o specie di Agoti, secondo ne dice il Buffon) somigliano le nostre Lepri; hanno però il corpo alquanto curvo visibilmente, e inarcato. Vivon' esse in società sotto terra nelle tane, che si lavorano, e cavano per ogni dove, fino a farne d'un miglio di circonferenza, con uscite diverse, e con appartiti ricoveri, in cui abitano le vecchie separatamente dalle piu giovane. Il terreno, nel quale pel comune use sono a formarli, si è il duro e infecondo, e sgombro del tutto, ma con delle boscaglie a poca distanza, e con del pascolo d' erba tenera, di radiche, e scorze d' alberi. Le ossa, il seccume dei arboscelli, e quanto trovano nelle vicinanze de' lor nascondigli, tutto ivi presso il radunano. Se alcuna cosa viene smarrita per que' contorni, si è sicuro di incontrarvela ammucchiata nel di seguente. Siccome son esse animali lucifughi, che poco veggono, veder perciò non si lascian di giorno, se non sull' ore prime della mattina, e sulla sera, dopo che tramontato già e il Sole. Di notte, soprattutto quando lucida fa vedersi la Luna, si è per esse l' opportuno tempo più adatto a cercarsi il sostentamento. Quelle trà le *Biscache,* dette Chinchillas, e che dir si possono della prima specie, e abitatrici soltanto delle montagni, e de' luoghi freddi, la grandezza uguagliano d' un coniglio, e adorna vanno di fino e lungo pelo. La lor leggierezza è sorprendente; slanciar si veggono da una balza ad un altra, quasi luogo avessero trà i volatili. L' altre di sopra dà noi accennate abitano le pianure, e i luoghi caldi. Son queste in grandezza al par delle Lepri, e alcune ancor maggiori; ruvido pero n' è il pelo, corta la coda, e i denti fortissimi, non meno che le lor unghie. Fiere che sono, e dotate ancor di coraggio, difendonsi a tutto potere da' cani, e talvolte alle gambe si avventano de' Cacciatori. Parlero nei viaggi, luogo lor più opportuno, delle tre curiose maniere, onde si fan venir fuori da' nascondigli, con dell' acqua cioè, con del fuoco, e col rifregare insieme de' bastoncini." p. 182–3.

[2] Tom. ii. p. 43. &c.

is much more precise in its description, although scarcely sufficiently technical for the purposes of the systematic naturalist. Before proceeding, however, to the latter class of writers, I shall conclude my account of what has been said of these creatures by travellers in their native country, by referring to Proctor[1], Head[2], Miers[3], and Haigh[4]. The first of these gives nearly all the particulars which are to be found in the rest, and I have therefore extracted his account in the note below[5]. Miers adds, that the skin of the *Viscacha* is among the articles of commerce brought by the Pampa Indians to Buenos Ayres[6].

A specimen of this animal, which, in 1814, was living at the Menagerie at Exeter 'Change, was the first that came under the notice of European naturalists. It was there observed by M. de Blainville and M. F. Cuvier, both of whom described it; the former in the 'Nouveau Dictionnaire d'Histoire Naturelle'[7], and the latter in the 'Dictionnaire des Sciences Naturelles'[8], under the name of *Dipus maximus*, Blainv., erroneously referring it to the family of the *Jerboas*, and not in the least suspecting its identity with the *Viscacha*. This identity was also overlooked by the late Mr. Brookes, who became possessed of the specimen in question after its death, and prepared from it a stuffed skin and a skeleton, which formed part of his valuable Museum. These materials became the basis of a paper by that celebrated anatomist 'On a new Genus of the Order *Rodentia*', read before the Linnean Society in June, 1828, and published in their 'Transactions' at the commencement of the following year[9]. To the new genus thus established Mr. Brookes gave the name of *Lagostomus*, and to the species that of *trichodactylus*: he described the animal and its skeleton (the latter at considerable length), and gave a plate[10] containing figures of both, together with the details of the teeth. The identity of this animal with the *Viscacha* of D'Azara became quickly ap-

[1] Narrative of a Journey across the Cordillera of the Andes, &c. London, 1825.

[2] Rough Notes taken during some rapid Journeys across the Pampas and among the Andes. London, 1826. pp. 82, 84–5.

[3] Travels in Chile and La Plata. London, 1826. vol. i. p. 68.

[4] Sketches of Buenos Ayres and Chile. London, 1829. pp. 28–9. & 66.

[5] "The whole country from Buenos Ayres to San Luis de la Punta, is more or less burrowed by an animal between a rabbit and badger, called the *biscacho*, which renders travelling dangerous, particularly by night, their holes being so large and deep, that a horse is almost sure to fall if he steps into one of them. The *biscacho* never ventures far from its retreat, and is seldom seen till the evening, when it comes out to feed, and hundreds may be observed sporting round their holes, and making a noise very similar to the grunting of pigs. Their flesh is much liked by the people, and they are remarkably fat, and on that account when caught at any distance from their holes are easily run down; they will, however, defend themselves from a dog a considerable time. The holes of these animals are also inhabited by vast numbers of small owls, which sit during the day gazing at the passing travellers, and making a very ludicrous appearance. The parts of the road most frequented by the *biscacho* are generally overrun by a species of small wild melon, bitter to the taste; whether it thrives particularly in the manure of the animal, or whether the *biscacho* chooses his hole near this running plant, does not seem to have been ascertained." pp. 18, 19.

[6] Vol. i. p. 259. [7] Tom. xiii. p. 117. [8] Tom. xviii. p. 471. [9] Vol. xvi. p. 95. [10] Tab. 9.

parent, and was noticed in the course of the same year by Cuvier in the second edition of his 'Règne Animal'[1]; in the English translation of which work by Mr. Griffith, it had also been previously figured and described from the same specimen, while living, under the trivial name of the *Marmot Diana.* At the dispersion of Mr. Brookes's Museum, both the skin and skeleton were sold, and passed, I believe, into the hands of M. Temminck, who purchased them for the Leyden Museum.

In the 'Annales des Sciences Naturelles' for November 1830[2], appeared a paper by MM. D'Orbigny fils, and Isidore Geoffroy-Saint-Hilaire, 'On the *Viscacha* and the *Chinchilla*, regarded as the types of a genus named *Callomys*, together with the description of a new species'. The authors of this notice seem not to have been aware that they had been anticipated with respect to both the animals named, for they make no reference to the various papers respecting them published in this country during the two preceding years. The generic union which they proposed between the *Viscacha* and the *Chinchilla*, was founded on an imperfect knowledge of the latter, of which they knew neither the teeth nor the toes[3]. Of the former they possessed excellent materials, and have given a good description; together with additional particulars of considerable interest relative to its geographical distribution, habits, and mode of life. The supposed new species was known to them only by the skin, deprived of its feet, its ears, and its tail: of it I shall have occasion again to speak.

In August, 1831, M. Lesson gave, in the 'Bulletin des Sciences Naturelles'[4], an extract from his 'Illustrations de Zoologie', containing a new description of the *Viscacha*, under its original name of *Lagostomus trichodactylus*, which M. Kuhn had previously (in a Notice of the paper in the 'Annales des Sciences Naturelles', contained in the January Number of the 'Bulletin',) restored to the animal. The 'Illustrations' themselves have since appeared, and contain, in addition to the description, a figure of the animal, and representations of its feet and of its muzzle. M. Goldfuss has subsequently published, in his 'Naturhistorische Atlas'[5], a figure of the *Viscacha*, and representations of its teeth, copied from those given in the 'Linnean Transactions' by Mr. Brookes.

For the history of the *Chinchilla* down to August 1829, I must refer to my account of that animal, published in the first Number of the 'Gardens and Menagerie of the Zoological Society'; to which I can add nothing of earlier date, except the slight mention in the extract from Jolis already given, and a reference to a figure of the

[1] Tom. i. p. 222.

[2] Tom. xxi. p. 282.

[3] During the passage of this paper through the press I have received, by the kindness of his venerable and distinguished father, the 'Notice sur les Travaux de M. Isidore Geoffroy-Saint-Hilaire', printed on the occasion of his successful competition for one of the zoological chairs in the Academie des Sciences. From this I have the pleasure to learn that M. Isidore Geoffroy has since seen reason to abandon his opinion of the generic identity of the two animals.

[4] Tom. xxvi. p. 186.

[5] Th. iii. p. 262. t. 289.

animal, unaccompanied by description, in Mr. Griffith's Translation of the 'Animal Kingdom', of the existence of which I was not then aware.

In August, 1830, Mr. Gray published, in the second Number of his 'Spicilegia Zoologica', the generic and specific characters of *Chinchilla lanigera*, together with a description and figure, the latter drawn by Col. Hamilton Smith from a specimen brought to England in 1827, and lithographed in 1828. In this notice the skull and teeth are particularly described; and an interesting account is given, obtained from Mr. Hennah, the gentleman by whom the specimen figured was brought home, of its domesticated habits.

A fourth original figure of the *Chinchilla* was given by M. F. Cuvier in the 'Histoire Naturelle des Mammifères', under the date of November, 1830, after a drawing made by a lady from the specimens in the possession of the Society. One of these having subsequently died, Mr. Yarrell examined both its *viscera* and skeleton, and laid an account of the results of his investigation before the Committee of Science and Correspondence at its first Meeting in February, 1831; an abstract of which was immediately published in the 'Proceedings' of that Committee[1]. From the 'Bulletin des Sciences Naturelles'[2] for March, 1831, it appears that M. Van der Hoeven published, about the same time, in the 'Bijdragen tot de Natuurkundige Wetenschappen'[3], (a Journal to which I regret that I have no present means of referring,) another figure of the *Chinchilla*, and that he also, without being aware of what had been written on the subject by English zoologists, regarded it as a distinct genus from *Lagostomus*, under the name of *Eriomys*.

In the 'Annales des Sciences Naturelles' for August, 1832[4], Dr. Rousseau translated into French my account of the *Chinchilla*, from the 'Gardens and Menagerie of the Zoological Society', attributing its date to 1831, which some of the later published copies of the volume bear upon the title-page, instead of 1829, when the number containing the *Chinchilla* was published. There are, however, in this version numerous inaccuracies, attributable probably to an imperfect acquaintance with the English language. The paper by Dr. Rousseau himself, to which the translation is appended, contains a good and detailed description of the animal and of its skeleton, which he follows Mr. Gray, Mr. Yarrell, M. Van der Hoeven, and myself, in considering as a genus necessarily distinct from, although closely allied to, the *Lagostomus* of Brookes, and for which he also adopts the name of *Chinchilla*. A plate giving a front view of the head, the skull in various positions, and the details of the teeth, accompanies this paper.

And lastly, M. Goldfuss, in his 'Naturhistorische Atlas'[5], has given a sixth original representation of the animal under the name of *Lagostomus laniger*, Wagl., referring as a synonym to the *Eriomys Chinchilla*, Mus. Frankf.

Having thus brought down the history of these three remarkable animals to the present time, I shall next describe at length the conformation, both external and in-

[1] Part I. p. 31.
[2] Tom. xxiv. p. 352.
[3] Deel vi. No. 1.
[4] Tom. xxvi. p. 349.
[5] Th. iii. p. 263. t. 290. f. 1.

ternal, of *Lagotis*, comparing it as I proceed with the *Chinchilla*, and occasionally with *Lagostomus* also. My materials for the description of *Lagotis* are derived from the observation of the living animal; its anatomical examination after death; and the study of its preserved skin and skeleton, which now form part of the Society's Museum. Of *Chinchilla* the Society has exhibited, during the last five years, no fewer than four living individuals; two of which have lately died, and have thus afforded me the opportunity of again investigating their internal structure, which I had previously observed in the specimen, also from the Society's Menagerie, formerly dissected by Mr. Yarrell. Besides these I have seen two entire skins in the most perfect condition. My knowledge of *Lagostomus* is founded on a detailed comparison of Mr. Brookes's account of the skeleton of that animal with the original while in his possession, an examination which enables me to bear the fullest testimony to the accuracy of the statements contained in his paper on the subject. I shall begin with the outward form, the peculiarities of the fur, and its colouring.

The *Lagotis Cuvieri*, or *long-eared Viscacha*, has the size and much of the general form of the Rabbit. Its head is of moderate size, broad at the *zygomata* and narrowing towards the muzzle, but considerably thickened out by the pads for implanting the very numerous, closely set, and heavy whiskers. These are entirely of a jet black, and ten or twelve of them on each side are exceedingly strong, rigid, and of great length, the longest when turned backwards projecting more than an inch beyond the tips of the ears, and measuring upwards of seven inches in length: they give a striking character to the physiognomy of the animal. There is no naked muzzle, the whole circumference of the nostrils, with the exception of their margins and an intervening slit, being covered with short projecting hairs. The nostrils are simple and oblique; that is to say, directed downwards and mesiad, so as to approach each other very nearly at their lower extremities. In the upper lip the fissure is so deep as to correspond by its sinus to the insertion of the incisor teeth. The eyes are not large, but full and prominent, and their anterior canthus is nearly equidistant from the base of the ears and the extremity of the muzzle. The ears have nearly the form of a long parallelogram regularly rounded at the upper end, and equal in length the distance between their base and the muzzle. Their breadth is about one third of their length, the respective measurements being one inch and three inches. Their anterior margin is rolled round upon itself, sloping inwards from above downwards, and occupying at the lower end more than one third of the breadth of the base of the ear. A corresponding fold, extending at the base to about the same distance inwards, commences a little lower down on the hinder margin. Behind this there is a supplementary auricle accompanying it for two thirds of its length. On the outside the ears are sparingly furnished with short scattered hairs, and on the inside still more sparingly, and with hairs still shorter: those which fringe the margin are rather longer, particularly on the anterior edge, where they are also more copious.

The neck is short and thick, and the body somewhat heavy in its proportions; or at least appearing so from the length and density of the fur, which during life was usually puffed out so as to present the tips rather than the sides of the hairs to the observer. The tail is moderately long and of a cylindrical form, unless when the hairs of the upper surface are erected. These hairs are long and rigid; they occupy the whole middle line of the tail above, and become gradually longer as they approach the tip, where they finally project in a bristly tuft three inches beyond the extremity of the *vertebræ*. On the sides and under surface of the tail, the hairs are short and closely adpressed.

The anterior limbs are much shorter than the posterior, and like them terminate in only four short toes, which are scarcely united at their base by an intervening membrane. On the fore feet the outer toe is the shortest, and the length increases gradually to the third, counting inwards; the fourth is shorter than the third, and about equal in length to the second. The claws are small, placed on the upper part of the ungueal *phalanx*, and slightly sharpened; they are entirely concealed by long and somewhat bristly hairs, which also pass down between the toes. On the sole there is one large basal tubercle, internal to which, and ranging with it in front, is a much smaller one; and anterior to these are placed three others, of nearly equal size, forming at the roots of the toes a curved line, the outer termination of which is somewhat posterior to the inner. On the hinder feet the outer toe is placed far backwards; it is also somewhat shorter than the others, and its extremity consequently does not quite reach the base of the next adjoining toe. Of the remaining three the middle is the longest, and the two others are nearly equal. The claws are larger and more curved than those of the anterior feet, and are, like them, concealed by long hairs. This description, however, does not apply to the inner toe, the claw of which is flattened, curved inwards, and exposed to view; the hairs immediately adjoining it consisting of a tuft of about eight rows of stiff, horny, curved bristles, approaching in their rigidity to the comb-like appendage which is found in almost the same situation in the *Ctenodactylus Massonii*, Gray. The sole consists of a long and large basal tubercle, internal to which is a smaller elongated one, extending further forwards; of a tubercle at the base of the outer and shorter toe; and of two tubercles ranging nearly with the tip of that toe, and placed at the base of the three remaining toes.

The hairy coat is almost entirely composed of a beautifully soft and downy fur, of considerable length, but loosely attached to the skin, and readily falling off, at least in the specimen examined, unless carefully handled. This fur is of a dusky hue at the base, and to within a short distance of the tip, where for a space of from one to three lines in extent it is of a dirty white, more or less tinged with yellowish brown. Through it protrude a few long hairs, which are entirely black, and are more numerous posteriorly. The mixture of these colours gives the general effect of a mottled greyish ash-colour. On the sides of the neck and body, where the tips of the fur verge more into yellowish brown than on the back, and where they are also of greater length, as well as on the haunches and beneath, this tinge appears rather more predominant. There is little of the dusky colour of the fur visible on the under surface. The hairs of the tail below are entirely of a brownish black; on the sides they are of two kinds, black and white; as is also the case with the long, rigid, and erectile hairs of the upper surface. The very long bristly hairs of the tip are wholly black. On the upper and fore part of the head and face, as well as on the limbs, the hair becomes much shorter than on the body.

In form the *Chinchilla* nearly resembles the *Lagotis*; but it is much smaller in size, more slender in its limbs, with shorter and more rounded ears, and whiskers less numerous, shorter, and less rigid. They are of two kinds, black and white, some few being black in the lower half and white in the upper: the longest measure about four inches. The face and muzzle are very similar to those of *Lagotis*; but the large rounded open ears measure in height little more than three fourths of the distance between their base and the extremity of the muzzle; their sides have none of the parallelism so remarkable in *Lagotis*; and their greatest breadth is little inferior to their length, or about an inch and three eighths to an inch and three quarters. In their lobes and mode of folding they differ in no material respect from *Lagotis*, and they are as scantily supplied with hair both within and without. The tail has precisely the same character, arising from short rigid adpressed hairs below, and long stiff erectile hairs on the upper surface, the latter projecting at the tip in a bristly tuft which exceeds the *vertebræ* by two inches.

The anterior and posterior limbs have nearly the same relative proportions to each other as those of *Lagotis*; but the former have an additional toe, corresponding to the thumb, which is entirely wanting in *Lagotis*, and this forms a striking part of the generic distinction between the two animals. The corresponding toes are similar in their proportions to those of *Lagotis*, but slenderer, and of greater comparative length in their free extent. On the anterior feet the thumb is much shorter than the rest, its extremity ranging nearly its own free length behind the base of the adjoining toe. The claws are small, flattened, ridged along the middle line, terminating in an obtuse point, and concealed by long bristly hairs; that of the thumb is less strongly ridged than the rest. In the palm the basal tubercles nearly resemble those of *Lagotis*; and the three which are placed at the base of the four outer toes form a curved line, the posterior extremities of which are nearly equally advanced. On the under surface the skin is deeply marked with strong transverse callous wrinkles, and each toe is furnished with a large cushion beneath its tip. The posterior feet have larger claws than the anterior, but nearly of the same form, and equally concealed by long hairs, with the exception of the inner, which in form and in the bristly comb-like appendage adjoining it, closely resembles that of *Lagotis*. The tubercles of the sole are disposed as in the latter animal; and the under surface of the toes is the same in every respect as in the fore feet.

The beautiful fur of the *Chinchilla* is still more soft and downy than that of the *Lagotis*, having fewer of the long black hairs passing through it and projecting beyond its surface. It adheres to the skin with a tenacity which adds much to its value in a commercial and economical point of view, and would alone give it a commanding superiority over that of the *Lagotis*. It has a similar dusky colour at the base, with short tips of greyish white, and with scarcely a shade of the yellowish brown tinge, except occasionally towards the haunches and on the croup, and then only very slightly marked. The under surface is mottled like the upper, but with a much greater proportion of white. On the under surface of the tail, the short adpressed hairs are of a dirty yellowish brown, while the much longer and more bristly hairs of the sides and upper surface are whitish at their base, brownish black from thence through the greater part of their length, and yellowish brown at the tip, with the exception of the tuft at the extremity, which appears of an almost uniform brownish black, the tips being less distinguishable in colour than in the rest.

For the external characters of *Lagostomus*, as I have not at present the skin to refer to and neglected formerly to take notes of it, I must refer to the paper of MM. Isidore Geoffroy-Saint-Hilaire and Dessalines D'Orbigny fils, and to the work of M. Lesson before quoted.

It may be also proper to mention here the supposed second species of *Chinchilla*, described by M. Isidore Geoffroy-Saint-Hilaire, in the paper just referred to, from skins in the possession of some Parisian furriers, without legs, ears, or tail. This animal would appear, from the description there given, to be indeed nearly related to *Chinchilla*, and even in some respects to approach my *Lagotis*. But the colours assigned to it (yellow tinged with greenish and slightly undulated with black above, and bright golden yellow shaded with reddish brown below,) are too strikingly different from those of *Lagotis* to admit of their being regarded as the same. It is further said that in the species in question, the *Callomys aureus*, Isid. G.-St.-Hil., the base of the fur is brown, while in *Chinchilla* it is dark grey. In *Lagotis*, on the contrary, the base of the fur is only a shade lighter than in the *Chinchilla*, and is of that peculiar hue which, from its near approach to black, without partaking of any decided colour, I have generally been in the habit of denominating dusky, or when deeper dusky black. It has not the slightest tendency towards brown.

The anatomical examination of *Lagotis* and *Chinchilla* gave the following results. In both animals, on laying bare the face, Meckel's muscle appeared very distinct from the *masseter* at its anterior termination, but was shown on further examination to be, as usual, only a developed portion of that muscle. The parotid gland extended in a flattened form along the neck; the submaxillary was more compact. The digastric muscle was strong, and had a slightly tendinous appearance in the middle, where it was connected with the *os hyoides*. The sterno-mastoid and cleido-mastoid muscles were distinct; and the interarticular cartilage between the clavicle and *sternum* was remarkably long, although less so than in the *Porcupine*, measuring in *Lagotis* three eighths, in *Chinchilla* about one quarter, of an inch. The thyroid gland ascended on each side of the *larynx* in a flattened form, the two portions being united below by a thin transverse band, which, in *Chinchilla*, was scarcely distinguishable. The lesser *cornua* of the *os hyoides* were united by ligament to the tympanic bone. In the soft palate, the lateral columns converged, and were placed near to each other in the posterior part of the *fauces*, leaving a large *cul-de-sac* external to them on each side, and a very small opening to the *pharynx* between them. The interior of the *meatus auditorius* was smooth and white. In *Lagotis* the pupil was found contracted in an elliptical form, the long diameter being obliquely downwards and forwards: in *Chinchilla* it was exactly circular. The crystalline lens was in both cases large and more than usually convex, its antero-posterior diameter in *Chinchilla* being to its lateral nearly as 4 to 5.

In *Lagotis* the *epididymis* was seen projecting through the external ring; and the external oblique muscle in both exhibited very little of a tendinous expansion. The intestines of both had the tenuity common to the *Rodentia*. In *Lagotis*, the *duodenum*, after descending to the right iliac region, made a fold by a sudden turn upon itself, and returning upwards became free after crossing the spine in the epigastric region. Within the fold, the *apex* of which was connected by a process of *peritoneum* to the right iliac region, were contained at its upper part the descending lobes of the *pancreas*. This organ was large, and extended, as usual, from the spleen behind the stomach, sending off processes down the *mesoduodenum*. The *cæcum* was of large size, and occupied the left side of the *abdomen*: it was of a sacculated structure, like that of the *colon*, and connected by a small process of *peritoneum*. Where the *ileum* entered the large intestine, the latter offered a considerable enlargement, below which the *cæcum* descended, of nearly equal size with the *colon*, passed spirally downwards and backwards for nearly a complete turn, and then bending upon itself returned in such a manner as to form a second nearly complete turn, the end of which curved over and was directed downwards at its termination in the blind extremity. The *colon* continued of the same sacculated structure across the pubic region, and up the right side of the *abdomen* as far as the *hypochondrium*, and then returned suddenly upon itself, the descending and ascending portions of the fold thus produced, which was six inches in length, being intimately connected together and attached to the same process of *peritoneum*. Towards the end of this fold the *fæces* began to be formed into pellets, and the sacculated character of the *colon* became less marked. A second fold of a similar character to the last, with its two portions similarly united, lying loose in the cavity of the *abdomen*, and measuring a foot in length, succeeded. Beyond this the intestine was much contracted, its coats becoming transparent in consequence of their extreme tenuity; and the remainder of the *colon* formed several convolutions on the left side of the *abdomen*. The entire length of the small intestines was seven feet four inches, and that of the large, nine feet three inches; the distance between the mouth and the *anus* measuring one foot and an inch.

The intestines of *Chinchilla* were on the whole of similar character, and for the most part disposed in the same manner: they offered, however, several peculiarities in detail, which are deserving of particular notice. In it the *duodenum*, after descending to the right lumbar region, made a not very sudden turn upwards, crossed the spine, and then became free. The *cæcum*, in form and structure nearly similar to that of *Lagotis*, had its blind extremity concealed behind the first fold: it occupied the left iliac region. The *colon*, arising from it posteriorly, proceeded behind and connected with it at the commencement to the pubic region, whence it curved upwards and towards the left side, passing partly in front of the *cæcum* to the umbilical region, and then by a second and very sudden fold upon itself again descended to the *hypogastrium*. From this point it reascended along the right side to the *hypochondrium*, where it was attached to the *duodenum* by a fold of *peritoneum*, and again returning upon itself descended in a long, loose, double fold, nine inches in length, the two portions forming the fold being, as in *Lagotis*, intimately united by *peritoneum*. The formation of pellets began at the commencement of this long fold, towards the end of which the intestine became more contracted, and so continued to its termination. The total length of the small intestines in this individual was about three feet nine inches, and of the large, exclusive of the *cæcum*, four feet nine inches; the length of the animal from mouth to *anus* measuring nearly nine inches.

The form of the stomach in the two animals offered very remarkable modifications. That of *Lagotis* represented a long linear-oblong bag, three inches and a half in length, and about an inch and five eighths in breadth, into which the *æsophagus* entered at a distance of an inch and three quarters from the left extremity, and consequently very near the middle of the cavity: the *pylorus* was situated near the right extremity superiorly, with a distance of about an inch between it and the œsophageal aperture. In *Chinchilla*, on the contrary, the stomach was pyriform, its length being two inches and a half, its greatest breadth towards the left, an inch and three quarters, and in the middle, little more than an inch: the *æsophagus* entered near the middle of the cavity; and the pyloric portion, which was much narrowed, formed a curve upwards, on which the commencement of the *duodenum* made a sudden turn.

In both animals the xiphoid cartilage of the *sternum* was spade-shaped; in *Chinchilla* very broadly so. The inferior *vena cava* passed in *Lagotis* through the substance of the liver, which was composed of a left lobe, a large cystic lobe, a right lobe partially divided, and a *lobulus Spigelii*, the suspensory ligament not advancing to the anterior margin of the cystic lobe. In *Chinchilla* the cystic lobe was deeply cleft, its *sinus* corresponding with the anterior edge of the suspensory ligament; and the *lobulus Spigelii* also presented a deep fissure. The gall-bladder in *Lagotis* measured three fourths of an inch in length; in *Chinchilla* about two thirds: it was of a pyriform shape, and only partially invested by *peritoneum*. In its course the cystic duct was joined by three or more hepatic ducts; it entered the *duodenum* about one third of an inch from the *pylorus*. The spleen was somewhat unciform in shape, broadest below, three-sided, and transversely notched at about half an inch from its upper extremity; it measured, in

Lagotis, an inch and a half in length, with a breadth of an inch at its lower extremity. The latter part was broader in proportion in *Chinchilla*, the corresponding measurements being one inch, and seven eighths of an inch. The kidneys were of the usual form, the right considerably higher than the left; the *tubuli uriniferi* terminating, as in most *Rodentia*, in a single conical *papilla*: they measured, in *Chinchilla*, nearly three quarters of an inch in length by half an inch in breadth. The renal capsules were oblong white bodies, lying mesiad of the upper part of the kidneys, and measuring in *Chinchilla* nearly half an inch in length. In *Lagotis*, the *omentum*, which was of moderate size, as well as the mesentery, contained fat; but this was wanting in *Chinchilla*, the individual having died most probably of a deficiency of nutriment, in consequence of an inability to masticate its food from the incisor teeth of the upper jaw having become excessively elongated and incurved, as happens not unfrequently in rabbits, rats, and other *Rodentia*.

In *Lagotis* the urinary bladder was large, a good deal distended, and contained a firm, gritty, coagulated substance of a white colour, which Mr. Owen conjectured might possibly be formed by inspissated *semen* thrown back into it. The *plexus pampiniformis* and spermatic *omenta* were well developed; and the *vasa deferentia* were large. The *vesiculæ seminales* formed tubes of three inches in length, giving off numerous *cæca* from one side. The *testes* were of the size of pigeon's eggs, and the fibres derived from the *transversalis* muscle, adhering to the upper part of the *epididymis*, formed a sheath from which its extremity projected into the *inguen*. The prostate gland was large and lobed; and the *penis* furnished with a bone. Both the *Chinchillas*, as well as that previously examined by Mr. Yarrell, were females: their organs presented little that was remarkable. The *cornua uteri* measured three inches and a half in length.

On opening the *thorax* of *Lagotis*, the heart was seen to be nearly quadrate in its form, with obscurely rounded angles; in *Chinchilla* it was more elongated and more rounded at the *apex*. The two superior *venæ cavæ* were distinct. The lungs on the left side were divided into three lobes, of which the lowest was the largest; and on the right into four, with the lowest also largest, and in *Chinchilla* deeply bifid. The section of the *trachea* was transversely oval, with the rings imperfect behind. The tongue, in both animals, was broad at the base, becoming narrower anterior to the molar teeth, from which point it was continued forwards nearly of the same breadth. It was rather flattened, and rounded at the extremity; its surface being finely papillose, except between the molar teeth, where it was smooth. Behind this part were two large oblong *papillæ fossulatæ*, disposed obliquely, with their posterior extremities directed inwards and towards the *epiglottis*.

My friend Mr. Owen, to whom I was indebted for assistance in the dissection of *Lagotis*, and who has since examined another specimen of *Chinchilla* from the Society's Collection, has favoured me with his notes, in which he gives a much greater length to the intestines of the latter than either Mr. Yarrell or myself: it is probable that he took more pains in loosening them from the loops of *peritoneum*, for his accuracy of observation is beyond question. He describes the small intestines as measuring four feet six inches, and the large seven feet six inches, in length. On each side of the ileo-cæcal valve, internally, he notices an oval patch of *glandulæ aggregatæ*, about two thirds of an inch in the long diameter. The *cæcum*, he observes, is drawn up into *sacculi* by two longitudinal bands: these *sacculi* being directed alternately from right to left, and *vice versâ*, give it at first the appearance of being spirally twisted, but on cutting across the longitudinal bands the *sacculi* fall down and the spiral character is lost. Connected with the extreme portion of the *colon*, he states that there is a lacteal gland of large size, with numerous lacteals evidently converging towards it; a circumstance which, if further evidence were wanting, proves, he remarks, the share taken by the large intestines in the process of chylification. The *trachea* was composed of twenty-three imperfect rings; the *larynx* formed two shallow *sacculi*; and the *epiglottis* was small, with a truncated *apex*. Mr. Owen adds, that Meckel's muscle was furnished, in its tendinous part, with a sesamoid cartilage.

In the general character of the skeletons of the two animals there exists a remarkable conformity; which admits, however, of very striking modifications, and particularly in the form of the *cranium*. The occipital ridge is scarcely at all visible in *Chinchilla*, but is strongly marked and prominent in *Lagotis*; the posterior boundary of the skull is consequently transversely truncate, or even retusely concave in the former, while in the latter it forms the convex segment of a circle. In *Chinchilla* the upper surface of the whole skull is remarkably flattened, and may be subdivided into three regularly graduated regions, the posterior of which, bounded anteriorly by the coronal suture, is nearly square in its outline; the middle or inter-orbital, formed wholly by the frontal bones, is a much narrower parallelogram, with the sides somewhat excavated; and the anterior, curved a little downwards and forwards, and formed by the intermaxillary and nasal bones, is still narrower and more linear. In *Lagotis* the posterior part of the frontal and parietal bones is strongly arched, and the narrowing of the skull forwards is more gradual, the inter-orbital region being much broader in proportion: there is a deep depression between the fore part of the orbits, contrasting strongly with the posterior arching of the *cranium*; and the narrow and perfectly linear projection, formed by the nasal and intermaxillary bones, is nearly horizontal, having only a slight elevation near its middle and no downward curvature. The greater breadth of the inter-orbital portion is principally owing to the spreading out of the margins of the orbit, which also adds to the expanse of the zygomatic arch. In both animals the infra-orbital *foramen* on each side is of great magnitude, its vertical diameter equalling two thirds of that of the orbit.

But perhaps the most striking feature in the skull of the *Chinchilla* is the extraordinary development of the tympanic cells, which occupy more than half of the apparent capacity of the *cranium*, and present externally, in consequence of their magnitude and the tenuity of their *parietes*, the appearance of three large vesicular protuberances on each side of the *cranium*. Of these the superior, placed immediately mesiad of the upper margin of the external *meatus*,(which is a large open cavity, penetrating deeply from above downwards,) is nearly hemispherical: the posterior, situated behind the *meatus*, is oblong, with its long diameter from above downwards: and the inferior, which with its fellow occupies nearly the whole inferior surface of the cranial cavity, is pyriform with its long diameter from before backwards, and its narrowest portion pointing backwards and outwards. At the point of junction of the posterior and inferior of these protuberances, which have but a slight appearance of separation from each other, the styloid process passes down, closely applied and firmly anchylosed to their substance.

In *Lagotis*, on the contrary, the tympanic cells have little increased development, and none of the vesicular appearance. Those of the upper surface of the *cranium* are placed at some distance mesiad of the margins of the *meatus externi*, and are flat and scarcely distinguishable: the posterior are long, narrow, and flattened: and the inferior bear no comparison to the size of the same parts in *Chinchilla*, although resembling them in shape. The external *meatus* is formed nearly in the same manner; but the styloid process is free from any attachment to the outer *parietes* of the cells. The whole tympanic apparatus of *Lagotis* does not equal one third of its proportional size in *Chinchilla*.

In both animals the *rami* of the lower jaw posterior to their union are remarkably thick and strong, and its angular plates thin and delicate: the coronoid process is but little developed, and that of the angle is much prolonged, especially in *Chinchilla*. It terminates in a point, between which and the condyle there occurs a broad, deep, semilunar excision. The condyle is small and longitudinal, and the glenoid cavity superficial, admitting of great freedom of motion in the antero-posterior direction.

In both animals the number of cervical *vertebræ* is, as usual, seven; the dorsal and lumbar are together nineteen; but unless a rib on each side has been lost in the preparation of *Lagotis*, (and of this I can perceive no proof in the existence of an articular surface,) its dorsal *vertebræ* are only twelve, while in *Chinchilla* they are certainly thirteen. Two anchylosed *vertebræ* form the *sacrum* in each; but the number of caudal *vertebræ* differs, *Lagotis* having twenty-seven, and *Chinchilla* only twenty-three. In both the *atlas* is broadly developed, and there is a considerable spinous process on the *dentata*; but scarcely any elevation exists at this part on the other cervical *vertebræ*. The spinous processes of the dorsal *vertebræ*, from the third to the ninth inclusive, are much elongated, and directed backwards; the tenth has the same direction. Those of the lumbar *vertebræ* are directed forwards, and are remarkably strong and conspicuous on the three last, as well as on the two sacral, where these processes resume a vertical direction. The caudal *vertebræ*, with the exception of the first seven, are long and cylindrical; and they are all, except the smaller terminal ones, furnished with V-shaped *apophyses*. The *sternum* is composed of six bony pieces, in addition to the xiphoid cartilage; of these the *manubrium* is long, broadly expanded in its anterior half, and somewhat paddle-shaped; the penultimate is by much the smallest. Seven pairs of the ribs are directly articulated with the *sternum*.

The clavicle is perfect, but slender and slightly curved; and the *scapula* small, with the spine nearly median and little elevated posteriorly, but terminating in a long *acromion*, the free portion of the spine being nearly equal to the whole attached length. On the outer and upper part of the *humerus* there is a strongly marked deltoid process, from which a ridge is continued downwards. The *olecranon* is large; and the *radius* and *ulna*, although distinct, are so closely applied to each other at their carpal extremity, as to appear anchylosed for one half of their length in *Chinchilla*, and one fourth in *Lagotis*. The four fingers of *Lagotis* are composed of three *phalanges*, additional to the metacarpal bones, and there is not the smallest vestige of a thumb. In *Chinchilla* the *phalanges* of the corresponding fingers are formed upon the same plan; and the thumb has two distinct *phalanges* in addition to its proper metacarpal bone. The *pelvis* is long and narrow, the *cristæ* of the *ilia* being much extended forwards, and the great size of the *obturator foramina* giving rise to a similar projection of the *ischia* backwards. The *femur* is straight and cylindrical; it is half as long again as the *humerus*. The *tibia* is twice the length of the *radius*. The *fibula* is complete and detached, but very slender. The length of the soles of the hinder feet, from the *calcaneum* to the tip of the longest toe, is nearly three times that of the anterior from the carpal articulation outwards. The whole length of the free portion of the posterior limbs is consequently about double that of the anterior. The metatarsal bones are four in number; and each toe has three *phalanges*, the outermost of the four just reaching the base of the next adjoining toe.

The comparative measurements of the bones in the two animals are as follow:—

	Lagotis.			*Chinchilla.*		
	No.	Ft.	In.	No.	Ft.	In.
Length of the head			3·2			2·3
——— *vertebræ*, cervical	7 . .		1·3	7 . .		·8
——— dorsal	12 . .		3·3	13 . .		2·3
——— lumbar	7 . .		3·6	6 . .		2·2
——— sacral	2 . .		·8	2 . .		·5
——— caudal	27 . .	1	0·4	23 . .		6·
Total length		2	0·6		1	2·1
Length of the skull			3·2			2·3
Breadth of do. at the *meatus auditorii* .			1·5			1·2
——— *zygomata* . . .			1·7			1·2

	Lagotis. In.	*Chinchilla.* In.
Distance between the orbits above[1]	·8	·45
Diastematic distance, upper jaw	·9	·5
——— lower jaw	·7	·4
Length of molar series in each jaw	·7	·5
——— mastoid process, or inferior division of the tympanic cells	·6	·7
Greatest breadth of do.	·45	·5
Length of the lower jaw (including the teeth)	2·5	1·8
Height of the coronoid process	·8	·7
Length of the clavicle	·9	·6
——— *scapula*	1·8	1·2
——— *humerus*	2·	1·2
——— *radius*	1·9	1·2
——— *ulna*	2·4	1·6
——— fore-foot to the end of the middle finger	1·4	·9
Length of the *pelvis* from the *crista ilii* to the *tuber ischii*	3·3	2·2
Greatest breadth of do.	1·7	1·2
Length of the *femur*	3·	1·9
——— *tibia*	3·8	2·3
——— hind-foot from the *calcaneum* to the end of the longest toe	3·6	2·2

With the animals just described *Lagostomus* corresponds in the general composition of its skeleton, and even in the form and proportion of most of the separate bones. It is still larger in size than *Lagotis*; and the figure accompanying Mr. Brookes's description exhibits several very striking differences in the form of the *cranium*. As, however, the details of that important part are not there made out with sufficient clearness, and I possess no notes relative to its peculiarities, I can do no more than refer to the plate itself. The number of ribs on each side, and consequently of the dorsal *vertebræ*, was twelve, and that of the lumbar *vertebræ* seven, corresponding in these par-

[1] This and the zygomatic breadth depend in *Lagotis* on the less oblique and more lateral position of the eyes, the orbits of which have their margins also much expanded, a structure perhaps connected with more nocturnal habits.

ticulars with *Lagotis*, and differing from *Chinchilla*. The sacral *vertebræ* are stated to be three in number; but in the plate, two only appear to be united to the *ossa ilii* by the sacro-iliac *symphysis*, as in the other known animals of the family. Making this allowance, the number of caudal *vertebræ* is twenty-one. The anterior extremities have little to distinguish them from those of *Lagotis*, with which they exactly correspond in the number of the toes: as in *Lagotis*, there is no vestige of a thumb. The posterior limbs bear the same proportion to the anterior, being just double their length; but the number of the metatarsal bones, and consequently of the toes, is only three, and the claws, especially the middle one, are much larger, stronger, and more produced. In this particular the figures given by Mr. Brookes are defective, as exhibiting the claws far smaller and more curved than is natural.

I now come to the consideration of the teeth, which I have purposely reserved to the last. With a general agreement in number and composition, these important organs offer, in the three animals under consideration, differences so essential as to justify of themselves, but more especially when considered in connexion with the striking modifications in the form of the *crania* and in the organs of locomotion, the formation of a distinct genus for the reception of each. In all, the incisor teeth have the number and form which are common to nearly the whole of the order: they are two in each jaw, chisel-shaped at the *apex*, and those of the upper jaw have their exserted portion nearly vertical, while those of the lower pass obliquely forwards and upwards. The diastematic space between them and the molars is considerable; and the latter are four in number on each side of both jaws. They are all constructed nearly upon the same model, having no distinct roots, and being each composed of either two or three parallel, ribband-like *laminæ* of osseous matter, each *lamina* surrounded by its own proper coat of enamel, and united to its fellow by an intervening cortical substance. In *Lagostomus* the *laminæ* are two in number in each tooth, with the exception of the hinder one of the upper jaw, which has a third but smaller *lamina* superadded posteriorly; and the *laminæ* on the worn surfaces of the teeth are perfectly straight, and nearly equal. In *Lagotis* the number of *laminæ* in each tooth is increased to three; the teeth of the upper jaw have the posterior, and those of the lower the anterior, *lamina* smaller than the others; and these smaller *laminæ* do not, in the former case, advance to the inner, or in the latter case to the outer margin of their respective teeth. In consequence of this arrangement the teeth of the lower jaw exhibit an appearance in some degree the reverse of those of the upper, and this effect is still further heightened by the latter having its posterior, and the former its anterior, tooth prolonged into a triangular shape, while all the rest are square. The two larger *laminæ* form on the worn surfaces of the teeth regular curves with the convexity directed forwards in the upper jaw and backwards in the lower; and the crowns exhibit in the former two grooves externally and one internally, marking the line of union of the separate *lamellæ*, while in the latter the grooves are, like the *laminæ* themselves, reversed. In *Chinchilla* the number of distinct *laminæ*, except in the anterior tooth on each side of the lower jaw, is the same as in *Lagotis*; and the same apparent reversal of the teeth in the two jaws is manifest. The posterior *lamina* of the teeth in the upper jaw, and the anterior in those of the lower, is also the smallest of the three, and these smaller *laminæ* fall short of the respective margins of the teeth, nearly as in *Lagotis*, giving rise to a similar anomaly in the grooving of the inner and outer surfaces of the crowns. But instead of the regular curve of the two larger *laminæ* which takes place in *Lagotis*, those of *Chinchilla* are nearly straight, with the exception of a sharp turn backwards of the inner extremity of the intermediate *lamina* in the upper jaw, and a slight prolongation forwards of the outer extremity of the same *lamina* in the lower. Add to this that a still more marked difference occurs in the anterior tooth in the lower jaw, which, instead of being composed of three distinct *laminæ* as in *Lagotis*, has the line of enamel subdividing its two anterior portions so abbreviated as to extend little more than half way across the tooth; which consequently consists of only two distinct *lamellæ*, the anterior bilobate internally, but with its osseous substance externally continuous. In all the family the *laminæ* of the teeth are directed obliquely backwards and inwards, and still more obliquely so in the lower than in the upper jaw.

From this account of the dentition of the three animals, the differences between *Lagostomus* and the other two will be at once obvious: those which distinguish *Lagotis* and *Chinchilla* will be better observed in the figures than they can be conveyed in words. The following, however, is a summary of the more remarkable points of discrepancy between them. These consist, firstly, in the curvature of the anterior *laminæ* of the teeth of the upper jaw in *Lagotis*, as compared with the straightness of the same *lamellæ* in *Chinchilla*; and in the curvature of the middle *lamella* taking place more gradually, and not in the sudden manner in which it occurs in *Chinchilla*: secondly, in the greater extent of the anterior *lamella* of the three posterior teeth of the lower jaw in *Lagotis*, as compared with *Chinchilla*: thirdly, in the complete disjunction of the two anterior *laminæ* of the anterior tooth of the lower jaw in *Lagotis*, while in *Chinchilla* the enamel advancing between them from within, extends on the surface of the crown but little more than half across the tooth, and thus leaves a space in which the osseous portions of the two *lamellæ* run into and are continuous with each other.

I shall conclude with the technical characters of the three genera which constitute the family of *Chinchillidæ*, and with a few observations on its place in the tribe to which it belongs.

Ordo RODENTIA.

Tribus Herbivora, *F. Cuv.*

Dentes molares eradicati, per totam vitam pulpâ persistente crescentes.

Fam. Chinchillidæ.

Dentes incisores $\frac{2}{2}$, superiores simplices; molares $\frac{4-4}{4-4}$, e lamellis osseis binis ternisve tænialibus inter se parallelis substantiâ vitreâ omnino circumdatis, constantes; coronidibus invicem exactè oppositis, attritu complanatis. *Americæ Australis incolæ, gregarii, subterranei, mites. Scelides antipedibus sub-duplo longiores. Cauda producta, ad apicem supernèque longè setosa.*

Genus 1. Lagotis.

Dentes incisores $\frac{2}{2}$, acutati; molares $\frac{4-4}{4-4}$, singuli e lamellis tribus completis obliquis constantes. Cranium posticè supernèque arcuatum, tympani cellulis superioribus inconspicuis. Pedes omnes 4-dactyli, pollice omnino deficiente, unguibus parvis subfalcularibus. Auriculæ longissimæ. Cauda longa. *Rupicolæ, (Peruviani,) vellere molli caduco induti.*

Lagotis Cuvieri.

Genus 2. Chinchilla.

Dentes incisores $\frac{2}{2}$, acutati; molares $\frac{4-4}{4-4}$, singuli e lamellis tribus completis obliquis constantes, præter anticum inferiorem bilamellosum lamellâ anteriore profundè bilobâ. Cranium posticè retuso-truncatum, supernè depresso-complanatum, tympani cellulis conspicuè inflatis. Antipedes 5-dactyli, pollice completo; scelides 4-dactyli; unguibus parvis subfalcularibus. Auriculæ amplæ. Cauda longiuscula. *Rupicolæ, (Chilenses et Peruviani,) vellere mollissimo tenacissimo induti.*

Chinchilla lanigera, Benn., Gard. & Men. Zool. Soc., i. p. 1. c̄. fig.—Rouss., in Ann. Sci. Nat., xxvi. p. 337. t. 13. (cranium dentesque.)

Mus laniger, Mol., Stor. Nat. Chil., p. 267.

Cricetus laniger, Geoff.—Desm., Mamm., p. 313.

Chinchilla, Griff., Transl. An. Kingd., fig.

Chinchilla laniger, Gray, Spic. Zool., p. 11. t. 7. (fig. sup.)

"*Eriomys Chinchilla*, Mus. Francof.," teste Fisch., Syn. Mamm. Add., p. 592.—"Van der Hœv., in Bijdrag. Naturk. Wetensch., Deel vi. No. 1. fig.," fide Bull. Sci. Nat., xxiv. p. 352.

Callomys laniger, Isid. Geoff., in Ann. Sci. Nat., xxi. p. 291.

Chinchilla, F. Cuv., Mamm. Lith., c̄. fig.

Lagostomus laniger, "Wagl."—Goldf., Naturh. Atlas, Th. III. p. 263. t. 290. f. 1.

Genus 3. Lagostomus.

Dentes incisores $\frac{2}{2}$, acutati; molares $\frac{4-4}{4-4}$, singuli e lamellis binis completis obliquis constantes, postico superiore trilamelloso. Antipedes 4-dactyli, pollice omnino deficiente, unguibus parvis falcularibus; scelides 3-dactyli, unguibus productis rectis robustis. Auriculæ mediocres. Cauda mediocris. *Campestres, (Bonarienses et Paraguaienses,) vellere parum utili induti.*

Lagostomus trichodactylus, Brookes, in Linn. Trans., xvi. p. 102. t. 9. (animal et ejus sceleton.)—Less., Ill. Zool., livr. 3. pl. 8.—Goldf., Naturh. Atlas, Th. III. p. 262. t. 289. f. 2. (figg. Brookes.)

Dipus maximus, Blainv.—Desm., in Nouv. Dict. Hist. Nat., xiii. p. 117.—F. Cuv., in Dict. Sci. Nat., xviii. p. 471.

Marmot Diana, Griff., Transl. An. Kingd., iii. p. 170. c̄. fig.

Callomys Viscaccia, Isid. Geoff., in Ann. Sci. Nat., xxi. p. 291.

Quærendum adhuc est ubi referendum

Callomys aureus, Isid. Geoff., in Ann. Sci. Nat., xxi. p. 291.

An generis Chinchillæ ?

The *Herbivorous* subdivision of *Rodentia*, as proposed by M. Fréderic Cuvier, embraces several strongly marked groups of forms, having an immediate affinity with each other, although it must be confessed that several of them are also nearly related to genera of the *Omnivorous* tribe. The persistence of the pulp of their molar teeth, and the consequent unceasing growth of those teeth, indicate, however, an inferior degree of development as regards those most essential organs; and appear to me to offer a sufficient bond of connexion between them.

Of the families composing this tribe, the *Leporidæ*, including *Lepus* and *Lagomys*, and represented by the *Hares* and *Rabbits*, are characterized by their supplemental incisors, and by the tendency to still further subdivision in the anterior pair, which in *Lagomys* especially are so deeply grooved and have the two portions so different in size and form, as to simulate two distinct teeth on each side of the *symphysis* of the upper jaw. The molar teeth are not in these animals opposed crown to crown, but those of the lower jaw pass, when the mouth is closed, almost entirely within those of the upper, and a considerable degree of lateral motion is consequently requisite for the due mastication of the food; which motion is much facilitated by the almost hemispherical form of the condyles of the lower jaw, and the freedom of their articulation in small glenoid cavities. By means of this organization the surfaces of the molar teeth are unequally worn, and offer transverse projecting lines of enamel, with intermediate depressions of the osseous substance.

To this family the *Chinchillidæ* are evidently very nearly related, in the lamellated composition of their molar teeth; in the general form of the body; in the nature of the hairy covering; and in habits and mode of life. They differ, however, in many essential particulars, such as the simplicity of their incisor, and the reduced number of their molar, teeth; the elongated form of the condyles of the lower jaw, and the consequent limitation of the process of mastication to a motion forwards and backwards, wearing down the crowns of the molars (which are exactly opposed to each other) in a perfectly equal manner; the depression of the upper surface of the head, which in the *Hares* and *Rabbits* is very strongly arched throughout its whole extent; the deep excisure of the posterior margin of the lower jaw, which in the latter animals is an extremely broad and rounded bony plate; and many other equally striking, but less important, modifications in the bony structure of the head alone. In the possession of perfect clavicles, and the substitution of a large open suborbital passage for the perforated bony plate found below the orbit in the *Hares* and *Rabbits*, they exhibit a more immediate affinity to the genus *Lagomys*, in which both these modifications are stated to occur.

Most nearly related to the *Chinchillidæ* on the opposite side is the genus *Capromys*, Desm., (*Isodon*, Say,) in which the molar teeth (also four in number on each side, with flattened crowns and surfaces exactly opposed to each other,) would appear on a superficial observation to be subdivided in a nearly similar manner. On looking closer, however, we observe that the processes of enamel do not, in *Capromys*, entirely traverse the teeth, but form alternate indentations, corresponding with external *sulci*, of which two are seen on one side of the tooth, and one only on the other. The anterior teeth are also more elongated, and that of the lower jaw projects forwards in an angular process, which has on its inner margin a third denticular fold of enamel. The *cranium* in *Capromys* is very narrow and much elongated, especially in its frontal and parietal portions, the latter having a slight convexity at its anterior part; the orbit is of small capacity; and the infra-orbital *foramen* is large and open, as in the *Chinchillidæ*. The number of the ribs, which is no less than sixteen, is here a marked peculiarity; and the great strength of the limbs, supported, as regards the anterior, by a complete clavicle, and having the bones of the fore-arm nearly equally developed, and the *fibula* strong and distinct, affords a characteristic difference, connected doubtless with the scandent habits of the animals.

The peculiarity noticed in the anterior tooth of the lower jaw in *Capromys* leads us by a natural transition to the typical *Arvicolidæ*, including *Arvicola*, *Lemmus*, and *Fiber*, in which only the three anterior molar teeth are developed. These have their enamel so folded inwards as to form on both the outer and inner side of each tooth a series of distinct triangles alternating with each other, and giving rise to acute-angled projections both externally and internally. In the genera of this family the increasing rounding of the anterior surface of the lower incisors renders their points, when obliquely worn down, either rounded or acute, instead of transversely truncate, as in the preceding groups.

Nearly related to *Arvicolidæ*, with which they agree in general appearance and in mode of life, are two genera, at present standing in some degree isolated, *Ctenodactylus*[1] and *Octodon*[2]. The resemblance in the form of the molar teeth in these two curious animals, (both of which have been very recently for the first time described,) one from Africa and the other from Chili, is very remarkable. They differ, however, in number. the latter having four and the former three only on each side of either jaw; and, be-

[1] Gray, Spicilegia Zoologica, p. 10. t. 10. [2] Bennett, in Proc. Comm. Sci. Zool. Soc., Part II. p. 46.

sides other minute differences in these organs, exhibit considerable discrepancy in the form of the skull and in various particulars of their organization, into which I may perhaps enter more fully on a future occasion.

At no great distance from these, if we are to judge alone by the characters of its molar teeth as figured by M. F. Cuvier, is placed the genus *Helamys*, of which unfortunately I possess neither skull nor skeleton for comparison. As far, however, as the stuffed skin can be relied on for such a purpose, it seems in many of its characters to approach *Lagostomus*; while the differences in the relative proportion of its limbs, in the elongated claws of its anterior extremities, in the character of its fur, and above all in the structure of its teeth, forbid a close approximation. With no better materials than I can at present refer to, it would be hazardous to attempt to assign its true position.

Equally anomalous appear, in the present state of our knowledge of the tribe, two North American genera, first established by Dr. Rafinesque, *Geomys* and *Diplostoma*; with which must be associated *Aplodontia* of Dr. Richardson. The teeth of *Geomys* and *Aplodontia*, as figured by the last-named zoologist, are more simple in their structure than those of any other genus of *Herbivorous Rodentia*; and, in so far, they seem to approach the groups of which I have just been speaking. But the discrepancies in other respects are so considerable, that further information must still be considered necessary to determine their real affinities.

To the *Arvicolidæ* succeed the *Caviidæ*, comprehending *Cavia*, *Kerodon*, and *Dolichotis* (*Cavia Patachonica*, Shaw); in which the dental triangles are more distinct and elongated, and form but one series instead of two, their acute angles projecting externally in the lower jaw and internally in the upper: they are also fewer in number. The number of the molar teeth is four; and here again, as in the *Hares* and *Rabbits*, their crowns are not directly opposed to those of the opposite jaw. The order is in these, however, the reverse of that which occurs in the genus *Lepus*, the teeth of the upper jaw being received within those of the lower; and a degree of obliquity is given to the insertion as well as to the surfaces of the teeth, sufficient to produce the effects of a more perfect opposition.

The series is closed by *Hydrochærus*, which exhibits, in its dental character, a still further complication of the structure observed in *Arvicolidæ* and *Caviidæ*, with much that is aberrant in the order. Some valuable observations on this point by Mr. Owen have been published in the 'Proceedings of the Committee of Science and Correspondence' of this body[1].

The mere enumeration of the groups of this interesting little tribe may serve as an illustration of the advances which the science of Zoology has made within a very few years. Of the nineteen genera named, no less than eleven (including the whole family of *Chinchillidæ*, *Capromys*, *Ctenodactylus*, *Octodon*, *Geomys*, *Diplostoma*, *Aplodontia*,

[1] Part II. p. 187.

Kerodon, and *Dolichotis*,) were absolutely unknown, in a zoological sense, only twelve years ago. Two of these, *Chinchilla* and *Lagotis*, were first fully described from specimens contained in the Menagerie and Museum of this Society; of a third, *Octodon*, the only account yet extant is derived from the same source; and to the history of two others, *Capromys* and *Ctenodactylus*, most important additions have been made from the examination of individuals formerly living in our Gardens.

In a department which has afforded, during so short a period, so many additions to science, it is reasonable to anticipate, and probably for many years to come, repeated and almost continual accessions. In various parts of the world which are comparatively well known, the *Rodentia* are far from being exhausted as objects of zoological inquiry; and the vast continents of Africa and America (the latter, especially in its southern half, apparently the metropolis of the order,) have hitherto, perhaps, furnished us with only a foretaste of what may be expected from them, when their interior shall be opened to the investigations of active and informed travellers. To the materials which will doubtless be collected by the zeal and enterprise of such men we must look for the means of correcting and completing the confessedly imperfect sketch of the *Herbivorous* portion of the order, which I have ventured to submit to the consideration of the Society.

PLATE IV.

Lagotis Cuvieri.

PLATE V.

Fig. 1. Stomach of *Lagotis Cuvieri*.
2. *Cæcum* of *Lagotis Cuvieri*.
3. Stomach of *Chinchilla lanigera*.
4. *Cæcum* of *Chinchilla lanigera*, less distended than that of *Lagotis*.

PLATE VI.

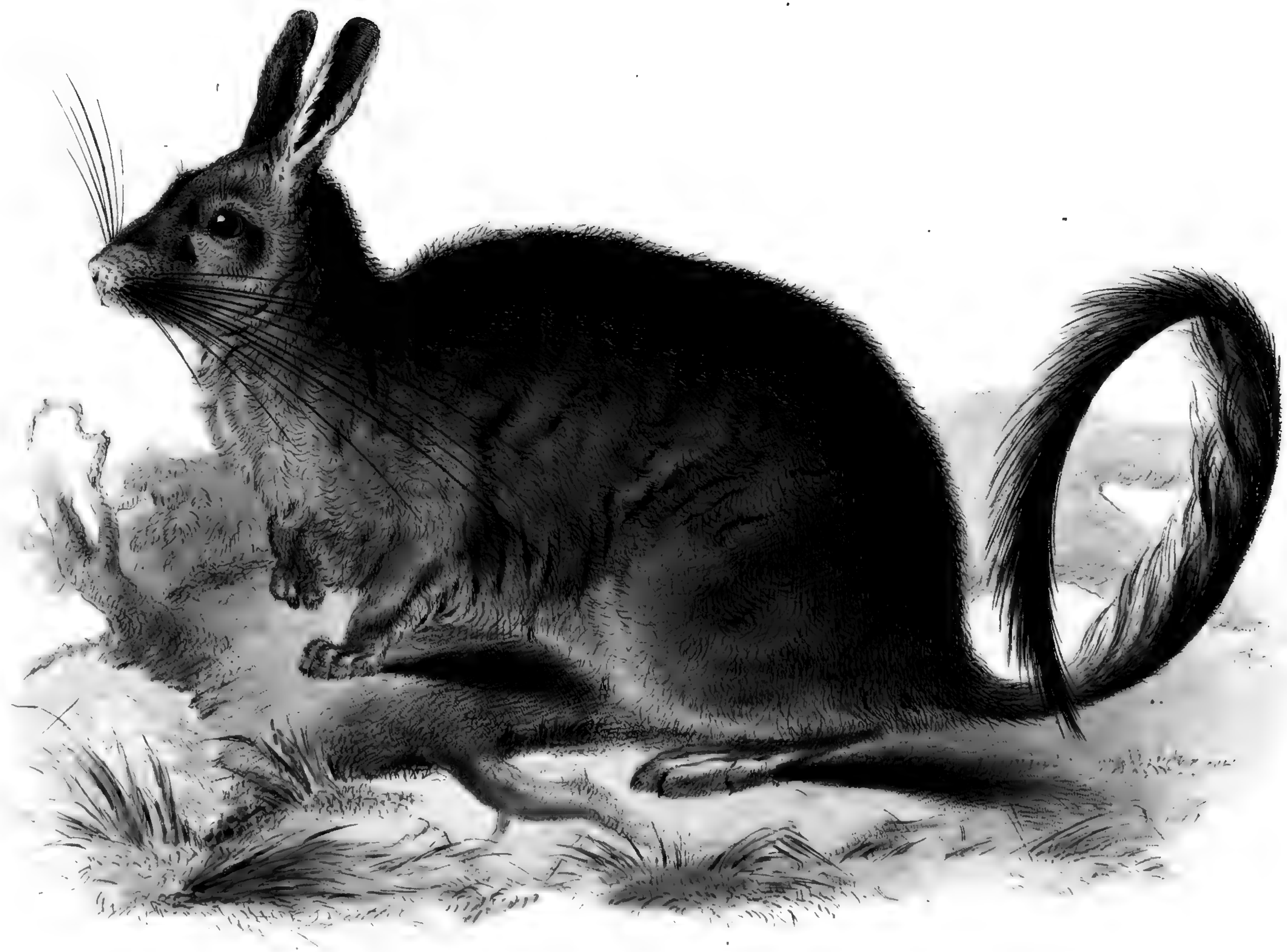
Skeleton of *Lagotis Cuvieri*, two thirds of the natural size.

Fig. 1. *Cranium* seen from above.
2. *Cranium* seen from below.
3. Lower jaw seen from above.
4. Crowns of the two anterior molar teeth of the lower jaw, enlarged.
5. Crowns of the two posterior molar teeth of the upper jaw, enlarged.

PLATE VII.

Skeleton of *Chinchilla lanigera*, natural size.

The separate figures represent parts of the osseous structure of *Chinchilla* corresponding with those of *Lagotis* represented in Plate VI., and are similarly numbered.



E. Lear del.

Lagotis Cuvieri.

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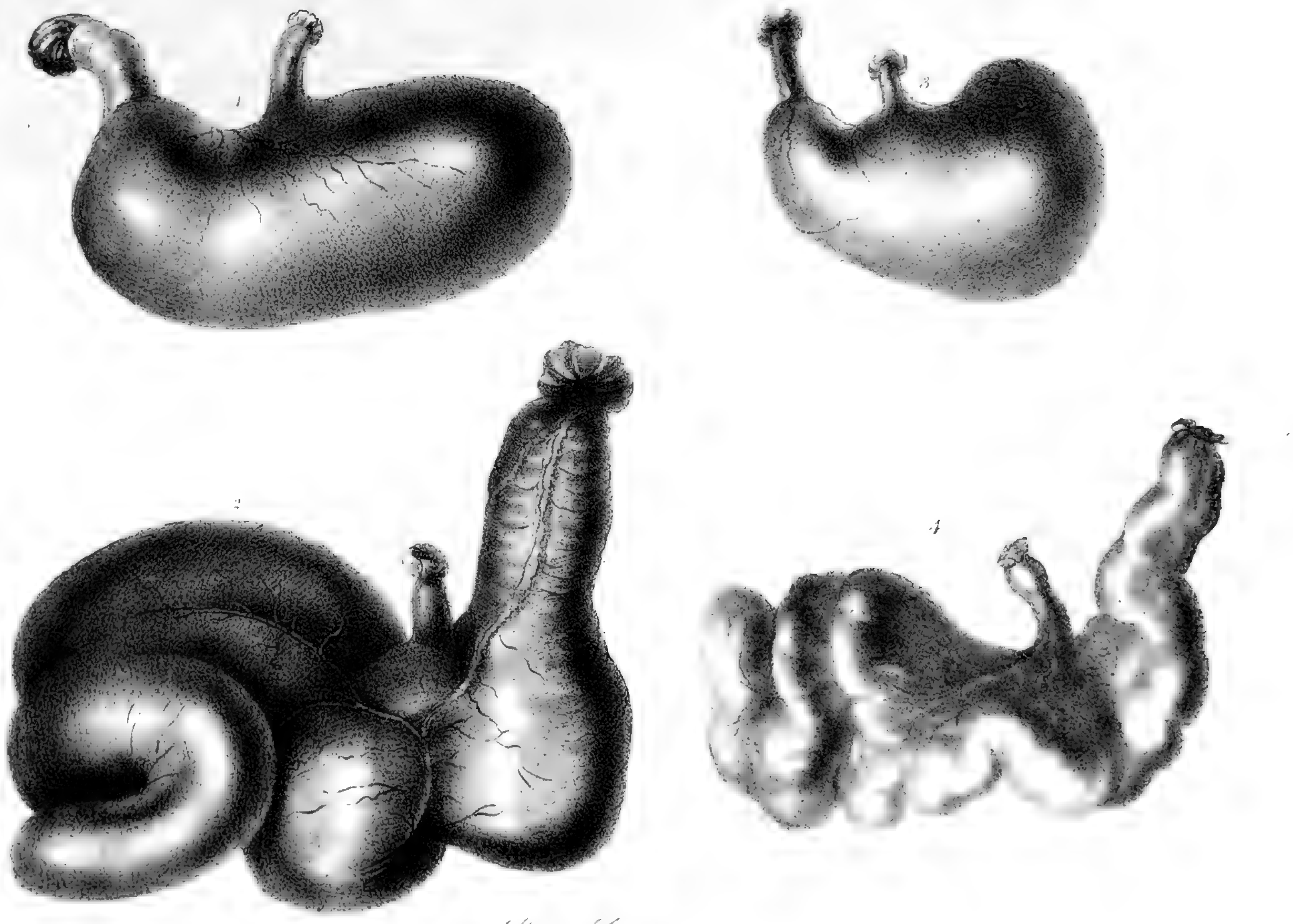
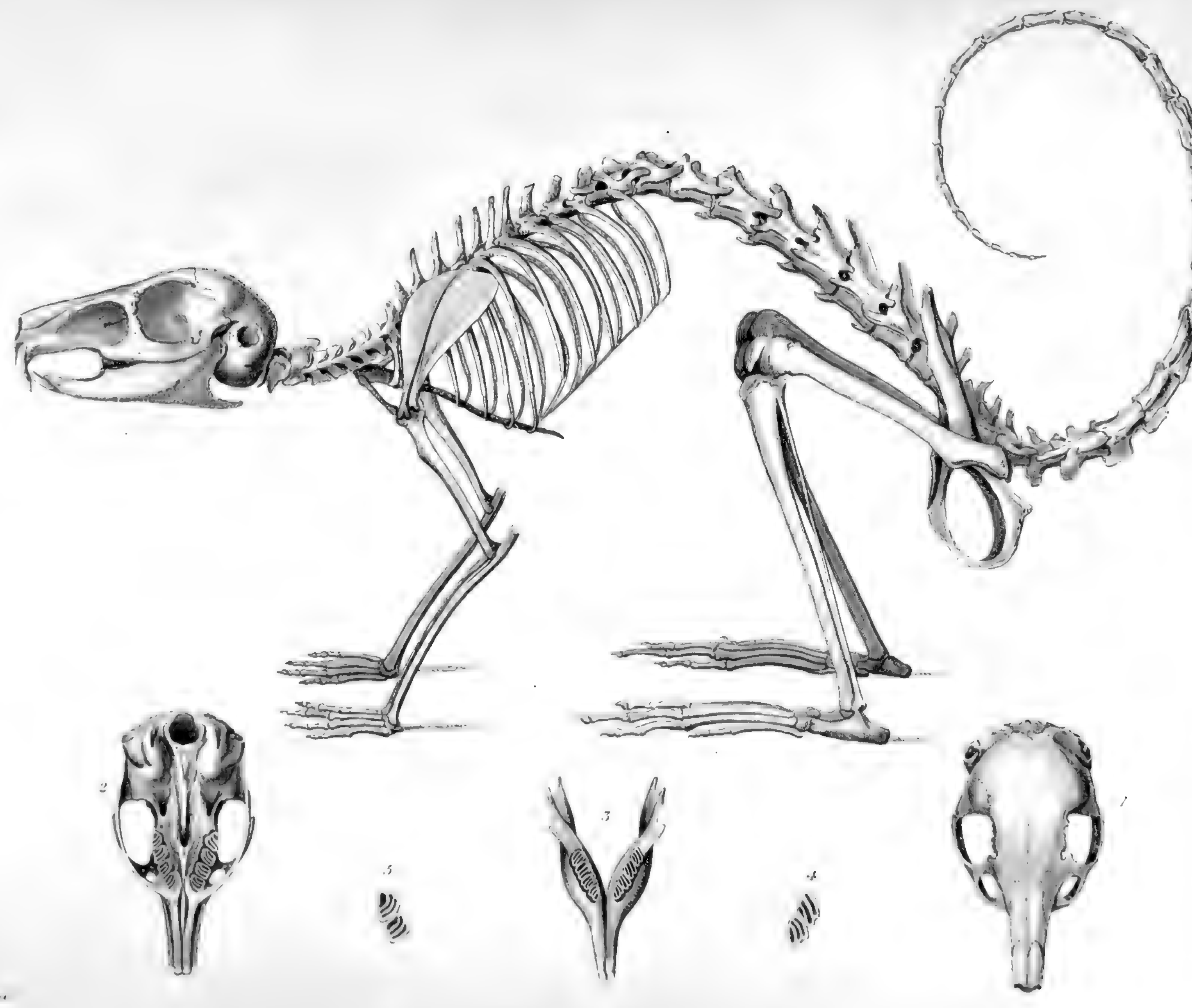
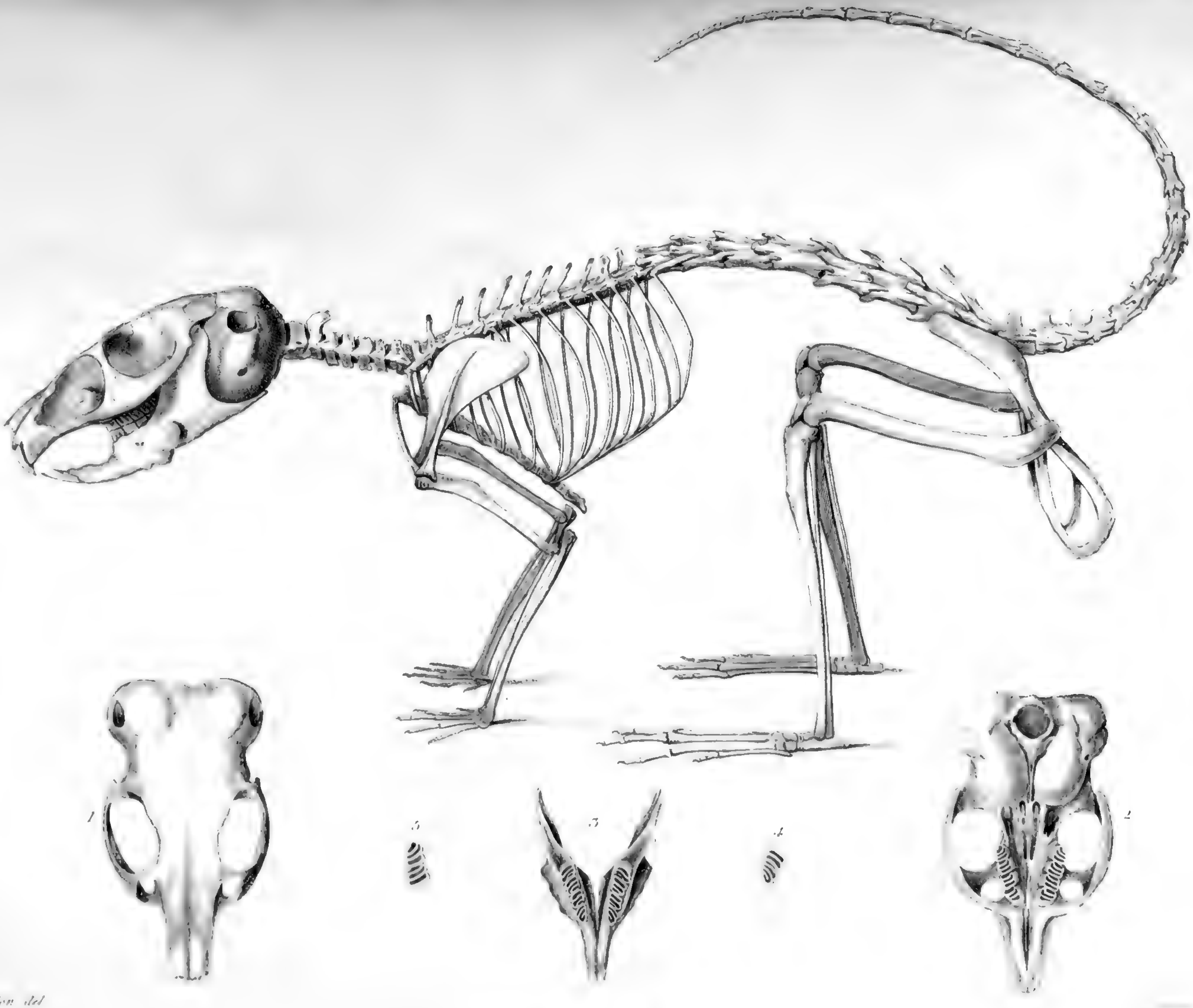


1. 2. Lagotis Cuvieri
3. 4. Chinchilla lanigera



Lagotis Cuvieri.



Newton del.

Chinchilla lanigera

VII. *On the sacculated Form of Stomach as it exists in the Genus* Semnopithecus, *F. Cuv.* *By* Richard Owen, *Esq., F.Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated June 11, 1833.

In the dissections of the animals of the class *Mammalia* which take place at the Museum of the Society, it rarely happens that the more important organs are found to present any remarkable deviations from the structures already known and described as characterizing the genus or group to which the species under examination may belong. Nor is it to be expected that novelties of much importance can often be detected in a class which has been so extensively investigated. Nevertheless, the necessity of continuing these examinations at every opportunity that occurs, must be admitted by every one: anatomical facts become more valuable to the physiologist as their authenticity is confirmed by repeated examination;—the means of forming conclusions as to the reciprocity of function, and the relative value of different organs, from their varying preponderance in different animals whose habits as burrowers, swimmers, climbers, &c., may affect the different functions;—these interesting and important deductions can only be founded on extensive tabular arrangements of the weights and admeasurements of the different organs. But whilst the anatomist is silently accumulating these data, it does happen every now and then that unexpected modifications of important organs present themselves, the discovery of which, while it serves as a healthy stimulus to his exertions, at the same time teaches him how dangerous it is to draw hasty conclusions as to analogy of internal structure from similarity of external form.

The singularly shaped stomachs which are now before the Society were taken from two species of a genus of *Monkey*, the *Semnopithecus*, F. Cuv., which in the system of Cuvier ranks only fifth in the descensive gradation from *Man*. This genus is of late formation, and not entirely the result of newly discovered materials: several species, on the contrary, were for a long time ranked with the *Guenons*, *Cercopithecus*, in which the stomach is of the usual simple construction: and it is almost superfluous to remark in this place, how slight is the essential zoological character, viz. an additional tubercle on the last molar of the lower jaw, which distinguishes genera presenting such wide discrepancies in the most important of their vital organs.

The larger of the two stomachs was taken from a full-grown female *Entellus Monkey*, *Semnopithecus Entellus*, F. Cuv., which measured, from the end of the nose to the root of the tail, 1 foot 8 inches. The admeasurements of the stomach, distended and dried, are as follows:—

	Ft.	In.	Lin.
Length along the greater curvature, beginning at the left extremity	2	7	0
Length along the lesser curvature	1	0	0
Greatest circumference (a little to the right of the *cardia*) . . .	1	0	6
Smallest circumference (at about two inches from the *pylorus*) . .		3	8

This stomach may be regarded as consisting of three divisions: 1st, a cardiac pouch, with smooth and simple *parietes*, slightly bifid at the extremity; 2nd, a middle, very wide and sacculated portion; and 3rd, a narrow elongated canal, sacculated at its commencement, and of simple structure towards its termination. The latter division, from its greater vascularity and the more abundant distribution upon it of the nerves of the eighth pair, I regard as the true digestive stomach; the preceding divisions appear to be preparatory receptacles or reservoirs.

The *œsophagus* enters into the left or cardiac division, which is separated from the middle division by a well-marked constriction. The diameter of this aperture of communication, when the stomach has been forcibly dilated, does not exceed 2 inches: so that it seems highly probable, when no distending force is operating at this part, that the circular fibres which surround the constriction may, by the act of contraction, render the separation complete, and thus form the cardiac pouch into a distinct cavity. A similar tendency to a separation of the cardiac from the pyloric moiety of the stomach has been observed to exist, in a greater or less degree, in stomachs of a much more simple structure, as in those of *Man* and of the *Carnivora*. It is, probably, the possession of this power, in a greater degree, that enables some men to regurgitate at will a small portion of the contents of the stomach, or to ruminate. Such an action is therefore still more likely to take place, occasionally at least, in animals which possess the complicated stomach here described: and there is a provision in these stomachs for the passage of ruminated food, or such as is of a fluid or easily digestible nature, directly into the second or sacculated division.

A ridge is continued along the pyloric side of the cardiac orifice obliquely to the fold in the middle division, which is situated next beyond the constriction: a second ridge is continued from the right side of the *cardia* into the lower part of the *septum* that separates the cardiac from the middle compartment: and consequently between these ridges a shallow canal is continued from the *œsophagus* to the middle division of the stomach. Supposing the circular fibres which form the two ridges to contract simultaneously with those forming the constriction above, then the communication between the *œsophagus* and middle division of the stomach would be cut off; but, on the other hand, if these fibres were relaxed, the food, and especially liquid food, would pass along the oblique canal directly into the middle compartment.

Longitudinal fibres are continued from the *œsophagus* upon the cardiac division; but they gradually converge towards its left extremity, and there begin to be collected into the narrow band which traverses nearly the whole of the greater curvature of the stomach.

The extremity of the cardiac division is thus slightly indented, reminding one of the similar but more marked division of the same part of the stomach in the *Kangaroo*, which in other respects bears so strong a resemblance to the present.

The length of the cardiac division is 3 inches; its greatest diameter, 3 inches 4 lines.

The second or middle compartment of the stomach is composed of a double series of *sacculi* of different sizes, puckered up upon the longitudinal band above mentioned. Some of these *sacculi* have a diameter of 3 inches, others of 1 inch. They are formed principally at the expense of the anterior *parietes* of the stomach, and are eleven in number. The *septa*, by which they are divided from each other, are of a semilunar form, and project into the cavity of the stomach to the extent of half an inch, and a few to that of an inch.

The length of this part of the stomach, in a straight line, is 5½ inches; its greatest diameter, 5 inches.

The third or pyloric division of the stomach commences a little to the right of the *œsophagus*, where the second longitudinal band begins. It is a narrow and almost cylindrical canal, gradually diminishing in diameter to the *pylorus*, bent in a sigmoid form, and terminating by making a complete turn upon itself. It is only this part of the stomach which is puckered up on the two bands above described. The *sacculi* thus formed are, however, by no means so large or so completely separated from each other as in the preceding division; and they become gradually less distinct to within 5 inches of the *pylorus*, where they cease altogether. A similar gradual disappearance of the *sacculi* is observable in the stomach of the *Kangaroo*.

The whole length of this division, taken midway between the two curvatures, is 1 foot 6 inches; its greatest diameter is 2 inches; its smallest diameter, 1 inch.

In considering this stomach as being made up of three principal divisions, I must not be understood to suppose them as being equally distinct with the different cavities of a ruminant or cetaceous stomach: they are not characterized by any essential difference of structure, for none of them possess a cuticular lining. The three divisions are, however, sufficiently obvious to justify their separate consideration for the facility of the description of so complicated an organ.

In another species of *Semnopithecus*, *Semn. fascicularis*, (the *Croo* of Sumatra and *Semn. comatus* of M. Desmarest,) the stomach presented precisely the same structure as the preceding. Its dimensions were not, however, quite so large in proportion to the size of the animal. The individual examined was younger than the *Entellus*, the stomach of which has just been described.

From the disproportionate size of the stomach in these animals, some differences are met with in the disposition of the other *viscera* of the abdominal cavity. The liver, instead of crossing the epigastric to the left hypochondriac region, extends downwards from the right hypochondriac to the right lumbar region; the whole of the opposite side of the *abdomen*, with the epigastric region, being occupied by the enormous stomach. The liver is proportionately smaller in *Semnopithecus* than in *Cercopithecus* or *Macacus*. The spleen is of a more regular triangular shape, and is attached to the *omentum* continued from the left side of the stomach. The *pancreas*, on the contrary, is proportionately larger than in these genera. Both the biliary and the pancreatic secretions enter the *duodenum* together, about 3 inches from the *pylorus*: were it not for the insertion of these ducts, one might almost suppose that what has been regarded as the true stomach was a portion of the intestinal canal.

With so complicated a stomach, it might also be expected that the intestines would not be so long as in those *Monkeys* which have a simple stomach; this, however, is not the case. The small intestines are longer in proportion to the body in *Semnopithecus* than in either *Cercopithecus* or *Macacus*, the ratio being respectively as 8 to 1, 6½ to 1, and 4 to 1. The latter genus evidently manifests in this respect its closer approximation to the *Carnivorous* type.

The following table exhibits the admeasurements:—

	Semnopithecus Entellus.		*Semnopithecus fascicularis.*		*Cercopithecus albogularis.*		*Macacus Cynomolgus.*	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Length of the body from the nose to the root of the tail . . .	1	8	1	2	1	9½	1	8
Length of the small intestines .	13	6	9	10	11	6	6	9
Length of the large intestines .	2	10	2	6	3	0	2	9
Length of the *cæcum*		4		2½		3		3

As in all the preceding animals the intestines were prepared for admeasurement in the same manner, I believe the relative proportions may be relied upon. I mention this because the admeasurements given by M. Otto of the *Semnopithecus leucoprymnus*, would lead to the conclusion that the intestinal canal was much shorter. His admeasurements of that species, as published in the 'Nova Acta, Bonn.' tom. xii. p. 511. are,

	Ft.	In.
From the nose to the root of the tail	1	8
Length of the small intestines	5	5
Length of the large intestines	1	8
Length of the *cæcum*		2

It is in the description of the above species of *Semnopithecus* by this scientific naturalist, that the first account of the sacculated form of stomach in *Quadrumana* appears:—a discovery which was made known to the English reader through the analysis of his paper contained in the third volume of the 'Zoological Journal'. The *leucoprymnus*, which M. Otto marks doubtingly as being a *Cercopithecus*, is now by common consent referred to M. F. Cuvier's new genus *Semnopithecus*; and the recurrence of this remarkable modification of the stomach in two other species of the same group, renders it highly probable at least that it is a generic peculiarity.

What then are the natural habits and food of this genus? Will future observers of these *slow Monkeys*, as M. F. Cuvier denominates them, be able to ascertain that their natural food is more strictly vegetable than that of the *Cercopitheci*, *&c.*? And that, like the *Sloths* of the new continent, so remarkable for their complex stomachs, they also crop the tender shoots and leaves of the trees in which they habitually reside? *Cercopitheci* and *Macaci* are provided by nature with receptacles (the cheek-pouches) for storing away ill-gotten food, hastily plucked from the cultivated grounds which they invade, and which they are thus enabled to carry off in sufficient quantity, and masticate and prepare for digestion in a place of safety. The complicated stomachs of the timid *Ruminants* are adapted to a similar end, allowing them to accumulate their requisite quantity of herbage from exposed pastures, which they then carry off to more secure situations and remasticate at leisure. Now in the *Semnopitheci* it is remarkable that the cheek-pouches are very small, or are wanting altogether. I have often fed the *Entellus Monkey* with nuts, and have observed that while his more fortunate neighbours, the *green Monkey*, *Cercopithecus Sabæus*, Geoff., and *Chinese bonneted Monkey*, *Macacus Sinicus*, La Cép., were stowing them quickly away by the dozen into their cheek-pouches, he could not cram more than two in the same situation, and was equally averse to swallowing anything but the kernel. In this case the complicated stomach did not serve him as a substitute; but I think it very probable that it may compensate for the want of cheek-pouches, when he is in a situation to collect together a quantity of soft fruits or herbs. In the Gardens of the Society the *Semnopitheci* which have been there exhibited, are fed exactly in the same manner as the other *Monkeys*; and the Keepers have not observed anything like rumination in them.

In both the species which I have dissected, where illness and gradual decay preceded death, the stomachs were almost empty.

With respect to stomachs of an analogous structure in other animals of the class *Mammalia*, I have hitherto limited my comparisons to that of the *Kangaroo*, so well known for its remarkable resemblance to a sacculated *colon* and *cæcum*. Between this animal and *Semnopithecus* there is a wide interval in the natural series. Stomachs, however, almost as complex as the preceding, are found in animals much more nearly allied to the *Quadrumana*. In a large *Bat* of the genus *Pteropus*, *Pteropus rubricollis*, Geoff., I found the cardiac moiety divided into two dilated compartments, of which the left is again subdivided, and plicated within, while the pyloric moiety is extended in an elongated tortuous form, proportionately exceeding in length that of *Semnopithecus Entellus*. It is to a *Pteropus* doubtless, and not to a *Vampyrus*, that is to be attributed a similarly complicated stomach described and figured by Sir Everard Home as belonging to the *Vampyre Bat*, and from which he draws the rather hasty conclusions that "the *Vampyre Bat* lives on the sweetest of vegetables; and all the stories related with so much confidence, of its living on blood, and coming in the night to destroy people while asleep, are entirely fabulous." I suspect that the stomach of the true

Vampyre Bat will be found to accord with the bloodthirsty habits so repeatedly ascribed to it; and in corroboration of which Professor Grant, in his late Lectures before the Society, gave some additional observations.

The complicated stomachs of the *Bradypodæ* are also well known; they approach in their external form more nearly to those of the true *Ruminants*. The chambers into which the stomach of the *Sloth* is divided, are not, however, characterized by the difference of texture of the lining membrane which exists in the *Ruminants*: they present only a difference in the degree of vascularity and villosity, and in that respect are analogous to the complicated stomach of the *Quadrumanous* genus.

To those who are more especially interested in investigating the natural affinities of the animal kingdom, it must be highly gratifying to find the *Quadrumana* manifesting new instances of relation to genera which the immortal Linnæus considered to be so closely connected with them.

PLATE VIII.

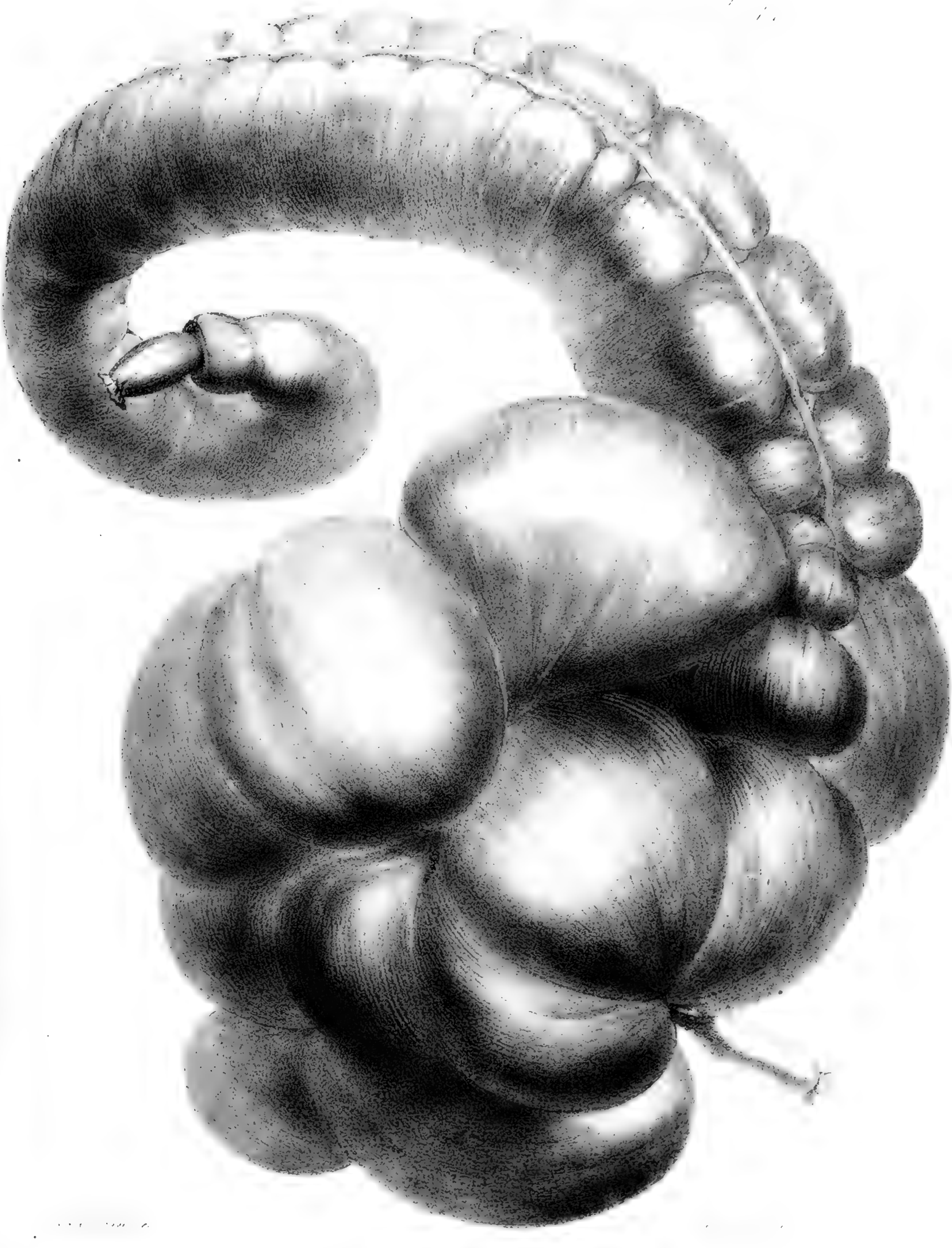
Stomach of *Semnopithecus Entellus*: front view, natural size.

PLATE IX.

Fig. 1. Stomach of *Semnopithecus Entellus*: back view, half the natural size.

Fig. 2. Outline of the cardiac pouch laid open. *a. œsophagus*; *b.* cardiac orifice; *c.* groove leading to the middle sacculated compartment; *d. d.* productions of the tunics of the stomach which form the constriction between the cardiac and middle division; *e. e.* similar productions separating the *sacculi* of the middle division. Natural size.

Fig. 3. Outline of the *cæcum*. *a.* ileo-colic orifice. Half the natural size.



Semnopithecus Entellus

VIII. *Description, with some additional Particulars, of the* Apteryx Australis *of Shaw.*

By William Yarrell, *Esq., F.L.S. & Z.S.*

Communicated June 25, 1833.

A SINGLE specimen of this very singular bird, first described and figured by Dr. Shaw in the 24th volume of the 'Naturalist's Miscellany,' under the name of the *ferruginous-grey Apteryx*, was brought from the south coast of New Zealand by Captain Barcley, of the ship Providence, about the year 1812. By Captain Barcley the specimen was presented to Dr. Shaw, through the kind offices of W. Evans, Esq., who was the mutual friend of both.

The notices of this bird, which have since appeared in the 'Manuel' of M. Temminck, (2nd ed. Anal. p. cxiv. 1820) ; in the continuation of Shaw's 'General Zoology', by Mr. Stephens (vol. xiii. part 1. 1825) ; in the 'Manuel' of M. Lesson (vol. ii. p. 211. 1828); in the 'General History of Birds' by Dr. Latham (vol. x. p. 395. 1828); and in the 2nd edition of the 'Règne Animal' (vol. i. p. 498, note. 1829) ;—have all been derived from the original description first named ; but very different opinions have been expressed on the subject of the bird itself.

M. Temminck, in his 'Analyse du Système Général d'Ornithologie', has instituted an order, which he has called *Inertes*, for the reception of the *Dodo* and the *Apteryx* ; two birds differing decidedly from each other in their beaks, but in reference to their imperfect wings, as also in the nature of their external covering, having obvious relation to the species included in his order *Cursores*. But the situation chosen for this order *Inertes*, at the extreme end of his systematic arrangement, leads me to infer that M. Temminck considered as imaginary the subjects for which it was formed[1].

M. Lesson seems to have still less faith in this bird, and at page 211, as before referred to, has the following paragraph :—" L'Apteryx de M. Temminck ne sérait-il pas fondé sur les pièces de dronte [*Dodo*] conservées au Museum de Londres ?" M. Lesson appears not to have been aware at the time, that at page 210 of his 'Manuel', he had described, as common in the forests of New Zealand, under the name *Kivi Kivi*, the bird whose existence he questioned at page 211.

By Baron Cuvier this bird has only been referred to in a note in the 'Règne Animal', (2nd ed. vol. i. p. 498.) and not admitted in the body of the work.

[1] Illiger, in his 'Prodromus,' 1811, instituted his Order *Inepti*, for the reception of the *Dodo* alone, (the *Apteryx* being then unknown,) but arranged it immediately before his *Cursores*, which contained the *Struthious* birds.

The specimen of the *Apteryx*, which formerly belonged to Dr. Shaw, and was sold after his death with his other effects, was purchased by Lord Stanley. Doubts having been thrown on the existence of such a specimen, it was sent by His Lordship for exhibition at the Zoological Society; and the materials with which it was stuffed having been previously removed, by his directions, the skin was exposed to a close examination.

The figures of this bird in the 'Naturalist's Miscellany' being but little known, and those of some of the minor parts deficient in character, it has been considered that a second representation of the bird, and a more detailed description, might be acceptable to zoologists.

The whole length of the bird from the point of the beak to the end of the body (for there is no tail,) is 32 inches; the beak is of a light yellow brown colour, long, slender, smooth and polished, in form resembling that of an *Ibis*, but rather more straight and depressed at the base; length from the gape to the point 6 inches and three quarters; the upper mandible is grooved on each outer side, near the margin, throughout its whole length; at the end of this groove on each side the nostrils are pierced, the apertures elongated, and covered by a membrane so suspended on the outside of each of them like a valve, that the slightest pressure against the outer surface, when flexible, as during life, would render the nostrils impervious, and effectually defend and cover them. A bristle introduced into the nostril, under and behind this defending membrane, passes up the whole length of the beak. The upper mandible terminates in a blunt truncated knob, projecting a little downwards, behind which, on its under surface, the end of the lower mandible ranges when both are closed. The lower mandible is also grooved slightly near the outer edges throughout its whole length. Both mandibles are broad and flat at the base, measuring full 1 inch across at the gape, and only 7 lines in height. The breadth of the upper mandible at the point is 2 lines, the under mandible still more narrow.

Throughout the whole length of the upper mandible and the distal three fourths of the under one, the inner or opposed surfaces of both are perfectly flat, producing when pressed together uniform and entire contact, and well adapted for compressing or crushing such substances as may be selected for food. The proximal fourth of the lower mandible is concave on its inner surface, affording space for the tongue, which must, in proportion to the beak, be small and short.

The form of the body in this preserved specimen is that of an elongated cone placed nearly upright over a pair of short and stout legs, and the bird is thus made to resemble a *Penguin*. In the plate annexed to the present description, the position and character assumed for it is that of the *Struthious* birds, in accordance with its real systematic relations.

From the crown of the head to the lower end of the body, the length is 24 inches, and the circumference at the lower part 18 inches. The feathers on the top of the head and forehead are short, and the skin, carried forwards over the base of the beak to the extent of an inch, is covered by a mixture of dark feathers, bristles and hair. About the gape on each side are also several long black bristles. The feathers of the neck are somewhat longer than those on the head, and they increase in length generally in proceeding downwards over the body. Those of the head and neck are of a hair brown colour, with the shafts lighter; on the back, sides and rump, the shafts and inner portions of the webs are reddish yellow brown, and the edges dark brown, producing an agreeably variegated appearance. On the lower part of the neck in front, the breast and the belly, the feathers are lighter in colour than on any other part of the body, the shafts still lighter than the webs, and greyish white. The feathers generally are uniform in structure, and resemble those of the *Emu*; but each feather is much shorter, the longest (those hanging over the rudimentary wings) not exceeding 4 inches and a half. The webs are of greatest extent, most flocculent and silky at the base of each feather, and become more linear and shorter towards its end; the whole of the fibres forming the web are disunited, and the shaft has no secondary or accessory plume.

On each side, about midway between the head and lower end of the bird, is a rudimentary wing, consisting of three distinct portions.

The part of the *humerus* that remains is about 1 inch in length, and from the appearance of the fractured end of the bone, within the skin, was broken off clear below the head; the radial portion figured by Shaw appears to be made up, as far as can be ascertained by present examination, of two distinct bones, each about 1 inch and three eighths in length, covered with a corrugated skin, and ending at the carpal extremity in a small horny claw, supported on a short ungueal bone, the two portions in conjunction measuring about three eighths of an inch.

To the radial portion of the wing several feathers are attached, of the same character as those of the other parts of the body; but the feathers above and behind this rudimentary wing are longer than those of any other part of the body, and being directed forwards and downwards, entirely cover and conceal this small and useless wing.

As far as I am able to judge by the preserved skin, the *femur* was probably 3 inches in length, the *tibia* about 5 inches; the articulation of the *tibia* with the *tarsus* is 1 inch and three quarters below the end of the body, and on a line with the pendent ends of the plumage of that part. The *tarsus* is 3 inches in length, and measures 2 inches and an eighth in circumference. The other bones of the leg appear to have been, like the tarsal bones, thick and strong. The *tarsi* are covered with hard and dense reticulated scales, larger in size, and arranged in transverse lines, in the front and behind, but smaller and more irregularly distributed on the sides.

The toes are four in number on each foot, the three anterior toes entirely unconnected. The middle toe is 2 inches and three eighths in length, the claw 1 inch; the inner and outer toes on each side are equal, and measure 1 inch and three eighths, the claws very nearly as large and as long as that of the middle toe.

On their upper surface these toes are covered with a series of broad imbricated scales, arranged in succession transversely; the under surface is defended by very small reticulated scales, and the lateral linear junction of these two coverings is marked by a well defined, but slightly prominent ridge, which appears to have been mistaken for the remains of an interdigital connecting membrane.

The claws are slightly curved, and taper gradually to a point; those of the middle toes are convex above, concave beneath; those of the inner and outer toes are also convex above, but the worn edges of the under sides give them a convex form beneath also, and they resemble a spur, curved downwards. The hind toe is placed on the inner flattened surface of the *tarsus*; it is directed backwards, and almost perpendicularly downwards. The connecting bones are articulated so high up on the *tarsus*, that the extreme point of the claw scarcely reaches the ground. The whole length of the hind toe is but 1 inch and an eighth, of which the claw measures three quarters of an inch. In form it is nearly straight, round, tapering and pointed, and has much more the appearance of the spur of a *Gallinaceous* bird than the claw of a hind toe. The *tarsi* and toes are yellowish brown, all the claws of a shining whitish horn colour.

The decided rasorial nature of the legs and feet, with the very elongated form of beak common to a different order of birds, thus combined in the *Apteryx*, present considerations of the highest interest to the ornithologist; and it is to be regretted that little or nothing is known of the habits of a bird possessing parts and peculiarities of such distinct and different character. Its short legs and divided toes prevent progression in water, and equally deny compensation for the want of the power of flight: it is obvious that it possesses no efficient means either of escape or defence. Its food is unknown; but Col. Sykes having found beetles, grasshoppers, worms, seeds, and vegetable fibres in the stomachs of some of the Indian species of *Ibis*, I am induced to conjecture that the food of the *Apteryx* is probably similar, or perhaps even still more exclusively insectorial.

No public or private collection is understood to possess another specimen of this singular bird; and it might reasonably be expected that so defenceless an animal must soon fall, even to extermination, when assailed by powerful and ingenious enemies.

The accounts, however, of several travellers furnish interesting information on this subject, from which future success may yet be confidently anticipated.

M. Lesson, in his account of the 'Voyage de la Coquille,' Zoologie, (tom. i. p. 418.) printed in 1828, has the following notice:—

"Les naturels [of the Bay of Islands] nous parlèrent fort souvent d'un oiseau sans ailes, dont ils apportèrent des débris, qui nous parurent être celles d'un Emiou; M. Kendal nous confirma cette pensée en nous affirmant l'existence de casoars analogues à ceux de l'Australie dans les bois de la Nouvelle Zélande. Les naturels chassent ces oiseaux avec des chiens, et les nomment *Kivikivi*. Nous ne doutons point aujourd'hui que ce ne soit l'*Apteryx Australis* de Shaw figuré," &c. &c.

M. D'Urville, in the 'Voyage de l'Astrolabe', (tom. ii. p. 107. 1830.) furnishes matter for another extract:—

"C'est ici—[this was in the Bay of Tolaga, or Houa-houa, on the east coast of the most northern of the two islands]—C'est ici que j'obtins les premiers renseignemens positifs sur la nature du *Kiwi*, au sujet d'une natte garnie de plumes de cet oiseau, et qui est un des premiers objets de luxe de ces naturels. Suivant eux le *Kiwi* serait un oiseau de la grosseur d'un petit dindon, mais, comme l'autruche et le casoar, privé de la faculté de voler. Ces animaux sont communs aux environs du Mont Ikou-Rangui. C'est dans la nuit, aux flambeaux et avec des chiens, qu'on leur fait la chasse. Il est probable que ces oiseaux appartiennent à un genre très voisin des casoars, et je crois qu'il a déjà reçu de quelques auteurs le nom d'*Apteryx*."

MM. Quoy and Gaimard, in their history of the 'Voyage de l'Astrolabe,' Zoologie, (tom. i. p. 158, 159. 1830.) have inserted the following paragraph:—

"Il nous a été impossible de nous procurer le singulier oiseau qu'a figuré Shaw sous le nom d'*Apteryx Australis*, dont les plumes tiennent de celles de casoar. Nous avons rapporté le manteau d'un chef qui était recouvert des plumes de cet oiseau, que les Zélandais de la Baie Tolaga connaissent sous le nom de *Kiwi*. Ils nous dirent qu'il était commun aux environs du Mont Ikou Rangui."

M. D'Urville again, in his account of the 'Voyage de l'Astrolabe,' (tom. ii. p. 480, 481. 1832.) has the following statement:—

"Dans les occasions solennelles, dans les fêtes, lorsqu'ils reçoivent des étrangers de distinction, les Nouveaux Zélandais portent des nattes d'un tissu fin et soyeux, tantôt d'une blancheur éclatante, avec des bordures élégantes et variées; tantôt couvertes de dessins sur toute leur surface; tantôt enfin garnies de poils de chien, ou des plumes précieuses de l'oiseau nommé *Kiwi*. Cette dernière espèce de natte est la plus estimée, et ne se fabrique qu'aux environs du Cap Est ou se trouve le *Kiwi*."

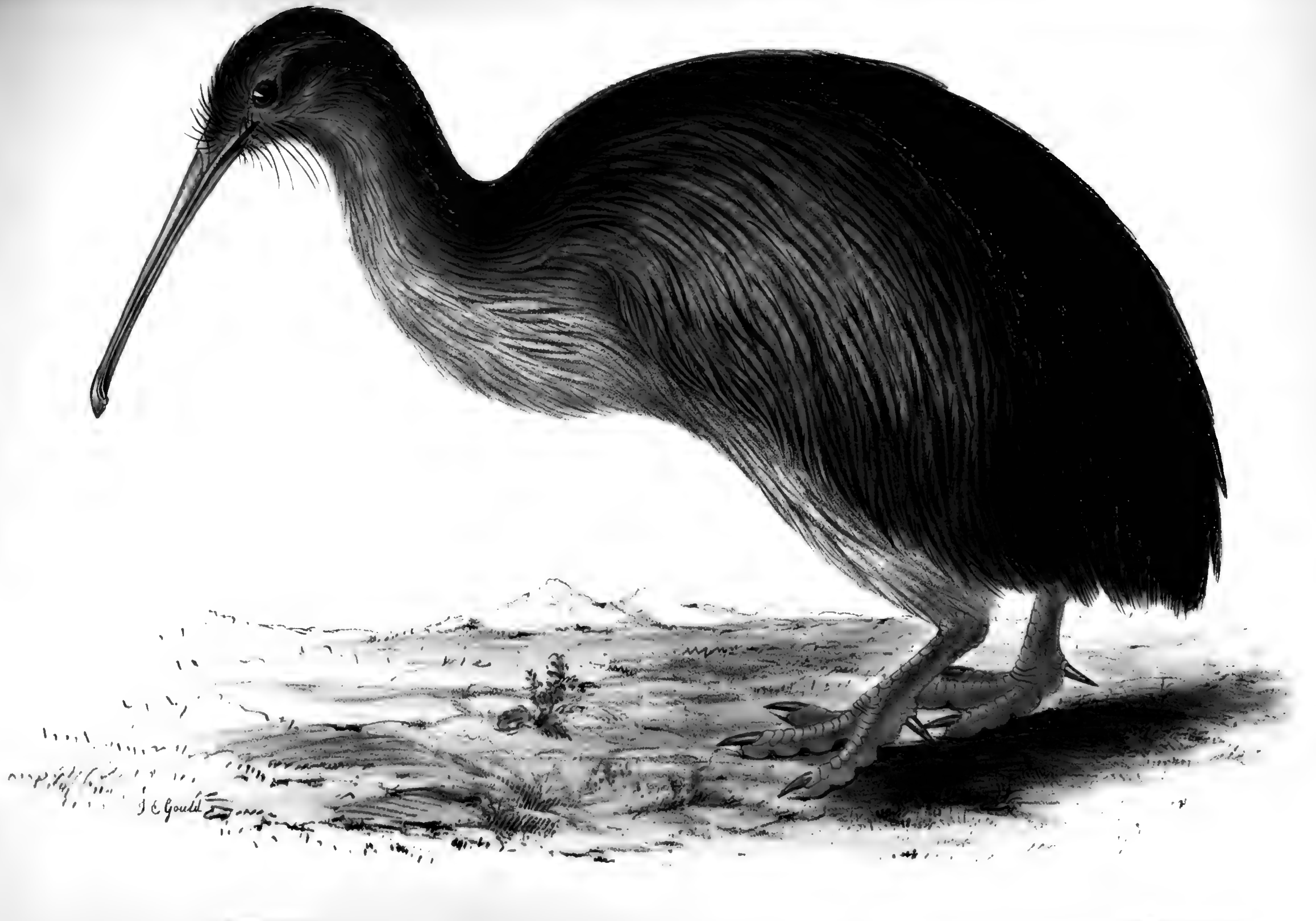
On this subject M. D'Urville also refers to a Note in Cruise's 'Journal of a Residence in New Zealand,' (p. 318. 1822.) which is as follows:—

"The Emu is found in New Zealand, though we were never fortunate enough to meet with one. The natives go out after dusk with lights, which attract their attention, and they kill them with dogs. Their feathers are black, smaller and more delicate than those of the Emu of New Holland; and a mat ornamented with them is the most costly dress that a chief can wear."

Our attention thus drawn to the exact localities inhabited by the *Apteryx*, we may fairly indulge the hope, that the zeal and liberality of the numerous friends and Corresponding Members of this Society in that part of the globe, directed to the attainment of this object, will yet be successful, and enable us at some future period, perhaps not far distant, to supply the deficiencies which at present exist in our knowledge of the natural history of the *Apteryx*.

PLATE X.

APTERYX AUSTRALIS, *Shaw*.



Apteryx Australis

IX. *On the Anatomy of the* Sepiola vulgaris, *Leach, and Account of a New Species* (Sep. stenodactyla, *Grant,*) *from the Coast of Mauritius. By* ROBERT E. GRANT, *M.D., F.R.S. Ed., L.S., G.S., Z.S., &c. Professor of Comparative Anatomy and Zoology in the University of London.*

Communicated March 26, and July 23, 1833.

THE *Sepiola vulgaris* is one of the most minute and least known of the *Naked Cephalopods* inhabiting the shores of Europe. It can scarcely, however, be considered as a rare animal; it is known to occur in the Mediterranean, and other parts of the European coasts, and has been met with as far north as Davis's Straits. I have met with it in the Frith of Forth, and have often obtained recent specimens of it in London, brought up with fishes from our eastern coasts. The specimens from the British coasts generally measure from an inch and a half to two inches in length from the round base of the body to the extreme points of the arms, the two *tentacula* being commonly as long as the total length of the rest of the animal. This interesting little *Cephalopod* belongs to that division of the class termed *Decapoda*, or *Decacera*, from the species possessing, besides the usual eight arms around the head, two long pedunculated *tentacula*, which extend from within the brachial disk. Like the animals of the genus *Loligo*, this *Decapod* has a thin flexible transparent dorsal *lamina* and fin-like organs, extending from the sides of the body to assist in progressive motion; and it has generally been ranked as a species of *Loligo* by Cuvier, Lamarck, M. Blainville, and other systematic writers. The shortness of its body and its rounded termination form, however, so remarkable an exception to the usual form in the genus *Loligo*, that Dr. Leach was induced to establish a new genus for this peculiar type, retaining for it the original specific name of *Sepiola*, which had been given to it from its external affinities to *Sepia*. This peculiar form had been hitherto known only as belonging to the single species of the European coasts, the *Sepiola vulgaris*.

It might have been expected that an external form differing so remarkably from that of the other *Loligines*, would have earlier excited the curiosity of the anatomist to examine, in an animal so common on the coasts of Europe, whether or not there were corresponding peculiarities of internal structure, particularly as the animals of this class are known to present many interesting peculiarities in the different species. The small size of the *Sepiola* appears, however, to have hitherto concealed it from anatomical examination, as no observations have been recorded, so far as I know, regarding any of its internal organs. This little *Cephalopod* is remarkable for the great size of its head and arms compared with the smallness and shortness of the body; its lateral fins are also unusually large, and are peculiar in their dorsal position and mobility on the back. The body or mantle of the specimens obtained from our coast measures generally about six lines in length, and as much in breadth; the head measures only four lines in length, and, from the magnitude of the eyes, is of equal breadth with the body; the arms are of unequal lengths, the largest being about an inch long, and the shortest about a line less. The first or dorsal pair of arms are the shortest; the second and fourth pairs are of equal lengths, and are a little longer than the first pair; the third pair are the longest. This is the order of the comparative lengths of the arms most common in the *Naked Cephalopods*. The third and fourth arms on each side are connected to each other by a musculo-membranous fold, which extends to about a third of their length, and is covered by the skin and subjacent coloured spots. The arms, which are allied to those of *Octopus* in their length, agree with those of *Loligo* in being provided with numerous long pedunculated suckers. The suckers are of a globular form, and are placed on long thick conical muscular peduncles; the suckers are arranged in two irregular rows on each arm, the bases of their muscular peduncles being in contact with each other, and placed alternately along the middle of the arms[1]. The general surface of the body has a pale reddish tint, and the spots, of a very dark purple colour, rare and small, extend over the mantle and dorsal surface of the fins, the head and arms, and partially over the *tentacula*. These spots are interspersed with a few patches of a larger size, and of the same deep purple hue. On removing a portion of the thick elastic *epidermis* from the back or head of this animal, it is easy to perceive that the spots, which remain uninjured on the surface of the subjacent skin and cellular tissue covering the muscles, are flat hollow vesicles containing a thin colourless fluid, in which are small portions of very dark coloured thick matter, imperfectly mixed with the thin fluid, and much resembling the ink of the animal. There appear to be a few pores in the *parietes* of these vesicles, of a dark colour, from which coloured matter can be pressed into the cavity of the vesicle, and moved to and fro in the colourless fluid without being dissolved by it. These coloured vesicles of *Cephalopoda*, situate in a cellular soft tissue covering the surface of the skin, occupy a place analogous to that of the *rete mucosum*, the usual seat of colour.

The *tentacula*, about an inch and a half in length, thin and cylindrical to near their termination, where they expand a little and terminate in a point, proceed as in other *Decapods* from between the third and fourth arms on each side. They take their origin from the outer and fore part of the head, external to all the arms and to the disk which forms them by its subdivision; in ascending they pass inwards between the bases of the arms just mentioned, which are the only two connected together by a membrane, and they thus appear to extend from behind these arms and their uniting membrane. When these two long and slender *tentacula* are retracted, they are concealed and protected by the folds as by two sheaths; and as none of the other arms are thus provided

[1] Plate XI. fig. 6.

with connecting folds, they are probably developed here chiefly to sheath the *tentacula*. The *Octopods* which have no *tentacula* have membranes extended between the bases of all their arms to serve as organs of progressive motion, because they have no other fins. The form of the two circular lips around the mouth, the structure of the horny mandibles, and the arrangement of the muscles which move them, agree with those of *Loligo*. The skin of the head passes transparent over the pupil, presenting only a slight looseness above the eye, which by folding produces the appearance of an upper longitudinal eye-lid. The eyes are very large and prominent, and with a remarkable subdorsal aspect. I have often found this animal broader across the eyes than at any other part of the body. The back part of the head is continuous with the dorsal margin of the mantle, where the dorsal *lamina* commences, for about a line in breadth, giving considerable support to both parts of the body. The free margin of the mantle in all the specimens I have seen, has a white band passing round the orifice of the sac. It is entirely destitute of the usual spotted markings of the surface, and it appears as if the spotted skin were forcibly retracted to the extent of half a line around the margin, and thus drew out the white lining membrane of the interior of the sac. The body of this animal is scarcely ventricose, being generally as wide at the upper margin of the sac as at its middle, and it is suddenly rounded and broad at the base. It is supported feebly along the middle of the back by a thin, short, tapering dorsal *lamina*, lodged, as usual, loosely in a capsule, without receiving any muscular insertions. It is broadest at the upper end, where it measures about half a line in breadth, and tapers regularly to a point as fine as a hair, extending only about a third of the length of the mantle[1]. On removing the skin from the place occupied by this most minute dorsal *lamina*, a dark line is seen extending along its course in the back. The existence of this short dorsal *lamina* in *Sepiola* is the only anatomical fact regarding this animal recorded by Cuvier, Lamarck, and other naturalists, and it forms a peculiarity by which it differs from all the known *Loligines* with which this animal has been generally associated. The two dorsal fins[2] are of great size and strength, though attached but loosely to the back of the mantle near the median plane. They are attached obliquely to the trunk, so as to strike the water most readily backwards and downwards during the act of swimming; they have a deep notch at their anterior point of junction with the mantle, by which they have greater extent of motion, and they terminate in a very thin semicircular free margin. The fins are supported by two firm crescentic cartilaginous plates, like *scapulæ*, which play freely on the outer surface of the mantle, and thus give great extent and effect to the motions of these powerful dorsal arms. An outer and inner layer of muscles, in form of minute white *fasciculi*, are seen to pass from the middle of the dorsal part of the mantle to be attached to these cartilaginous *scapulæ*, and singularly resemble the mode of attachment of the anterior extremities of *Vertebrata*. The *syphon* is here

[1] Fig. 5.

[2] Fig. 5.

of considerable size, and extends to a great length from the sac; the lateral valvular prolongations of its base are broad, and pass deep into the cavity of the mantle. About the middle of the dorsal surface of the canal of the *syphon*, is seen the usual tongue-like valvular fleshy fold, extending forwards, with a cavity behind it like that of the semilunar valves of the heart of *Mammalia*, and serving for the same purpose. This valve of the *syphon*, and the lateral prolongations of the base of the funnel within the mantle, serve to direct the currents of water in respiration; and the former protects the *viscera* of the sac from the impulse of the water when the animal is swimming forwards, as the valvular nostrils of diving *Mammalia*.

The cavity of the mantle is comparatively small in this *Cephalopod*, and its whole extent is occupied by the abdominal and pelvic *viscera*. The genital organs, as in higher classes, occupy the bottom of the cavity, and the digestive organs, as usual, lie immediately above them. The circulating and respiratory organs occupy the middle of the sac, and the liver and ink gland its upper part. From the back part of the base of the *syphon*, two strong muscular bands pass forwards and downwards on each side of the *anus*, and are attached to the anterior portion of the sac on its inner surface. These two strong muscles, which first present themselves on opening the sac, are calculated to act as a *frænum* to limit the dilatation of the mantle. As the *rectum* passes up to the base of the funnel between them, they may act as a sphincter to the *anus*; and as they pass over the two lateral lobes of the ink gland, they also serve to compress powerfully that organ, and expel the ink when required. All the *viscera* contained in the sac are largely developed in this minute *Cephalopod*, particularly the digestive organs, the ink gland, and the two glands of the oviducts. The entrance of the alimentary canal is provided with powerful organs of prehension in the large muscular arms with their pedunculated suckers, and with strong organs of mastication in the density of the mandibles, and the magnitude of their muscles. The *tentacula*, however, are not provided with suckers at their extremities; they present here a villous surface, on the usual place of the suckers in *Loligo* and *Sepia*. The minute filaments of this villous part of the *tentaculum*, when examined through a lens, present the appearance of very small soft transparent suckers, incapable of performing their ordinary function. The mouth, surrounded by the usual double muscular fold, is provided with a short, broad, fleshy tongue, covered with strong white shining recurved teeth. Some of the larger teeth, arranged like a comb on the anterior part of the tongue, have their points of a brown colour, as we observe in the larger *Cephalopods*. On removing the oral apparatus from the cup-like cavity which it occupies immediately above the œsophageal *ganglia*, we perceive a large white nervous trunk passing from the anterior *ganglion* of the *œsophagus* to the base of each of the arms around the mouth. These eight large nerves pass in a radiating manner along the floor of this cavity, and the nerves of the two *tentacula* come from the same part by more than one trunk on each side. The *tentacula* themselves arise from muscular *fasciculi* close to the anterior *ganglion*, between it and the orbit on each side, and external to the brachial disk which forms the eight arms, so that they are analogous in position to those of *Gasteropoda* and other *Mollusca*.

From the commencement of the *œsophagus*[1] at the root of the tongue to its termination in the gizzard, it is narrow, cylindrical, without the usual longitudinal *plicæ* of its mucous coat, and does not perceptibly dilate to form a crop; its *parietes* are thin, smooth, and transparent. The inferior pair of salivary glands[2] are in contact with the *œsophagus*, of considerable size, and placed behind the upper margin of the two lobes of the liver. The gizzard[3], of a lengthened form, with distinct longitudinal muscular bands strengthening its *parietes*, measures, when slightly inflated, about three lines in length and two lines in breadth. It is extended in a longitudinal direction, and its muscular *fasciculi* are chiefly confined to its middle portion: it is situate on the right side, immediately above the *ovarium*, and close to the branchial heart of that side. From the direction followed by the *œsophagus* downwards behind the liver and towards the right side, and the course taken by the intestine upwards in front of the liver on the left side, the gizzard in the *Cephalopoda* lies a little behind the spiral stomach on its right side, and it is placed a little lower in the sac. The spiral stomach[4] of the *Sepiola* opens from the gizzard by a passage wider than the *œsophagus*; and they are so continuous, that the digested contents of the stomachs pass freely to and fro, from the one cavity to the other, on the slightest pressure or motion of these sacs. This stomach is marked with transverse *plicæ* of its *parietes*, producing the usual puckered appearance of its surface and its internal folds. It forms only a semicircular curve, terminating abruptly in a rounded shut extremity, and is about half the size of the first stomach. This cavity receives the hepatic and pancreatic secretions, as in most of the known genera of *Naked Cephalopods*. The intestine passes very wide and almost straight from the back part of the spiral stomach over the fore part of the liver and ink bag, and terminates in the *anus*, immediately above the ink bag, within the widely expanded base of the funnel. The *anus*[5], situate between the two longitudinal muscles above described, opens by a circular aperture with thin loose *parietes*, and has two very small tentacular folds extending from its sides, as in most other genera of this class.

The liver[6], consisting of two lengthened lobes rounded above and tapering below, is of a light yellow colour and very soft texture, and extends along the back of this short animal from immediately under the orbits to the *ovarium*. The two lobes are united at their upper and back part, and their component *cœca* are filled with a turbid yellowish-white fluid. The hepatic ducts[7] come out from the lower part of the liver, one from near the inferior *apex* of each lobe, and unite into one at a short distance from their termination in the spiral stomach. Their oblique orifice in the spiral stomach is provided with the usual prominent valvular lips, which can be traced along the intestine

[1] Fig. 8. *a. a.* [2] Fig. 8. *g. g.* [3] Figg. 7. 8. *b.* [4] Figg. 7. 8. *c.*
[5] Fig. 7. *e.* [6] Figg. 7. 8. *f. f.* [7] Fig. 7. *g.*

towards the *anus*. The hepatic ducts are surrounded during nearly their whole course with a large cluster of regular ovoidal vesicular glands, filled with their light yellow secretion. These glands exist in most of the genera of *Naked Cephalopods*, in *Sepia*, *Loligo*, *Loligopsis*, *&c.*; and from their analogies with the pancreatic glands of higher classes, I was induced to consider them as these organs in 1825 [1]. There are about a hundred of these glands in *Sepiola*: they present the usual subdivided cellular internal structure, and terminate in the hepatic canals, each by a separate short duct. On opening the hepatic ducts, the numerous orifices of these pancreatic glands are easily perceived, like those of the vesicles opening into the veins in these animals[2]. In several specimens of *Sepiola* which I dissected, I found globules of oil, probably derived from the food, mixed with the ordinary secretions in the hepatic ducts, in the pancreatic glands, in both stomachs, and in the intestine. These appear to be the only glands in the *Cephalopods* which have any analogy to the *pancreas*,—an organ which exists also in many of the *Gasteropods* and in articulated classes, as well as in all the *Vertebrata*. The *rectum* of *Sepiola*, passing up in front of the abdominal *viscera* to the base of the *syphon*, lies over the middle of a very large quadrangular ink bag[3], and is accompanied, for a short space, by the duct of that gland before it penetrates its *parietes*. The ink gland is here equally remarkable for its magnitude and its form. It lies almost within the base of the funnel, and consists of three lobes placed transversely, and extending more in that direction than longitudinally. The two lateral lobes are kidney-shaped, with thick white glandular *parietes* in front, and of a deep purple colour with a dull surface behind. Each of these reniform lobes has a rough black tubercle projecting from the middle of its lateral margin. The depression between these lobes is occupied by a smaller third lobe, over the front of which pass the *vena cava* and *rectum*; and from the upper part of this lobe the duct of the gland arises[4]. This gland appears to be proportionally much more developed in the smaller species of *Naked Cephalopods* than in the larger. In this animal I have seldom detected a trace of that metallic lustre so common on the surface of this gland in other *Cephalopods*; and it is very loosely connected with the surface of the liver, on which it rests. The two longitudinal muscular bands embracing the *anus* act also as sphincters to the duct of the ink gland; and while the sides of the mantle and the base of the *syphon* compress the large lateral lobes of the gland, these muscles acting on the middle of the organ may press out forcibly the contained secretion.

The *vena cava*[5] passing down in front of the liver, along with the intestine, divides, as usual, into two trunks, which are provided with large vesicular bodies opening into their interior, and accompanying them to the branchial auricles. The veins are very wide, and with thin soft loose *parietes*: their vesicles were found empty and flaccid. The branchial hearts or auricles are here large cavities, of a white colour, and of a lengthened ovate form: each of them is provided with the usual fleshy *appendix*, attached to its lower surface and towards its branchial extremity[6]. These fleshy *appen-*

[1] Edin. Phil. Journ., July 1825. [2] Fig. 13. *c. c.* [3] Fig. 7. *h. h.* [4] Fig. 7. *k.* [5] Fig. 9. *a.* [6] Fig. 9. *d. d.*

dices do not exist on the branchial auricles of *Loligopsis*, where the *branchiæ* are single on each side as in other *Naked Cephalopods*. They consist here of a soft, white, fleshy, round mass, attached by a very short broad peduncle, flattened outwardly and concave in the middle, but without any internal cavity or any communication with that of the hearts, to which they are attached. The branchial hearts [1], or the two portions of the divided auricle of this class, have here the usual position at the base of the *branchiæ*, on each side of the systemic heart, and propel the venous blood along the margin of the ligament connecting each gill to the sides of the mantle. The *branchiæ* [2] have the usual structure and attachments, and each contains about twenty pectinated *laminæ* on each of its sides. The form of these pectinated *branchiæ* of *Naked* and *Testaceous Cephalopods*, and their lateral position under the open mantle, correspond strikingly with those of *Pectinibranchiate Gasteropods*, and have also obvious affinities with those of the *Cyclostome Fishes*. They are double in these *Gasteropods* as in *Nautilus*, but are developed only on the left side, the right side being occupied with the terminations of the digestive and the genital apparatus. These passages in *Nautilus* and in the *Naked Cephalopods* terminate on the median plane under the funnel, and thus allow the two sides of the body to become symmetrically developed, as in the higher classes of animals. The arterialised blood coming along the free margins of the *branchiæ* in two very capacious veins, is poured into the systemic ventricle at points not corresponding on the two sides. The systemic heart[3] is of a lengthened compressed form, placed transversely between the lateral hearts, and anterior to the stomachs: it is broadest in the middle, and tapers regularly to the two extremities, which terminate in vessels of a very different nature. The left *apex* of the systemic ventricle receives the left branchial vein, which, as well as the right, is a little dilated before it enters the heart[4]. The right branchial vein, however, enters this ventricle about a third from its right *apex*, and on its anterior aspect. The right *apex* of this lengthened fusiform heart gives origin to the great dorsal ascending *aorta*[5] which winds round on the right side, behind the liver and *œsophagus*, to ascend to the head, along the middle of the back of the mantle. About a third from the left extremity of the systemic heart, and from its lower margin, comes off the anterior descending *aorta*[6], which immediately gives off two large lateral trunks[7] to the great glands of the oviducts and to the ovary, and then bends forwards to ascend and ramify upon the anterior *parietes* of the mantle. The form of the systemic ventricle varies remarkably in the *Naked Cephalopods*, as well as the direction in which it is extended; but there is great uniformity in the distribution of its vessels. Most generally it is extended transversely across the body, receiving the arterialised blood by a single branchial vein on each side, and sending out a large dorsal *aorta*, which ascends to terminate in the head, and a smaller descending *aorta*, which bends forwards, after supplying the genital apparatus, to terminate on the ventral surface of the mantle. In *Nautilus*, where the *branchiæ* are double on each side, this ventricle receives the blood by four venous trunks instead of two.

[1] Fig. 9. *c. c.* [2] Fig. 9. *f. f.* [3] Fig. 9. *i.* [4] Fig. 9. *h.* [5] Fig. 9. *k.* [6] Fig. 9. *l.* [7] Fig. 9. *m.*

The *ovarium*[1] is intimately united to the lower extremity of the first stomach, and occupies the base of the sac. It consists of a thin membranous cavity, of an oval form, filled with clusters of *ova* hanging from its upper part. The *ova*[2] exist in all stages of development within the same *ovarium*: the smallest are white, round and opaque; the largest, filled with a gelatinous substance which projects from the open extremities, exhibit the same reticulate white markings on the surface which we observe in *Sepia* and other large *Cephalopods*. All the *ova* are attached to the extremities of ramified peduncles, till they are ready to pass out through the oviducts. The glands of the oviducts[3] lie above and before the ovary, and have here a rose-red colour, the usual laminated structure, and a deep *sulcus* passing up along their anterior and posterior surfaces, almost dividing them into two parts. They are broad and rounded at their lower extremity next the *ovarium*, and become much narrower at their upper end: they are proportionally very large in this animal, and receive large arteries from near the origin of the ventral *aorta*. In the female of this animal there is another glandular organ of a crescentic form and opaque yellow colour, lying between the bases of the glands of the oviducts, and which appears to communicate with a rose-coloured sac between the upper extremities of the oviducts, containing numerous small convoluted *cæca*. In the male, which is comparatively rare, the testicle[4], of a light purple colour, and lying at the bottom of the cavity of the mantle, as the ovary of the female, consists of innumerable minute glandular *cæca*, contained in a loose sac, which sends out a *vas deferens* to a wide convoluted *epididymis*. This terminates in a slender lengthened tubular *penis*[5] on the left side, which appears to possess minute *appendices* at its termination, like the *rectum*.

Thus the *Sepiola*, the minutest of the *Naked Cephalopods*, possesses a structure as complex and elaborate as that of the largest *Octopus* or *Loligo*. By the magnitude of its cephalic arms, and their numerous large pedunculated suckers, it compensates for the want of developed suckers on its long *tentacula*. By the great development of its ink gland, and the magnitude of its organs of vision, it compensates for the want of more solid means of protection. The rounded form of its body required the dorsal *lamina* to be shortened, which would have impeded the motions of the mantle had it extended, as in *Loligo*, to its extremity. The great muscular strength of its dorsal fins, and the mobility of their *scapulæ*, give rapid and varied motion to this delicate and defenceless animal; and they constitute the most perfectly developed arms of this class. Its organs of secretion are all largely developed,—its salivary, hepatic, pancreatic, and ink glands. Its digestive, circulating, and respiratory organs are constructed according to the most perfect form of the cephalopodic type; and the great development of its generative apparatus is well adapted to repair the rapid destruction of its race.

A very large specimen of *Sepiola*, from the coast of the Mauritius[1], was lately sent to the Zoological Society by Charles Telfair, Esq., the most active of our valuable cor-

[1] Fig. 10. *c.* [2] Fig. 12. [3] Fig. 10. *d. d.* [4] Fig. 11. *a.* [5] Fig. 11. *d.*

respondents there, which, though agreeing in general form with the European species, presents peculiarities sufficiently marked and important to entitle it to be regarded as the type of a new species. Its proportions are massive, short, and broad; and its colour is a deep purplish brown, extending to the points of the arms, and produced by large closely set spots of that colour. It measures three inches from the base of the body to the point of the arms, being about twice the ordinary length of the European species; the two *tentacula* themselves measure three inches and three lines in length. The length of the mantle behind is one inch and one line, the length of the head is six lines, and that of the longest arms one inch and three lines. The body measures one inch and one line in breadth; and the breadth of the head across the pupils is one inch. The *tentacula* extend from within two muscular folds, connecting the third to the fourth pair of arms in front, as in the *Sep. vulgaris*: they are small and cylindrical to near their extremity, where they expand, and present a villous surface, but have no suckers developed. The suckers of the arms are large and irregularly crowded, of a spherical form, and placed on long thick peduncles. In place of being in two alternate rows, as in *Sep. vulgaris*, the suckers are here[2] crowded seven or eight deep on the broadest part of the arms: each sucker is provided with a circular dark-coloured osseous ring at its orifice. The arms are proportionally much thicker and shorter than in *Sep. vulgaris*; and hence they present a much broader inner surface for the attachment of numerous rows of suckers. From this contracted form of the cephalic arms, by which it differs so much from the European species, I have termed it *Sep. stenodactyla*. In some parts of the arms the crowded arrangement of the suckers is seen to depend on the zig-zag direction taken by the rows of peduncles on each side. The coloured markings on the outer surface of the arms are in the form of transverse bands; in *Sep. vulgaris* they are generally minute detached spots. The white band around the upper margin of the mantle, the lengthened form of the *syphon* and the position of its valve, the form and the subdorsal direction of the eyes, the shape and the position of the dorsal fins, and the rounded termination of the mantle, are like those of the common species. This Indian species, however, is more than four times the size of any European specimen which I have seen, and the form of the mantle is more ventricose. The specimen, being the property of the Society, and the only one obtained, was not dissected.

PLATE XI.

Fig. 1. *Sepiola stenodactyla*, back view, natural size.
Fig. 2. *Sepiola stenodactyla*, front view, natural size.
Fig. 3. *Sepiola vulgaris*, back view, natural size.
Fig. 4. *Sepiola vulgaris*, front view, natural size. *a. a.* muscular fold extended be-

[1] Plate XI. figg. 1. 2. [2] Fig. 6. *a*.

tween the third and fourth arms on each side; *b. b.* spotless white band around the orifice of the sac; *c. c.* villous surface of the expanded termination of the *tentacula.*

Fig. 5. Back view of the trunk with the skin removed. *a.* soft transparent dorsal *lamina*; *b. b.* cartilaginous *scapulæ* of the dorsal fins, with muscular *fasciculi* passing on to them from the surface of the mantle; *c. c.* extensor muscles of the dorsal fins; *d.* longitudinal muscular *fasciculi* of the exterior of the mantle.

Fig. 6. *a.* alternate double series of pedunculated suckers of the arms of *Sepiola vulgaris*; *b.* one of these suckers with its muscular peduncle magnified; *c.* crowded irregular arrangement of the pedunculated suckers of *Sep. stenodactyla.*

Fig. 7. Front view of the digestive organs of *Sepiola vulgaris.* *a. œsophagus*; *b.* gizzard marked by longitudinal muscular bands; *c.* spiral stomach; *d. d.* intestine drawn towards the left side; *e.* the *anus,* with its two minute tentacular folds; *f. f.* the two lobes of the liver; *g.* the two hepatic ducts surrounded by the pancreatic glands in their course to the spiral stomach; *h. h.* trilobate form of the ink gland; *k.* duct of the ink gland terminating in the *rectum.*

Fig. 8. Back view of the digestive organs of *Sepiola vulgaris.* *a. a.* course of the *œsophagus* along the middle of the back; *b.* gizzard; *c.* spiral stomach; *d.* entrance of the hepato-pancreatic duct into the spiral stomach; *e.* intestine passing up on the anterior surface of the liver; *f. f.* the two lobes of the liver united at their upper part; *g. g.* the inferior pair of salivary glands; *h. h.* their ducts passing up behind the *œsophagus.*

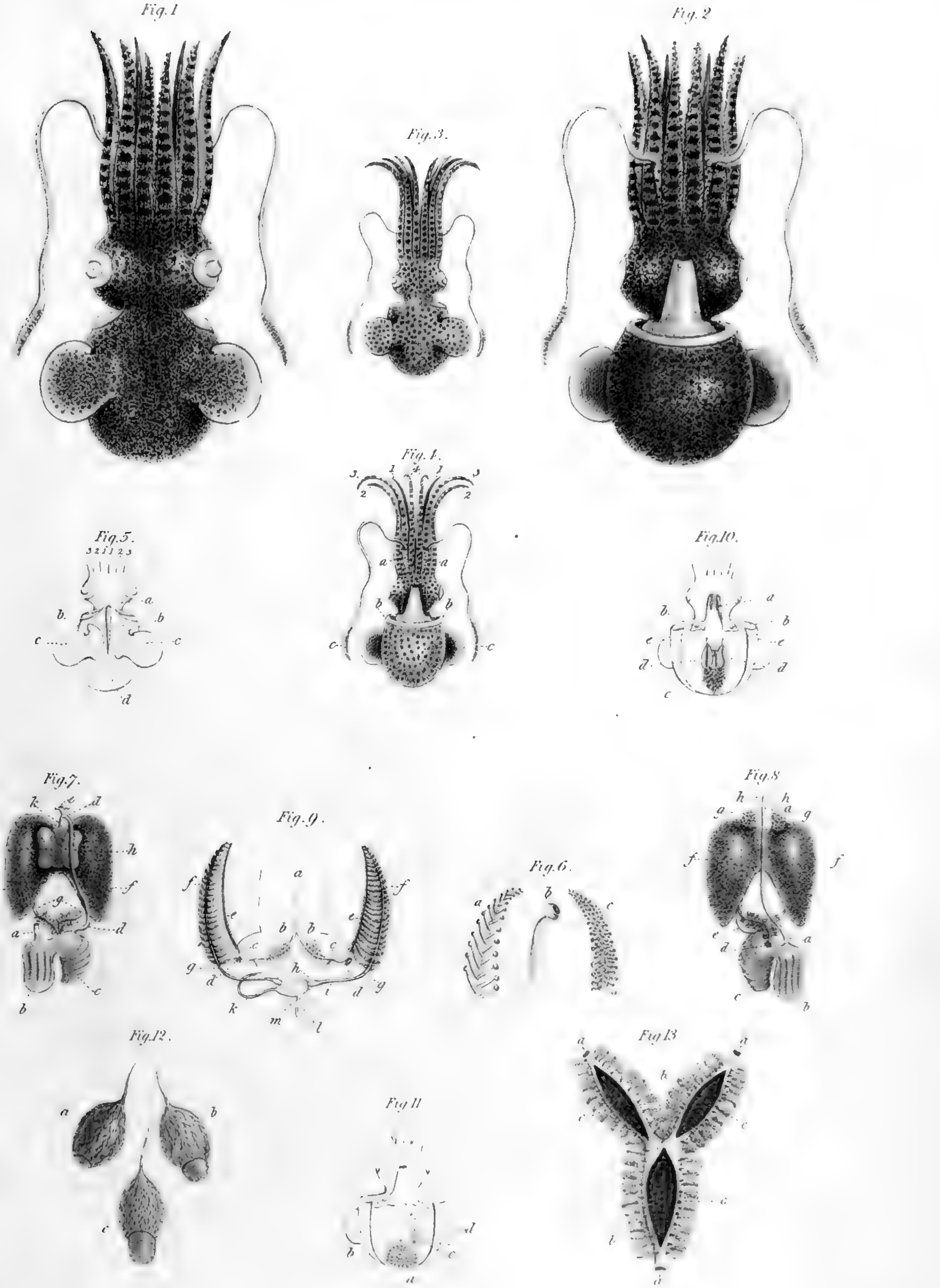
Fig. 9. Circulating and respiratory organs of *Sep. vulgaris.* *a. vena cava*; *b. b.* vesicular bodies on the two branchial arteries; *c. c.* two branchial hearts or portions of the auricle; *d. d.* fleshy *appendices* of the branchial hearts; *e. e.* branchial arteries; *f. f. branchiæ*; *g. g.* branchial veins; *h. h.* enlargements of the branchial veins at their entrance into the systemic heart; *i.* the systemic heart or ventricle; *k.* the dorsal or ascending *aorta*; *l.* the ventral or descending *aorta*; *m.* branches to the organs of generation from the trunk of the ventral *aorta.*

Fig. 10. Female organs of generation of *Sep. vulgaris* seen from before. The mantle and the *syphon* are here cut open. *a.* valvular fold in the interior and back part of the *syphon*; *b. b.* articular cartilages connecting the base of the *syphon* to the *parietes* of the sac; *c. ovarium* filled with *ova,* and occupying the base of the sac; *d. d.* two large glands of the oviducts; *e. e.* terminations of the two oviducts.

Fig. 11. Male organs of generation seen from before. *a. testis*; *b. vas deferens*; *c. epididymis*; *d. penis.*

Fig. 12. Structure of the *ova* as seen through the microscope.

Fig. 13. Portion of the hepatic ducts laid open to show the oblique orifices of the ducts of the pancreatic glands. *a. a.* hepatic ducts laid open; *b. b.* pancreatic glands; *c. c.* their openings into the hepatic ducts.



J. E. Grant ad nat. del.

Zeitter sc.

Fig. 1-2. Sepiola stenodactyla. Fig. 3-13. Sepiola vulgaris.

X. *On a new Genus in the Family of* Corvidæ. *By Mr.* John Gould, *F.L.S. Communicated by the Secretary.*

Read May 14, 1833.

In bringing before the notice of the Society three species of a natural group of birds forming part of the Family of *Corvidæ*, one of which I have reason to believe is new to science, I am actuated by two motives: the first is a wish to establish the right of the present group to rank as a distinct genus, separate from that of *Pica*, to which it has hitherto been assigned; and the second to delineate the characters of a species which appears to have been until now unobserved.

The examples of the present group, although bearing a great similarity to the genus *Pica*, may be easily discriminated by an attentive observer of the forms of Ornithology, as possessing in common certain distinct characteristics, harmonizing with their habits and manners, as detailed by observers in their native country, and which analogy would lead us to anticipate.

Although the true *Pies* are classed among birds inhabiting trees, still their lengthened and strong *tarsi* and powerful pointed bills endow them with powers for gaining their subsistence almost exclusively on the ground; their food, in fact, consists of such substances as are only to be acquired there, such as grubs, worms, snails, and occasionally putrid animal matter. On the other hand, the birds of the group under consideration possess characters of an almost opposite description, indicating their habitat to be more exclusively the branches of trees: the *tarsi* are short and comparatively feeble; the tail is more elongated than in the typical species of the genus *Pica* (the *Common Magpie*, for example), and its feathers are considerably more spatulate, and equally graduated, excepting the two middle ones, which exceed the others nearly as much again as their due distance. To this may be added, that the beak is also of a very different construction, being much broader at the base, shorter, and of an incurved form, and excellently adapted for taking fruits and berries, but not for digging in the ground in search of *larvæ*: the nostrils are only partially covered with hair-like feathers.

On account of the arboreal habits of the birds composing the group which is thus distinguished, I propose for them the generic appellation of *Dendrocitta*.

Respecting the most common species of this genus, the *Pica vagabunda* of authors, it may be observed, that this name has been given to it from its restless and wandering disposition; for, unlike the *common Magpie*, which remains stationary, seldom travelling from its accustomed haunts, it has been observed to be perpetually flitting from branch to branch, and from tree to tree, instigated no doubt by the desire of procuring food, and hence travelling through a circuit of considerable extent. These wandering habits we may reasonably consider, from their similarity of form, to belong to the other species also, all of which are natives of eastern Asia.

The nearest affinity of this Eastern group appears to be that which it bears to the genus *Crypsirhina*[1] of M. Vieillot, with which it accords in the essential character of the short and weakened *tarsi*. In the characters of the bill, however, it so materially differs, as to render the line of demarkation between the two groups clear and natural, and thus to authorize the separation of them. This member in *Dendrocitta* is stronger and less regularly arched than in *Crypsirhina*, and it is entirely devoid of those velvet-like appendages that cover the nostrils in the latter genus. In this respect it accords more closely with *Pica*, as well as in the outline of the bill towards the extremity; still near the base of this member a gradual approach to the form as it exists in *Crypsirhina* shows itself by a lateral swelling and by a considerable development in breadth. *Dendrocitta* thus stands intermediate between *Pica* and *Crypsirhina*, and rests its claim to the rank of a separate genus on the prominence of the station it holds in nature, marking at once the distinction as well as the union between these two important groups.

The species of the genus *Pica* afford many subordinate modifications of characters among themselves, which are for the most part accordant with their geographical distribution. Those which approach most nearly to *Dendrocitta*, chiefly by the corresponding characters of the bill, appear to be the Eastern species; for instance, *Pica erythrorhyncha*, *&c.* These, again, seem to have a near alliance to the American group whose chief habitat may be considered to centre in Mexico, of which *Pica gubernatrix* (*Garrule commandeur*, Temm., Pl. Col. 436.) and *Pica Colliei*, Vig. (Zool. Journ. vol. iv. pl. 12.) may be given as examples. The *European Pie*, the type of the group, appears to succeed to these: and from thence a South American tribe, exemplified in the *Pie Ging* of M. Temminck (Pl. Col. 169.), and *Pie Acahé* of the same author (Pl. Col. 58.), partaking in a great degree of the characters of both *Pies* and *Jays*, leads from the present group to the conterminous one of *Garrulus*.

[1] This is the *Phrenothrix* of Dr. Horsfield, well illustrated and compared with *Pica* in his 'Zoological Researches'.

Classis. AVES.

Ordo. Insessores, *Vig.*

Tribus. Conirostres, *Cuv.*

Fam. Corvidæ, *Leach.*

Genus. Dendrocitta.

Rostrum capite brevius, ad basin latum, incurvum ; mandibulâ superiore culmine arcuato, lateribus subtumidis.
Nares basales, plumis setaceis partim tectæ.
Alæ mediocres, remigibus 5tâ 6tâque longioribus.
Cauda cuneata, rectricibus spatulatis.
Tarsi breves, debiles. *Digiti* mediocres ; postico forti, *ungue* forti incurvo.

Dendrocitta leucogastra.

Dend. fronte, genis, gutture, femorum tectricibus, alis, rectricibus lateralibus, apicibusque duarum mediarum atris ; capite posteriori, nuchâ, abdomine, uropygio, maculâque mediâ alarum albis ; rectricibus duabus mediis præter apicem albescenti-cinereis ; dorso, scapularibus, crissoque castaneis.

*Rostrum pedes*que atri. Longitudo 18½ unc. ; *caudæ*, 11½ ; *alæ*, 5½ ; *rostri*, 1⅓ ; *tarsi*, 1⅓.

Dendrocitta Sinensis.

Dend. fronte, alis, rectricibusque brunnescenti-nigris, gulâ, genisque pallidioribus ; occipite, nuchâ, uropygio, rectricibusque duabus mediis usque ad apicem cinereis ; dorso abdomineque brunnescenti-griseis ; maculâ mediâ alarum albâ ; crisso castaneo.

Pica Sinensis. *Gray, Illust. Ind. Zool. Hardw., Part* iii. *pl.* 4.—*Gould, Cent. Him. Birds, pl.* 43.

*Rostrum pedes*que brunnescenti-atri. Longitudo 15 unc. ; *caudæ*, 9½ ; *alæ*, 5½ ; *rostri*, 1¼ ; *tarsi*, 1⅓.

Dendrocitta vagabunda.

Dend. capite toto, nuchâ, colloque in fronte fuliginoso-griseis ; dorso, scapularibus, uropygio, corporeque subtùs sub-castaneis, hoc pallidiori ; alis rectricibusque atris ; tectricibus alarum rectricumque basibus albis.

Pica vagabunda. *Wagl., Syst. Avium.*—*Gray, Illust. Ind. Zool. Hardw., Part* iv. *pl.* 5.—*Gould, Cent. Him. Birds, pl.* 42.

*Rostrum pedes*que brunnescenti-atri. Longitudo 16 unc.; *caudæ*, 10; *alæ*, $5\frac{1}{2}$; *rostri*, $1\frac{1}{4}$, *tarsi*, $1\frac{1}{3}$.

PLATE XII.

DENDROCITTA LEUCOGASTRA.

Dendrocitta leucogastra

J & E Gould del et lith

Printed by C Hullmandel

XI. *Characters and Descriptions of several New Genera and Species of* Coleopterous Insects. *By the Rev.* F. W. Hope, *A.M., F.L.S. & Z.S.*

Communicated May 28, 1833.

Ordo. COLEOPTERA, *Linn.*

Sectio. PENTAMERA, *Lat.*

Stirps. Geodephaga, *MacLeay.*

Fam. Brachinidæ, *MacLeay.*

Subfam. Lebiides.

Genus Aploa[1].

Corpus depressum.
Mentum in medio edentulum.
Palpi subcylindrici.
Thorax margine postico recto.
Tarsi haud dilatati, unguibus simplicibus.

Antennæ 11-articulatæ, articulo primo crasso, secundo minimo, tertio priores duos longitudine æquante, reliquis longitudine æqualibus. *Palpi maxillares* externi 4-articulati, articulo ultimo subcylindrico, simplici: *labiales* articulo ultimo elongato, subcylindrico, ad apicem truncato. *Mandibulæ* elongato-trigonæ, dentibus nonnullis minutis in medio armatæ. *Labrum* transversum, subemarginatum, ciliatum. *Mentum* transversum, angulis acutis porrectis, dente medio nullo.

Caput ovale, oculis magnis prominentibus. *Thorax* cordato-truncatus, subconvexus, anticè capite latior, margine postico recto. *Corpus* latum, depressum. *Elytra* abdomine breviora, abruptè truncata, thorace multo latiora. *Pedes* simplices. *Tibiæ* anticæ emarginatæ. *Tarsi* articulo primo majore, duobus proximis æqualibus, quarto minore, quinto basalem longitudine æquante. *Ungues* simplices.

The insect upon which I have established this genus belongs to a group which I have termed *Lebiides*. The generic appellation of *Aploa* is derived from the simplicity

[1] Ἄπλοος, *simplex.*

of its general structure. Its situation appears to be between *Cymindis*, Lat., and *Plochionus*, Dej. It agrees with both those genera in the penultimate joint of the *tarsi* being destitute of lobes; and differs from both by having its claws toothless. In other respects the characters of *Aploa* are very similar to those of *Lebia*, Lat.

Aploa picta.

Tab. XIII. Fig. 1.

Apl. flava; elytrorum maculis tribus fasciâque undulatâ posticâ nigris; antennis extrorsùm obscurioribus.

Long. *corporis* 5½ lin.; lat. 2½.

Hab. in Indiâ Orientali, circa Poona.

Mus. Sykes.

Descr. *Antennæ* fuscæ, articulis prioribus quatuor testaceis. *Caput* flavum; oculi nigri. *Thorax* flavus. *Scutellum* concolor. *Elytra* striata, interstitiis punctatis, punctis vix distinctis; maculis tribus (quarum duæ humerales parvæ, tertia major scutellum ambiens et ad medium disci descendens,) fasciâque irregulari undulatâ ante apicem sitâ nigris notata. *Corpus* infrà flaveolum, abdominis marginibus lateralibus segmentoque postico nigris. *Pedes* flavi.

Fam. Carabidæ, *MacLeay*.

Genus Calosoma, *Web.*

Calosoma Orientale.

Cal. suprà obscurè viridi-æneum, infrà piceum; elytris crenato-striatis, interstitiis æqualibus transversim rugosis punctisque impressis viridi-æneis in triplici serie dispositis; tibiis intermediis subincurvis; unguibus rufescentibus.

Long. *corporis* 10½ lin.; lat. 4⅘.

Hab. in Indiâ Orientali, circa Poona.

Mus. Sykes.

The only *Calosoma* allied to the present is *Cal. chlorostictum*, Klug, a species which is found in Egypt, and which has been confounded by the Baron Dejean with *Cal. rugosum*, an insect common at the Cape of Good Hope.

Cal. Chinense, Kirb., and *Cal. Indicum*, Hope, are, I believe, the only Indian species hitherto described. The latter occurs in the collection of Major-General Hardwicke.

Fam. HARPALIDÆ, *MacLeay.*

Genus. CHLÆNIUS, *Bon.*

CHLÆNIUS SYKESII.

Tab. XIII. Fig. 2.

Chlæn. ater; capite metallicè tricolori; thorace nigricante; elytrorum maculis sex aurantiis; antennis pedibusque nigris.

Long. *corporis* 9 lin.; lat. 4.

Hab. in Indiâ Orientali, circa Poona.

Mus. Sykes.

DESCR. *Antennæ* nigræ, articulis prioribus tribus rubris. *Palpi* picei. *Caput* punctulatum, anticè rubrum, in medio cyaneum, posticè viride. *Thorax* punctatissimus, ater, marginibus lateralibus æneo-virescentibus. *Elytra* striato-punctata, interstitiis striarum serie duplici punctorum elaboratis, maculisque sex aurantiis ornatis, quarum prior humeralis minor, media maxima ferè ad suturam extensa, tertia rotundata ante apicem posita attamen margines elytrorum haud attingens. *Corpus* infrà nigro-piceum.

I have named this beautiful insect after my friend Lieut.-Colonel W. H. Sykes, in whose cabinet it is preserved, and to whose kindness I am indebted for the free use of the interesting collection formed by him during a residence of several years at Poona. His zeal and exertions for the advancement of the zoology and geology of India are deservedly appreciated by the naturalists of England.

Stirps. NECROPHAGA, *Lat.*

Fam. SILPHIDÆ, *Leach.*

Genus. OICEOPTOMA, *Leach.*

OICEOPTOMA TETRASPILOTUM.

Tab. XIII. Fig. 3.

Oic. atro-violaceum; thorace miniato, quadri-maculato; pedibus nigro-cyaneis.

Long. *corporis* 9 lin.; lat. 4¼.

Hab. in Indiâ Orientali, circa Poona copiosè.

Mus. Sykes.

DESCR. *Caput* atrum. *Antennæ* piceæ, capitulo fusco tomentoso. *Thorax* subtilissimè punctatus, ruber, maculis quatuor nigris posticè notatus. *Elytra* nigro-violacea, subacuminata, versus apicem obliquè truncata, fortissimè punctata, suturâ lineisque elevatis, lineâ tertiâ ad medium disci descendente tuberculoque cum lineâ secundâ connexâ. *Corpus* subtùs violaceum. *Femora tibiæ*que nigro-cyaneæ. *Tarsi unguesque* brunneo-picei.

A common opinion prevails among entomologists, that the typical *Silphidæ* are rare in warm countries. My own collection contains, however, several African and tropical species. *Necrophagus Nepalensis*, Hope, and *Silpha melanaria*, Ej., are from India; as is also *Necrodes osculans*, Vig.

I may add, that I have recently received from Japan two species of *Silpha*, one of which I have named, from its locality, *Silpha Japonica*, and the other in honour of the celebrated Dr. Siebold.

Fam. ENGIDÆ, *MacLeay*.

Genus. LANGURIA, *Lat.*

LANGURIA CYANEA.

Tab. XIII. Fig. 4.

Lang. cyanea; antennis piceis; elytris punctato-striatis.

Long. *corporis* 3 lin.; lat. 1.

Hab. in agro Nepalensi.

Mus. Hope.

DESCR. *Caput* rugâ transversâ inter oculos impressum. *Antennæ* piceæ, longæ, articulis tribus ultimis dilatatis. *Thorax* glaber, subtilissimè punctatus, posticè contractus. *Elytra* punctato-striata, cyanea. *Corpus* infrà concolor. *Pedes* elongati. *Tarsi* subtùs fusci, flavo-pubescentes.

This insect recedes from the type of *Languria*, and will probably form at some future period a subgenus with other Indian species. The *antennæ* are long, with a slightly incrassated club of three joints only; the legs are comparatively long; the *tarsi* are narrow; and the posterior part of the *thorax* is contracted: characters by which it differs from the usual form of *Languria*.

The Brazilian species of this genus appear also to form another subgenus.

Stirps. MALACODERMATA, *Lat.*

Fam. TILLIDÆ, *Leach.*

Genus. OPILUS, *Lat.*

OPILUS AURIPENNIS.

Tab. XIII. Fig. 5.

Op. ater; thorace nigro; elytris auratis nitidissimis; pedibus nigricantibus.

Long. *corporis* 7 lin.; lat. 2.

Hab. in Brasiliâ, juxta Rio Janeiro.

Mus. Hope.

DESCR. *Antennæ* nigræ, pubescentes, articulis tribus apicalibus maximis internè valdè productis. *Palpi* nigro-picei. *Thorax* ater nitidus, foveolâ mediâ impressâ, subtilissimè punctatus, ante medium contractus, lateribus pone medium rotundato-dilatatis. *Elytra* viridi-aurata nitidissima, anticè fortissimè punctata, posticè glaberrima nitoreque flammifero fulgentia. *Corpus* subtùs nigrum, punctatum. *Pedes* pilis albidis obsiti. *Tarsi* infrà flavi, spongiosi.

Variat *thorace rubro; antennis pedibusque rufescentibus.* Fortè specimen immaturum.

This Brazilian insect is most nearly allied to *Opilus*: it will, however, probably form a subgenus. Its chief differences consist in the variation of the joints of the club of the *antennæ*, and in the bluntness of the mandibular teeth as compared with those of *Opilus*. The last three joints of the *antennæ* in the latter genus are widely different; the ninth and tenth are trigonate, and the eleventh is obliquely truncated: in the present insect the ninth and tenth are trigonate with a deep incision, and the eleventh is ovate and depressed. Another remarkable distinction exists between this insect and the *Opili* generally: its *tarsi* are only four-jointed, the basal articulation usually found in that genus not being here observable. With these exceptions, its characters are those of the other *Opili*.

Stirps. LAMELLICORNES, *Lat.*

Fam. SCARABÆIDÆ, *MacLeay.*

Subfam. COPRIDES.

Genus. COPTORHINA[1].

Caput magnum, ecorne: *clypeo* profundissimè inciso (scil. dente forti utrinque porrecto).

[1] Κόπτω, *scindo*; ῥὶν, *nasus*.

Thorax anticè declivis.
Elytra ad latera basin versus sinuata.

The insects forming this group differ so materially from the type of *Copris*, Fab., that I have not hesitated in considering them as forming a distinct genus, to which I have applied the name of *Coptorhina*, in allusion to the deeply notched *clypeus*. Those species of the great group *Ateuchus* of Fabricius which have a strong emargination of the *elytra* at their lateral edge near the base, were separated from that genus by Illiger, who gave them the generic name of *Gymnopleurus*. A corresponding emargination had not before been observed among the *Coprides*, and its existence in the insects which I am about to describe, authorizes their separation on precisely similar grounds to those on which the genus *Gymnopleurus* rests.

Coptorhina is apparently the connecting link between *Copris* and *Gymnopleurus*; and I have little doubt that in tropical Africa many species of this form will be found, and probably also a subgenus connected with it, having the *clypeus* entire, and the *elytra* sinuated near the base. The connecting link between *Copris* and *Ateuchus* appears to me to be still wanting, for I cannot consider as such the genus *Circellium*, Lat. It is more difficult to connect *Copris* with *Onitis*, Fab.; but it is probable that in India, or in some of the islands adjacent to it, such a link may be found, assuming the form of *Onthophagus*, Lat. It is most likely that such a form should occur where *Onitis* is not a prominent group.

1. Coptorhina Africana.

Tab. XIV. Fig. 1.

Copt. nigra; thorace anticè retuso, posticè valdè elevato; elytris convexis, tenuissimè punctato-striatis.

Long. *corporis* (dentibus clypei inclusis) 8 lin.; lat. 5.

Hab. in Sierra Leone.

Mus. Hope.

Descr. Insectum totum nigrum, punctatissimum. *Clypeus* profundè incisus, seu melius dentibus duobus magnis armatus. *Thorax* recurvus, anticè retusus, posticè prominentiâ latâ foveolâ mediâ impressâ lineâque utrinque impressâ vix distinctâ neque ad marginem posticum extensâ. *Elytra* ad latera sinuata, undique punctis minutissimis sparsis instructa, striisque septem punctorum majorum octavâque laterali curvâ ad apicem excurrente cumque striâ dorsali secundâ conjunctâ. *Scutellum* nullum. *Corpus* magnum, gibbum. *Elytra* abdomen longitudine æquantia. *Pedes* breves, antici 5-dentati.

2. COPTORHINA KLUGII.

Copt. nigra; clypei dentibus subreflexis; thoracis prominentiâ mediâ indistinctè foveolatâ.
Long. *corporis* 6 lin.; lat. 4.
Hab. ad Caput Bonæ Spei.
Mus. Hope.

Dedicated to the distinguished Klug, the first of German entomologists.

Except in the particulars noticed in the specific character, *Copt. Klugii* agrees generally with the preceding species. It is, however, considerably smaller.

A third species of *Coptorhina* has also come under my notice, the locality of which I believe to be the Soudan.

Fam. MELOLONTHIDÆ, *MacLeay.*

Genus. PHÆNOMERIS[1].

Antennæ 9-articulatæ, articulo septimo duobus sequentibus majore.
Elytra abdomen haud tegentia.
Coxæ posticæ maximæ, pone abdominis margines protensæ.
Ungues quatuor anteriores bifidi, postici duo simplices.

Antennæ 9-articulatæ, articulo basali elongato ad apicem dilatato, secundo globoso, duobus proximis æqualibus, quinto breviore, sexto brevissimo, tribus ultimis magnitudine decrescentibus capitulumque rotundum formantibus. *Labrum* transversum, a capite suturâ transversâ divisum. *Palpi maxillares* 4-articulati, articulo primo minimo, proximis ferè æqualibus, extimo ovato-elongato ad apicem conico: *labiales* 2-articulati, articulo primo brevi, secundo subreniformi. *Maxillæ* 5-dentatæ. *Mentum* subquadratum, ad basin dilatatum.

Caput oblongiusculum, angulis anticis rotundatis. *Corpus* ovato-elongatum. *Thorax* longitudine latitudini inæqualis, angulis anticis rotundatis. *Scutellum* isoscele. *Elytra* abdomine breviora, segmentis duobus abdominalibus denudatis trigonis. *Coxæ* femoribus æquales. *Pedes anteriores* quatuor femoribus simplicibus, anticorum tibiis brevibus in spinam productis, tarsorum articulis æqualibus, unguibus bifidis dentibus acutis; *postici* duo robusti, femoribus incrassatis externè paullò rotundatis, tibiis 2-spinosis, obliquè truncatis, fovearumque impressarum serie instructis, tarsorum articulis inæqualibus, articulo primo majore trigono, secundo minore, proximis duobus inter se æqualibus, ultimo longissimo, unguibus simplicibus.

[1] *Φαίνω, ostendo; μηρὸς, femur.*

PHÆNOMERIS MAGNIFICA.

Tab. XIII. Fig. 6.

Phæn. viridis; capite nigro; thorace aurato; elytris igne micantibus, punctato-striatis; pedibus bicoloribus.

Long. *corporis* 7 lin.; lat. 3.

Hab. in Africâ.

Mus. Hope.

DESCR. *Caput* nigrum, subrugosum, margine antico rotundato elevato, lineâ sinuatâ ferè inter oculos sitâ, margine antico lateribusque auratis. *Antennæ* articulo primo viridi, sequentibus quinque nigro-cyaneis, capitulo obscuriore. *Thorax* glaber, foveâ utrinque impressâ, lateribus punctatis, punctisque aliquot posticis sparsis. *Scutellum* sparsim punctatum. *Elytra* flammifera, punctato-striata, striis novem in singulis fortiter impressis. *Abdomen* segmentis suprà viridi-auratis punctatissimis; infrà anticè nigro posticè viridi variegatis, punctorum impressorum serie interpositâ. *Corpus* reliquum subtùs viride, nitidum, punctatum. *Mesosternum* anticè productum, crassum, pilis albis obsitum. *Pedes* bicolores, femoribus tibiisque suprà viridibus subtùs cyaneis, tarsis saturatè cyaneis.

This beautiful insect was sent to England from the Soudan by the unfortunate Ritchie.

Fam. CETONIIDÆ, *MacLeay.*

Genus. MACRONOTA, *Wied.*

MACRONOTA TETRASPILOTA.

Macr. nigro-olivacea, punctata; thoracis lateribus pallidè stramineis; elytris olivaceis, maculâ mediâ irregulari alterâque apicali minore notatis.

Long. *corporis* 8 lin.; lat. $4\frac{1}{2}$.

Hab. in Indiâ Orientali, circa Poona.

Mus. Sykes.

Genus. CETONIA, *Fab.*

CETONIA CRETOSA.

Cet. picea; thorace utrinque maculâ albâ notato; elytris albo variegatis.

Long. *corporis* 8 lin.; lat. 4.

Hab. in Indiâ Orientali, circa Poona.

Mus. Sykes.

DESCR. *Caput* punctatum, nigrum, posticè album. *Thorax* piceus nitidus, margine utrinque cretaceo, punctatus, punctisque duobus albis posticè prope scutellum impressis. *Elytra* albo variegata, maculâ utrinque mediâ majore difformi alterâque minore ad apicem positâ. *Corpus* infrà piceum, pectoris lateribus lineisque abdominis duabus incurvis a pectore ad anum ductis albis. *Anus*, seu abdominis segmentum ultimum, maculis duabus albis insignitus. *Pedes* picei.

Fam. LUCANIDÆ, *Leach.*

Genus. LUCANUS, *Linn.*

1. LUCANUS DOWNESII.

Tab. XIII. Fig. 7.

Luc. ater; thorace elytrisque ferrugineo-brunneis; mandibulis multidentatis, femoribus, tibiisque piceis; tarsis nigris.

Long. *corporis*, mandibulis inclusis, 31 lin., mandibulis exclusis, 21; lat. *thoracis* 8, ad humeros 7.

Hab. in Africâ, apud Fernando Po.

Mus. Hope.

DESCR. *Antennæ palpi*que nigri. *Caput* magnum, atrum, in medio depressum, anticè 2-spinosum. *Mandibulæ* valdè exsertæ, ad apicem acutæ, longitudine elytra æquantes, dentibus majoribus tribus quorum unus ad apicem ferè latissimus, minoribus plurimis. *Thorax* capite latior, utrinque dentatus, ferrugineo-brunneus. *Scutellum* atrum, posticè rotundatum. *Elytra* ferruginea, suturâ marginibusque nigris. *Corpus* subtùs nigro-brunneum. *Pedes* antici infrà nigricantes, reliquorum femoribus tibiisque rubro-corallinis, geniculis, tarsis, unguibusque nigris.

I have named this magnificent insect in honour of my much-valued friend Commander Downes, R.N., an officer whose gallantry at sea is equalled only by his devotion to science at home.

2. LUCANUS ÆRATUS.

Tab. XIV. Fig. 2.

Luc. æneo-virens; mandibulis dentatis nigrescentibus; tarsis flavo-pubescentibus.

Long. *corporis*, mandibulis inclusis, 10 lin., mandibulis exclusis, 9; lat. *thoracis* 4, *elytrorum* 4.

Hab. in Indiâ Orientali ad litus Tenasserim.

Mus. Hope.

DESCR. *Caput* quadratum. *Antennæ* piceæ. *Mandibulæ* 3-dentatæ, nigro-virescentes.

Corpus suprà æratum, viridi tinctum. *Thorax* confertissimè punctatus. *Elytra* lineâ longitudinali impressâ vix distinctâ, punctatissima, suturâ marginibusque virescentibus. *Corpus* infrà cupreo-brunneum. *Tibiæ* anticæ 2-spinosæ. *Tarsi* subtùs flavo-pubescentes.

This species of *Lucanus* is remarkable for its metallic colour, quadrate head, ciliated *tarsi*, and semicircular *mentum*. In other respects it may be arranged under the genus *Dorcas*, MacLeay.

Genus Pholidotus, *MacLeay.*

Pholidotus irroratus.

Tab. XIV. Fig. 3.

Phol. ater; thorace albo irrorato; elytris lineâ elevatâ instructis alboque variegatis. (♀)

Long. *corporis* $5\frac{1}{4}$ lin.; lat. 2.

Hab. in Brasiliâ, apud Rio Janeiro.

Mus. Hope.

Descr. *Caput* transverso-quadratum. *Antennæ* piceæ. *Mandibulæ* 1-dentatæ, nigræ. *Thorax* lineis duabus elevatis mediis anticè conjunctis nigris, granulisque albis notatus. *Elytra* nigra, lineâ elevatâ nigrâ ante apicem terminatâ, angulis anticis posticisque albo granulatis, granulisque aliquot albis per discum totum sparsis. *Corpus* infrà nigrum, punctatum. *Tibiæ* anticæ multi-dentatæ; intermediæ 3-spinosæ, dente medio majore, reliquis vix distinctis; posticæ 2-dentatæ. *Ungues* simplices.

Mas adhuc latet.

This insect is certainly referrible to *Pholidotus*, which genus may be divided into two sections, depending on the form of the head in the female, and on that of the *thorax*. The distinction may be thus expressed:

* ♀ Capite trigono; thorace orbiculari.

** ♀ Capite transverso-quadrato; thorace transverso.

Sectio. HETEROMERA, *Lat.*

Fam. Anthicidæ.

Genus. Anthicus, *Fab.*

Anthicus cyaneus.

Tab. XIV. Fig. 4.

Anth. cyaneus; capite nigro; antennis pedibusque atris.

Long. *corporis* 2 lin.; lat. $\frac{1}{3}$.

Hab. in Novâ Hollandiâ.

Mus. Hope.

DESCR. *Antennæ* nigræ, articulo basali crasso, reliquis extrorsùm sensim crassioribus. *Thorax* ovalis, anticè posticèque contractus, nigro-cyaneus. *Elytra* cyanea, nitida, glaberrima. *Corpus* subtùs nigrum. *Pedes* concolores.

As the structure of this insect recedes in many respects from the typical formation of *Anthicus*, I propose the name of *Anthelephila*[1], to designate a subgenus for its reception. The maxillary *palpi* are unusually large, while the labial are scarcely longer than the *labium*, and are terminated by a cup-shaped articulation.

Fam. HELOPIDÆ.

Genus. LYPROPS[2].

Labrum transverso-quadratum, anticè emarginatum.

Mandibulæ breves, validæ, ad apicem 2-dentatæ.

Palpi maxillares articulo ultimo securiformi: *labiales* articulo ultimo ad apicem attenuato.

Antennæ sub capitis margine insertæ.

Caput angulis anticis lateraliter subproductis.

The insect possessing the above characters differs so much from all the *Helopidæ* with which I am acquainted, as to induce me to separate it under the name of *Lyprops*, having reference to its dull appearance. The insertion of the *antennæ* beneath the produced anterior angles of the head is a remarkable feature. The labial *palpi* resemble in their form those of *Helops* as figured by Mr. Curtis in his 'British Entomology.'

LYPROPS CHRYSOPHTHALMUS.

Tab. XIV. Fig. 5.

Lypr. ater; oculis auratis; thorace elytrisque punctatissimis; tarsis infrà flavo-pubescentibus.

Long. *corporis* 5 lin.; lat. $1\frac{3}{4}$.

Hab. in Indiâ Orientali.

Mus. Hope.

DESCR. *Antennæ* nigræ. *Caput* punctatum, marginis antici punctis paullò elevatis. *Oculi* auro micantes. *Thorax* convexus. *Elytra* profundè punctata, ad latera indistinctè striata. *Pedes* nigri. *Tarsi* subtùs flavo-pubescentes, spongiosi.

[1] Ἄνθηλη, *flosculus*; φίλος, *amator*.

[2] Λυπρὸς, *tristis*; ὦψ, *vultus*.

Sectio. TETRAMERA, *Lat.*

(Rhynchophora, *Lat.*)

Fam. Attelabidæ, *Lat.*

Genus Isacantha[1].

Rostrum longum.

Antennæ ante rostri medium insertæ, versus apicem incrassatæ, haud pectinatæ.

Elytra ad basin rotundata paullòque supra thoracem producta.

Pedes antici maximi, femoribus dentibus duobus æqualibus versus apicem instructis.

Antennæ 11-articulatæ, extrorsùm crassiores, rostro paullò ante medium insidentes, articulo primo longiusculo subarcuato extrorsùm crassiore, secundo brevi obconico, tertio quartoque subæqualibus, quinto prioribus duobus breviore, insequentibus quinque magnitudine crescentibus obconicis extrorsùm crassioribus, ultimo præcedenti paullò longiore ad apicem conico. *Labrum* vix distinctum. *Labium* anticè productum, ad basin transversè dilatatum. *Mandibulæ* 3-dentatæ, dentibus ferè æqualibus. *Maxillæ* apertæ. *Palpi* brevissimi, conici. *Mentum* subtransversum, quadratum.

Thorax parùm convexus, anticè angustior. *Corpus* elongatum, posticè dilatatum, alatum. *Femora* antica longiora, reliquis crassiora, versus apicem 2-spinosa. *Tibiæ* anticæ ad basin subarcuatæ. *Tarsi* pulvinati. *Ungues* simplices.

This genus appears to unite *Rhinotia*, Kirby, with *Belus*, Schönh. All the three groups are from New Holland[2].

Isacantha rhinotioides.

Tab. XIV. Fig. 6.

Is. grisea; elytris punctatissimis.

Long. *corporis* $5\frac{1}{4}$ lin., rostro incluso, 7 lin.; lat. 2.

Hab. in Novâ Hollandiâ.

Mus. Hope.

[1] Ἴσος, *æqualis*; ἄκανθα, *spina*. The two spines on each of the anterior *femora* are of equal size.

[2] To another nearly allied and novel genus, lately received from the same country, I have given the name of *Pachyura*: it may be thus briefly characterized:—

Isacanthæ affinis; antennis extrorsùm crassioribus; rostro deflexo; thorace anticè angustiore; elytris posticè valdè dilatatis; pedibus inermibus.

The species on which this genus is founded I have named *Pach. Australis.*

DESCR. *Caput* punctatum. *Rostrum* porrectum, teres, caput thoracemque longitudine æquans, anticè glabrum, posticè punctulatum. *Antennæ* rostro longiores, ad basin attenuatæ, articulis ultimis subpubescentibus. *Oculi* hemisphærici, prominuli, pilis albidis cincti. *Thorax* obconicus, anticè angustatus, posticè latitudine longitudinem æquans, ad latera rotundatus, suprà parùm convexus, lineâ dorsali vix distinctâ, tuberculis numerosis obsitus. *Scutellum* breve, flavidum. *Elytra* anticè supra thoracem paullò producta, posticè dilatata, rotundata, tuberculata, piloso-albida, maculis quibusdam fulvo-aureo-pilosis. *Femora* antica majora, 2-spinosa, spinis æqualibus; posteriora mediocria. *Tibiæ* posteriores ferè rectæ, subspinosæ. *Tarsi* tibiis paullò breviores, subtùs spongiosi, articulo primo subobconico, secundo subtrigono, tertio latiore bilobo, ultimo elongato 2-unguiculato. *Corpus* infrà griseum, albido-pilosum, abdominis segmentis maculis fulvo-aureo-pilosis triplici ordine dispositis. *Pectus* pilis longioribus auratis balteatum.

(LONGICORNES, *Lat.*)

Fam. LAMIIDÆ.

Genus. LAMIA, *Fab.*

1. LAMIA ROYLII.

Tab. XV. Fig. 1.

Lam. nigra; antennis corpore longioribus; elytris mucronatis, ad basin scabris, maculis albis octo notatis.

Long. *corporis* 28 lin.; lat. $8\frac{3}{4}$.

Hab. in Indiæ Orientalis montibus Mussoonee dictis.

Mus. Royle.

DESCR. *Antennæ* nigræ, serrato-spinosæ, articulo ultimo elongato sublineari. *Caput* cum oculis latitudinem thoracis anticè ferè æquans, fronte depresso, nigro-fuscum, maculis linearibus albis pone oculos. *Thorax* longitudine latitudini inæqualis, utrinque spinâ acutâ armatus, maculâ albâ dorsali lineam elevatam nigram includente. *Scutellum* album. *Elytra* ad basin thorace multò latiora, humeris elevatis subspinosis, singula maculis albis quatuor notatis, quarum anteriores majores sequentes magnitudine decrescentes. *Corpus* infrà fuscum, vittâ albâ balteatum. *Pedes* nigri. *Tarsi* flavo-pubescentes.

I have named this fine insect in honour of J. F. Royle, Esq., by whom it was collected, and whose researches in the upper provinces of British India have furnished him with ample materials for his interesting 'Illustrations of the Botany and other branches of the Natural History of the Himalayan Mountains, &c.' now in course of publication.

It is distinguished by having the basal joint of the *antennæ* terminated internally by a strong spine, and each of the succeeding joints beautifully fringed at its extremity by down. The anterior *tibiæ* are grooved, and have a spine near the *apex*; the intermediate are slightly tuberculated.

2. Lamia Crux nigra.

Tab. XV. Fig. 2.

Lam. straminea; thorace nigro, vittis tribus luteis; elytris maculá cruciformi nigrá, alterisque duabus rotundatis aurantiis.

Long. *corporis* 11 lin.; lat. 4.

Hab. in Sierra Leone.

Mus. Hope.

Descr. Species pulcherrima. *Antennæ* corpore longiores, suprà nigræ subtùs griseæ. *Caput* atrum luteo variegatum, maculis aurantiis duabus infra oculos notatum. *Thorax* niger, maculâ utrinque aurantiâ, vittis duabus lateralibus tertiâque dorsali luteis, hâc anticè interruptâ posticè ante scutellum concolorem desinente. *Elytra* pallidè straminea sparsim aurantio variegata, cruce nigrâ, guttis aurantiis duabus mediis, maculisque totidem albis ornata. *Corpus* subtùs unicolor. *Pedes* suprà nigri, subtùs grisei.

This beautiful insect was captured by Mr. Palin during his residence at Sierra Leone. It is almost impossible to describe accurately its play of colouring; a pale straw colour predominates, which passes into lemon as well as into light and dark orange. The underside of the *antennæ* is of a light greenish grey.

It is probable that this insect is an *Aphelocnema* of Mr. Stephens; but this I cannot accurately determine, as the characters of that genus are not yet published.

Fam. Prionidæ.

Genus. Prionus, *Fab.*

1. Prionus Hayesii, *Downes, MSS.*

Tab. XVI.

Pri. nigro-brunneus; thorace marginato, multispinoso; mandibulis porrectis, quadridentatis; pedibus anticis valdè elongatis.

Long. *corporis* 4½ unc.; lat. ad humeros 12 lin., *elytrorum* 17.

Hab. in Africâ Occidentali.

Mus. Nav.-Mil.

DESCR. *Antennæ* nigræ, corpore longiores, articulis omnibus aculeato-spinosissimis, septimi sequentiumque (præter ultimi) lateribus ad apicem dilatatis, ultimo elongato subensiformi. *Mandibulæ* variolosæ, 4-dentatæ, dente interno majore, cæteris apicalibus, externè 1-tuberculatæ. *Thorax* niger, margine spinis acutissimis armato, disco tuberculis difformibus scabroso-varioloso. *Elytra* ad apicem mucronata, nigro-brunnea, ad basin variolosa, posticè quasi vermibus erosa (scilicet disci variolis apicem versus minoribus), singula lineis quatuor elevatis quarum interna sequenti posticè conjuncta. *Pedes* antici cæteris longiores, scabri, femoribus densissimè spinosis, tibiis aculeatis ad apicem hamis inflexis quatuor armatis; posteriorum femoribus suprà infràque aculeatis, tibiis suprà infràque subarmatis. *Tarsi* suprà picei, subtùs brunnei, pulvinati. *Ungues* picei, simplices.

This magnificent insect is remarkable on account of the outer portion of its trochanters being pubescent. In size it is not surpassed by any coleopterous species with which I am acquainted. Many of the spines of the *antennæ* are curved at the tip; and the hooks at the extremities of the *tibiæ* are evidently for the purpose of enabling the insect when at rest to support its weight. I am not aware that similar hooks have been hitherto noticed, except in the insect constituting the genus *Chiasognathus*, Steph. Their existence in the *Chias. Grantii*, and in the present insect, leads to the presumption of an affinity between the *Lucanidæ* and the *Prionidæ*.

It was captured at West Bay, Prince's Island, in the Bight of Biafra, and received from the sailors, on account of its gigantic size, the whimsical appellation of King of the Cockroaches. It is now in the Naval and Military Museum, to which it was presented by Capt. J. Hayes, R.N., C.B., in honour of whom it has been named by Capt. Downes.

2. PRIONUS CUMINGII.

Tab. XIV. Fig. 7.

Pri. ater; thoracis bifoveolati angulo antico utrinque dilatato hamato; elytris varioloso-tuberculatis.

Long. *corporis* 27 lin.; lat. ad humeros 8, *elytrorum* 12.

Hab. in Chili.

Mus. Hope.

DESCR. *Antennæ* nigræ. *Palpi* picei. *Maxillæ* arcuatæ, 1-dentatæ, dente ferè medio. *Caput* nigrum, punctatum, anticè depressum, ad antennarum insertiones elevatum, lineâ longitudinali inter oculos profundè impressâ. *Thorax* anticè posticèque marginatus, pilis aurantiis obsitus, angulis anterioribus in hamum productis, foveolis duabus rotundatis dorsalibus. *Scutellum* posticè rotundatum, punctatum. *Elytra* coriacea, varioloso-tuberculata, lineis tribus longitudinalibus vix distinctis. *Corpus* infrà piceum. *Pedes* atri.

This insect was obtained at Concepçion and Valparaiso, on the trunks of trees, by Mr. H. Cuming, in honour of whom I have named it. The success of his indefatigable exertions in various branches of Natural History, is well known by the extensive and interesting collections which he has recently brought to this country.

The species is remarkable for the form of its armed *thorax*; and also on account of the under surface of the basal joints of the *tarsi* being smooth and cylindric, and entirely destitute of the pulvination which exists in most of the *Prionidæ*. These considerations induce me to regard it as the type of a subgenus, to which the name of *Acanthinodera*[1] may be applied.

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3. Prionus Pertii.

Tab. XV. Fig. 3.

Pri. ater; capite oblongo; thorace nigro; elytris castaneis; femoribus piceis; tarsis ferrugineis.

Long. *corporis* 12 lin.; lat. 4.

Hab. in Indiâ Orientali.

Mus. Sykes.

Descr. *Antennæ* nigræ, corpus longitudine æquantes. *Mandibulæ* incurvæ, acutissimæ. *Palpi* picei, pilis flavis vestiti. *Caput* oblongum, nigrum, punctatum, tuberculis ad antennarum insertiones, foveolâque inter oculos positâ. *Thorax* subquadratus, lateribus in spinas duas productis. *Scutellum* nigrum. *Elytra* rubro-castanea, nigro marginata, lineis quibusdam vix distinctis. *Corpus* infrà nigro-piceum. *Prosternum* inter pedes anticos productum, anticè valdè incisum, posticè attenuatum et infra mesosternum extensum; hoc etiam paullò porrectum. *Femora* antica parùm incrassata, picea. *Tibiæ* concolores, ad apicem rufescentes. *Tarsi* ferruginei; anticorum articulus tertius bilobus, intermediorum sub-bidentatus, posticorum bifidus bidentatus.

I have named this insect in honor of Dr. Maximilian Perty; and propose for it the subgeneric designation of *Dissosternus*[2], in allusion to the very remarkable structure of the *sterna* of its *prothorax* and *mesothorax*.

h

Fam. Stenocoridæ.

Differing from the greater number of entomologists, I regard the genus *Stenocorus*,

[1] Ἀκάνθινος, *spinosus*; δέρη, *collum*.

[2] Δισσὸς, *duplex*; στέρνον, *sternum*.

Fab., as a family; and compared with *Lepturidæ*, it has certainly stronger claims to rank as such, both from its widely extended geographical distribution, and the numerous forms included in it. The *Lepturidæ* are chiefly confined to a northern latitude, and the metropolis of the family is probably North America, or Northern Europe. There are, it is true, a few species found in South America; but these recede, according to my views, from the type of *Lepturidæ*. *Stenocorus* affects warmer climates, and has not yet, I believe, been found in Europe. It is widely dispersed in North and South America, and is met with in various parts of the Continent of India and in Java, as well as in New Holland. The following table will give a concise view of the *Stenocoridæ*, the family being divided in the first instance into two sections, depending on the armature of the *antennæ*.

Sectio 1. Antennæ spinis plus minusve armatæ.

	Genus	Thorax	Elytrorum apex	Typus et species	Patria
	1. *Stenocorus*, Fab.	utrinque armatus	2-spinosus	*semipunctatus*, Fab., *obscurus*, *punctatus*, Don., aliæque sex.	Nova Hollandia.
n.	2. *Acanthinomonus.*	utrinque armatus	1-spinosus	*spinicornis*, Fab.	Brasilia?
n.	3. *Cycliopleurus.*	lateribus rotundatis	2-spinosus	*irroratus*, Fab., aliæque duodecim.	America Bor. et Mer.
	4. (Nondum detectum)	lateribus rotundatis	1-spinosus	————	America Meridionalis?
	5. *Tmesisternus*, Lat.	lateribus rotundatis	truncatus	*biguttatus*, aliæque duæ.	Nova Hollandia.

Sectio 2. Antennæ plus minusve pubescentes, haud spinosæ.

	Genus	Thorax	Elytrorum apex	Typus et species	Patria
n.	6. *Tetracanthus.*	4-spinosus	2-spinosus	*festivus*, Fab., aliæque quatuor.	America Meridionalis.
n.	7. *Dissacanthus.*	2-spinosus	2-spinosus	*quadrimaculatus*, Fab., aliæque decem.	America Meridionalis.
	8. *Uracanthus.* (Antennæ 11-articulatæ)	subspinosus, anticè angustatus constrictus	2-spinosus	*triangularis*, et *sericeus*.	Nova Hollandia.
	9. *Scolecobrotus.* (Antennæ 12-articulatæ)	subspinosus, anticè angustatus constrictus	2-spinosus	*Westwoodii.*	Nova Hollandia.
	10. *Strongylurus.* (Antennæ 11-articulatæ)	lateribus rotundatis, anticè angustatus	rotundatus	*scutellatus.*	Nova Hollandia.
	11. *Coptopterus.* (Antennæ compressæ)	lateribus rotundatis, anticè angustatus	acuminatus, subobliquè incisus	*cretifer.*	Nova Hollandia.
	12. *Piesarthrius.* (Antennæ compressæ)	lateribus rotundatis	acuminatus, extrorsùm rotundatus	*marginellus.*	Nova Hollandia.

The above twelve genera seem to embrace the whole of the *Stenocoridæ*; but the family will admit of yet more subdivisions. *Stenocorus discoideus*, Sturm, for instance, with *Sten. rufipes*, Klug, both from Mexico, must at some future time be formed into a subgenus.

Of the new genera and species indicated in the preceding table, I propose at present to illustrate but two. The illustration of the others would amply repay any one for the time and patience which he might devote to their attentive investigation; and I should be happy to aid him in such an undertaking. All the insects referred to are contained in my collection, on which the table is, in fact, entirely founded.

Genus. Uracanthus[1].

Elytra lineari-oblonga, ad apicem 2-spinosa.

Antennæ 11-articulatæ, corpus ferè longitudine æquantes.

Thorax obconico-truncatus, ad latera subspinosus.

Antennæ filiformes, articulo primo majore basi angusto apice incrassato, secundo minimo ferè orbiculari, cæteris æqualibus, ultimo ad apicem acuto. *Labrum* transversum. *Mandibulæ* corneæ, acutæ. *Palpi maxillares* 4-articulati, articulo primo minimo, secundo tertioque æqualibus, externo crassiore ovato truncato: *labiales* 3-articulati, articulo primo minimo, secundo obconico, tertio elongato ovato truncato.

Caput porrectum, oblongiusculum, inter oculos canaliculatum, ante antennas declive. *Oculi* prominuli, reniformes. *Thorax* latitudine posticè longitudinem æquans, anticè valdè angustatus. *Pedes* simplices.

Uracanthus triangularis.

Tab. XV. Fig. 4.

Ur. brunneus; thorace tuberculato, albo lineato; elytris albo-pubescentibus, apicibus bidentatis lateribusque purpureo-fuscis.

Long. *corporis* 14 lin.; lat. 3.

Hab. in Novâ Hollandiâ.

Mus. Hope.

Descr. *Antennæ* fusco-brunneæ, articulo primo saturatiore. *Caput* anticè rubrum, posticè brunneo-sericeum. *Thorax* concolor, tuberculis duobus mediis armatus, rugis transversis constrictus, vittis duabus dorsalibus totidemque lateralibus albo-pilosis. *Elytra* anticè brunnea, lineis elevatis quatuor parùm distinctis; posticè, præter apices, albo-sericea; in singulis eminet triangulum laterale brunneum. *Corpus* infrà brunneo-sericeum, pedibus concoloribus.

[1] Οὐρὰ, *cauda*; ἄκανθα, *spina*.

I possess another species of this genus, which is also from New Holland, and which I have designated *Ur. sericeus.*

Genus. Scolecobrotus[1].

Antennæ 12-articulatæ, corpore longiores, articulis prioribus tribus *Uracanthi* similibus, sequentibus æqualibus serratis erosis, externo breviore scalpelliformi subserrato.

In cæteris *Uracantho* simillimus.

This genus possesses many characters in common with the preceding, but is at once distinguished from it by the *antennæ*, which in *Uracanthus* have eleven joints, whereas in *Scolecobrotus* there are twelve, all of which, except the first three, are serrated; the last joint also is shorter than those which precede it, and resembles the blade of a pen-knife slightly serrated: they appear as if eroded by worms, whence the name of the genus. The *thorax* is transversely channelled; and the *elytra* are extremely scabrous at the base.

Scolecobrotus Westwoodii.

Tab. XV. Fig. 5.

Scol. flavo-ferrugineus; elytris ad basin punctulatis, ad apicem bidentatis.

Long. *corporis* 14 lin.; lat. 3.

Hab. in Novâ Hollandiâ.

Mus. Hope.

Descr. *Antennæ* ferrugineæ, articulis prioribus tribus glabris, cæteris serrato-dentatis dente apicali in singulis fortiore, externo breviore subserrato. *Caput* oblongiusculum, anticè rubrum, lineâ longitudinali inter oculos impressâ, pilis flaveolis obsitum. *Thorax* tuberculis duobus ferè mediis ornatus, rugisque transversis balteatus. *Elytra* ad basin punctatissima, posticè flavo-pilosa, 2-dentata. *Corpus* infrà unicolor. *Pedes* suprà rubescentes, subtùs flavo-pubescentes.

I have much pleasure in naming this singular species in honour of J. O. Westwood, Esq., whose tact in dissecting and delineating insects is not surpassed by any entomologist, either British or foreign.

[1] Σκωληκόβρωτος, *vermibus erosus.*

PLATE XIII.

Fig. 1. APLOA PICTA.

a. Anterior part of the head, seen from above; exhibiting the *labrum*, mandibles, and basal joints of one of the *antennæ*.

b. Anterior part of the head, seen from beneath; exhibiting the *labium* and its *palpi*, the *mentum*, and the *maxillæ* and their *palpi*.

c. Anterior *tarsus*.

2. CHLÆNIUS SYKESII.

d. Head and *trophi*, seen from below.

3. OICEOPTOMA TETRASPILOTUM.

e. Head, seen from above.

4. LANGURIA CYANEA.

f. Anterior part of the head, seen from above; exhibiting the *labrum*, mandibles, and one of the *antennæ*.

g. *Maxilla* and *palpus* attached.

h. Posterior *tarsus*.

5. OPILUS AURIPENNIS.

i. *Labrum*.

j. Mandible.

k. *Maxilla* and *palpus*.

l. *Trophi*, seen from below, including the *labium* with its *palpi* and the *mentum*.

m. *Antenna*.

n. Posterior *tarsus*.

6. PHÆNOMERIS MAGNIFICA.

o. Head and *trophi*, seen from above.

p. Mandible.

q. *Maxilla* and *palpus*.

r. Head and *trophi*, seen from below.

s. *Labium* and *palpi*.

t. *Antenna*.

u. Anterior *tibia* and *tarsus*.

v. Intermediate *tarsus*.

w. Posterior *femur*, *tibia*, and *tarsus*.

x. Terminal segments of the *abdomen*, seen from below.

7. LUCANUS DOWNESII.

PLATE XIV.

Fig. 1. Coptorhina Africana.

a. The insect, seen from below.

b. The insect, seen laterally.

c. Head, *trophi*, and one of the *antennæ*, seen from below.

2. Lucanus æratus.

d. *Trophi* and *antenna*, seen from below.

3. Pholidotus irroratus.

e. Head, *trophi*, and *antenna*, seen from above.

4. Anthicus cyaneus.

f. *Labrum*.

g. *Maxilla* and *palpus*.

h. *Labium* and *palpi*.

i. Anterior *tarsus*

j. Posterior *tarsus*.

5. Lyprops chrysophthalmus.

k. Anterior part of the head, seen from above; exhibiting the *labrum*, mandibles, and basal joints of one of the *antennæ*.

l. *Maxilla* and *palpus*.

m. *Mentum*, *labium*, and *palpi*.

6. Isacantha rhinotioides.

n. *Antenna*.

o. Anterior *femur*, *tibia*, and *tarsus*.

7. Prionus Cumingii.

PLATE XV.

Fig. 1. Lamia Roylii.

2. Lamia Crux nigra.

3. Prionus Pertii.

a. Anterior portion of the insect, seen laterally.

b. *Prosternum* and *mesosternum*.

c. *Trophi*, seen from below.

d. Posterior *tarsus*.

4. Uracanthus triangularis.

a. Head, seen from above, exhibiting the *trophi* and the insertion of one of the *antennæ*.

f. *Trophi*, seen from below.

g. *Labium* with its *palpi*, and *mentum*.

5. Scolecobrotus Westwoodii.

h. Eleventh and twelfth joints of the *antenna*.

PLATE XVI.

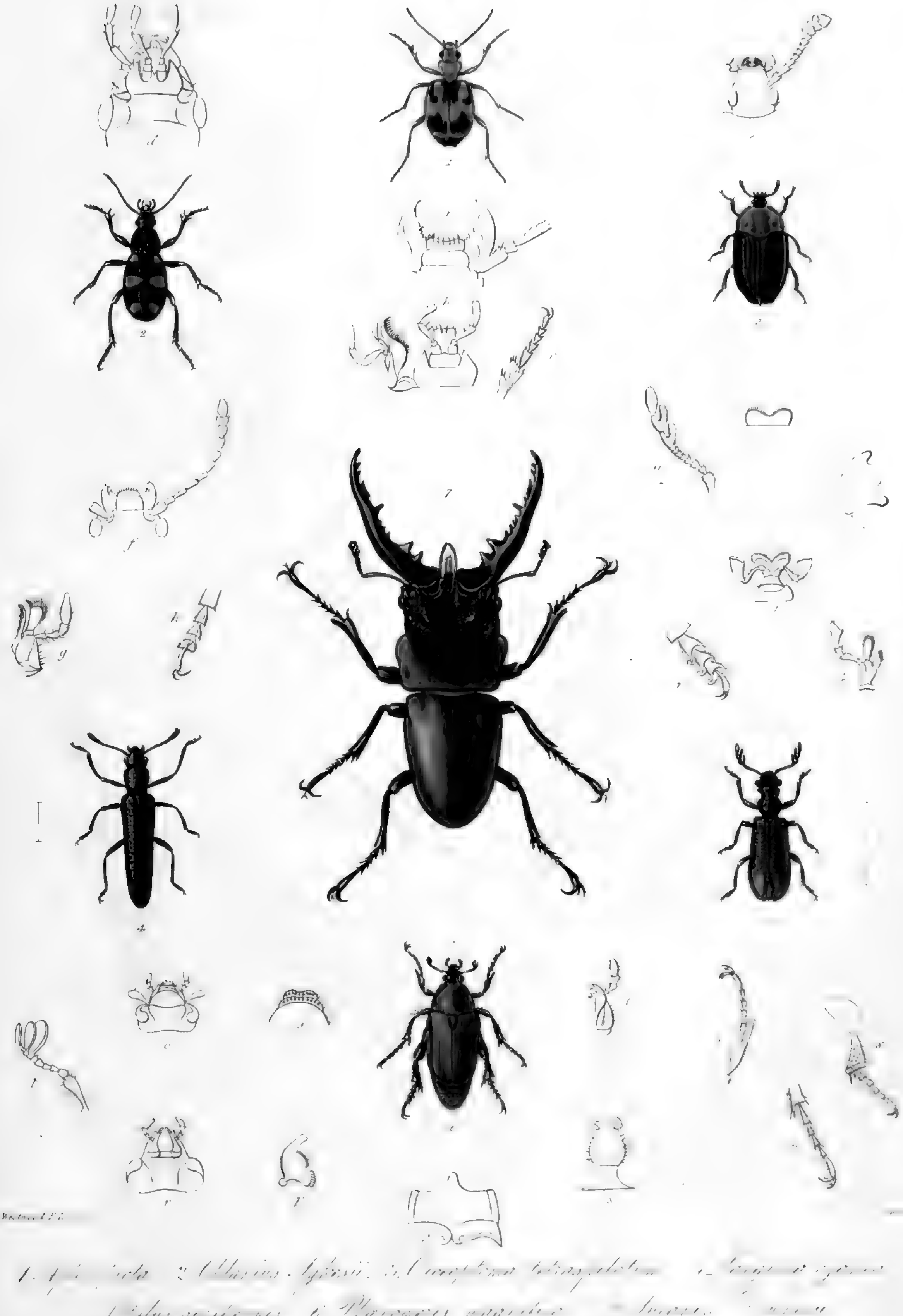
Prionus Hayesii.

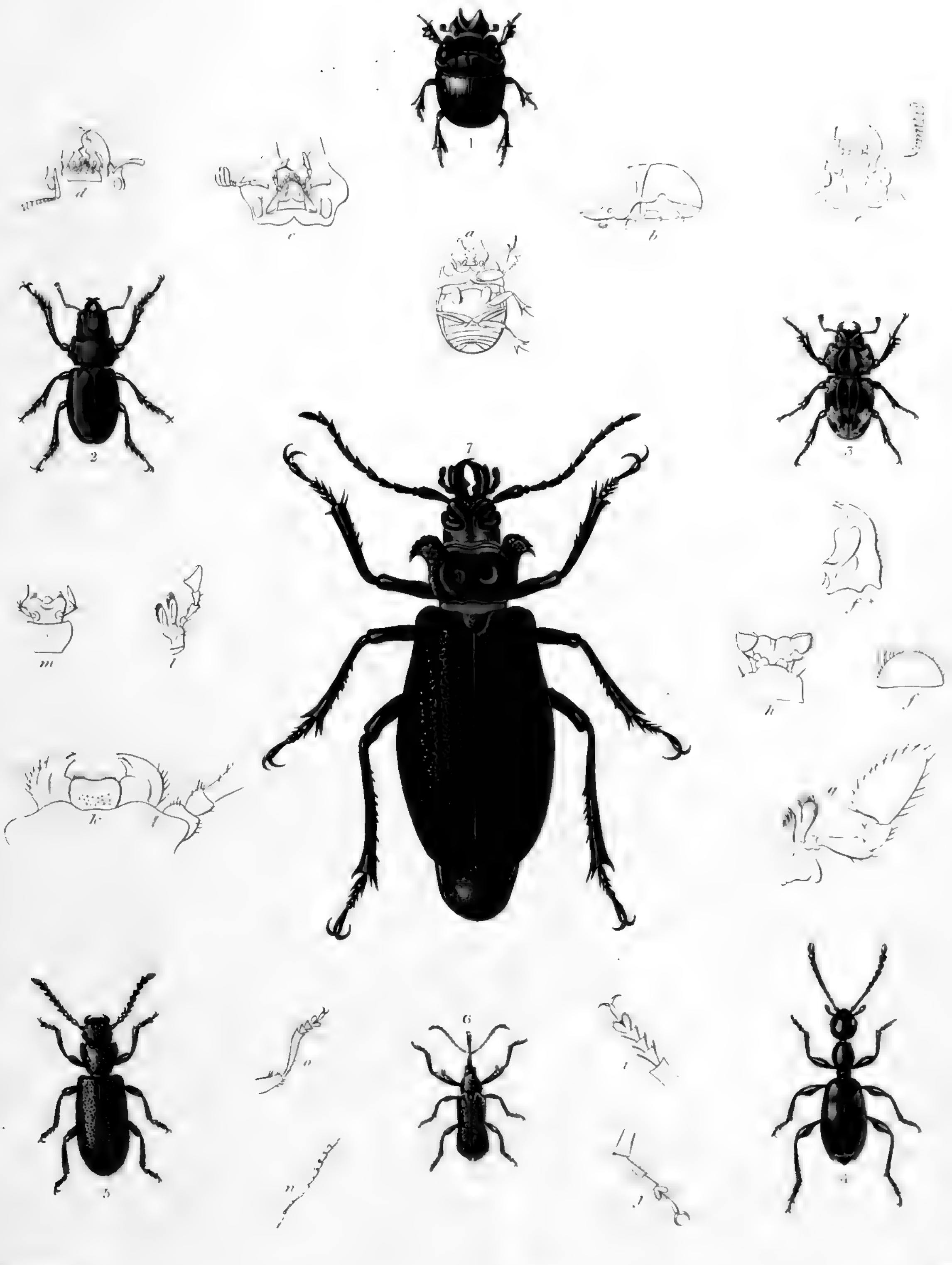
a. Head and *trophi*, seen from below.

b. *Prosternum* and *mesosternum*.

[In these Plates the insects are represented of the natural size, except where a line is placed near the figures: whenever a line is so placed, its length indicates that of the insects.

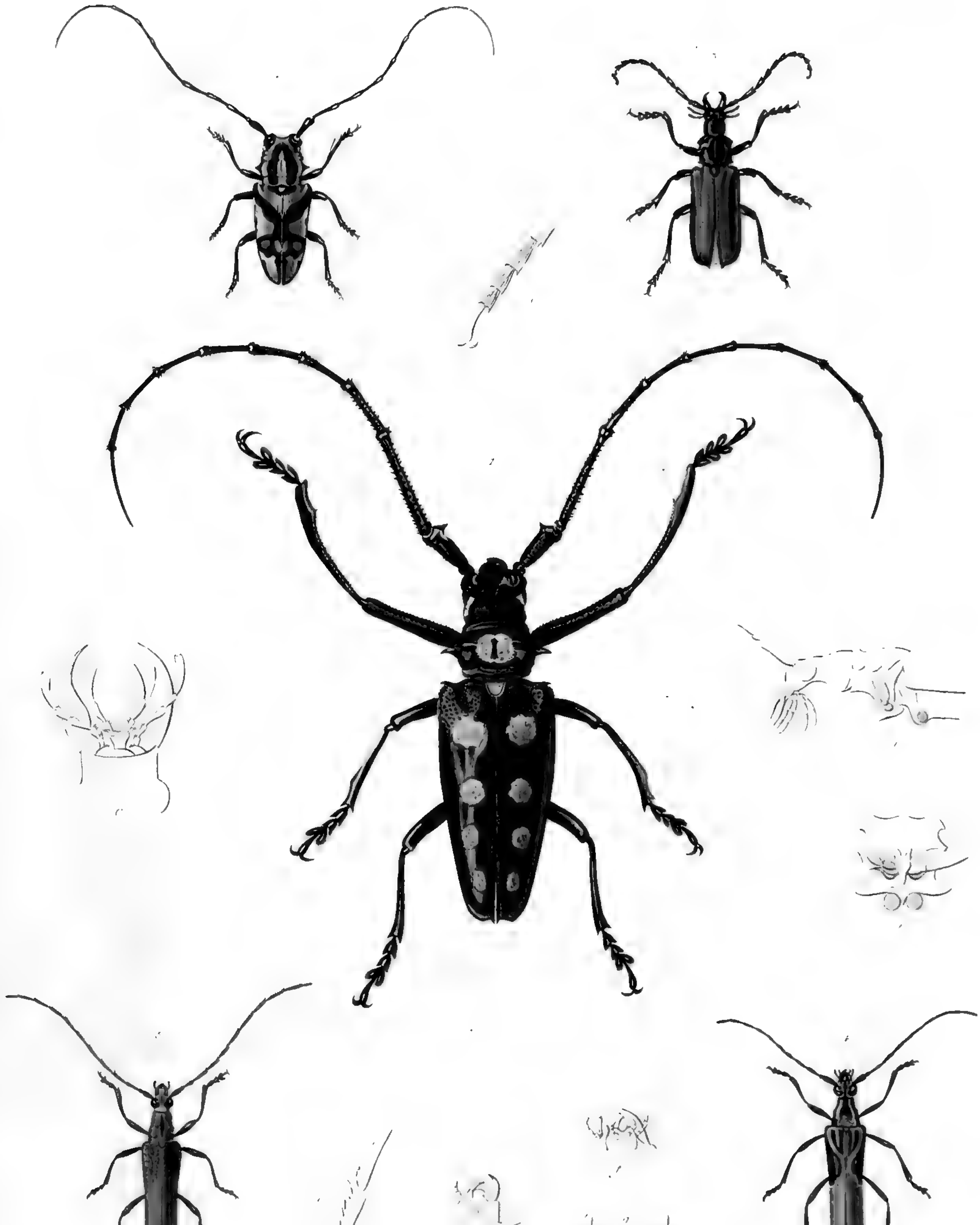
The details throughout (except in *Prionus Hayesii*) are magnified in various degrees.]

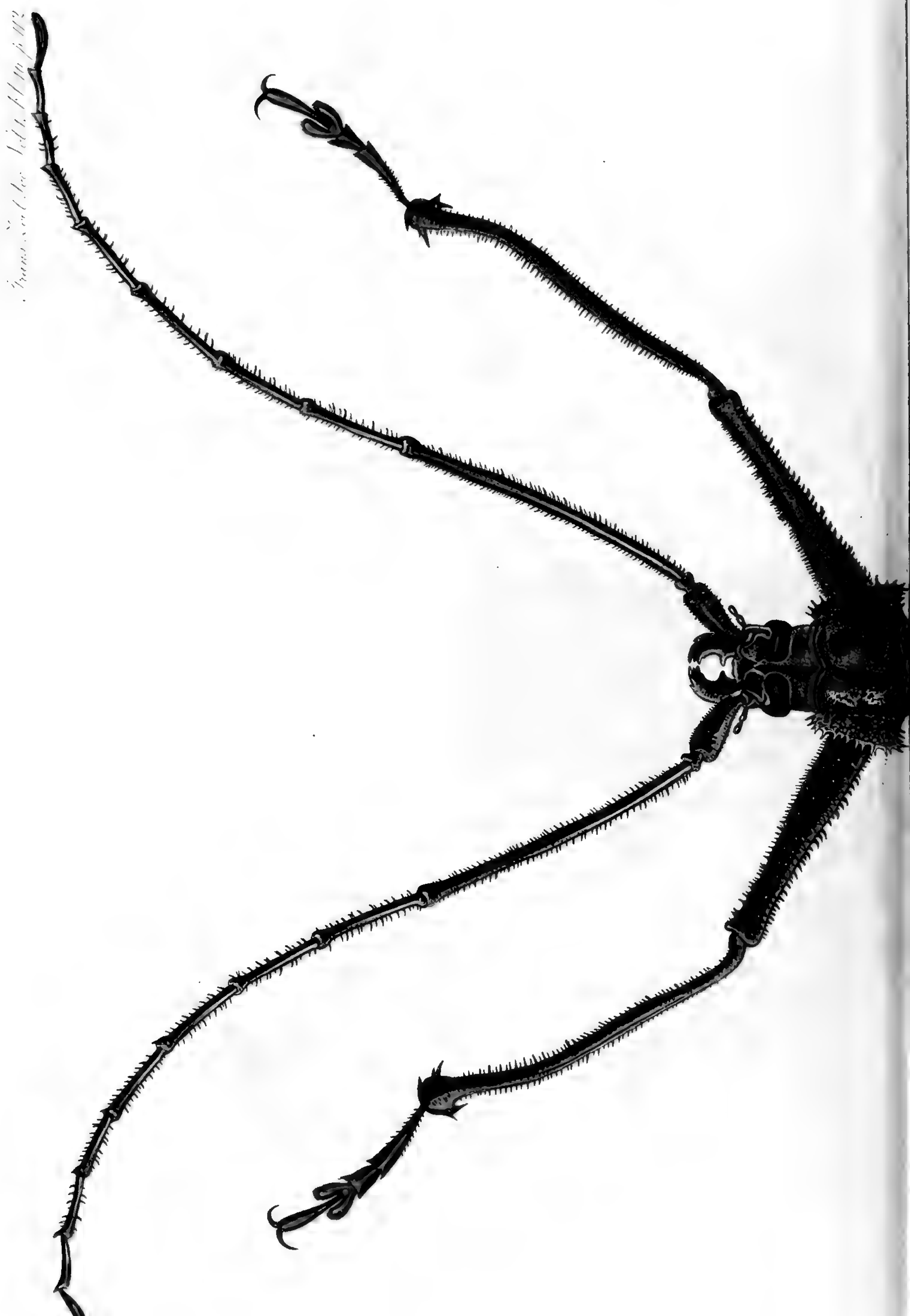


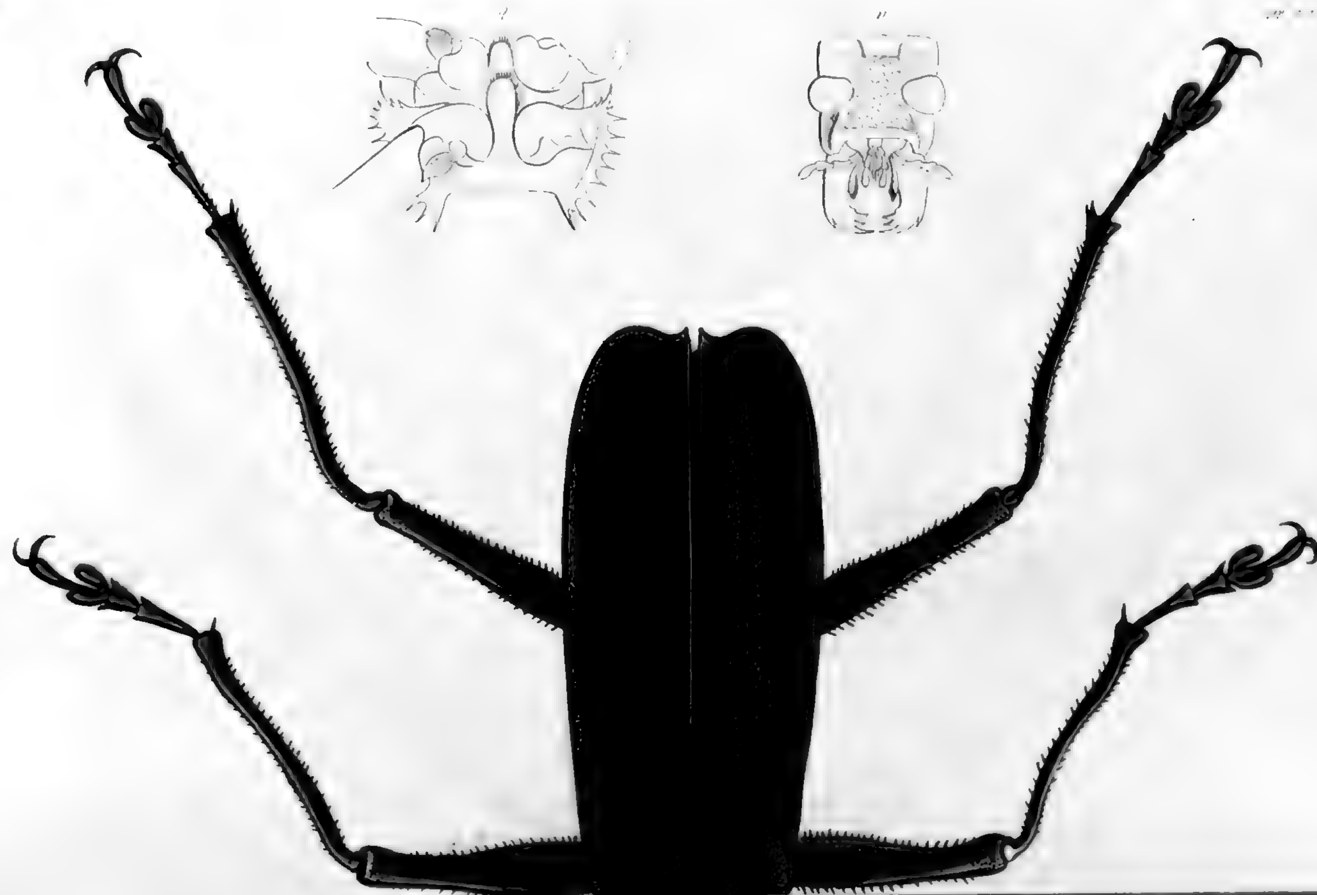


J. O. Westwood F.L.S. del

1. Coptorhina Africana. 2. Lucanus cantor. 3. Pholidotus cruciatus. 4. Actinus imperialis.
5. Syprops chrysophthalmus. 6. Leucantha Rhinotioides. 7. Pausus Curingi.







XII. *Observations on the Neck of the* Three-toed Sloth, Bradypus tridactylus, *Linn.* *By* THOMAS BELL, *Esq., F.R.S., L.S., G.S., & Z.S.*

Communicated August 13, 1833.

THE laws which regulate the numerical variations in the different systems of organs in animals, are perhaps less defined, or at least less understood, than those which relate to many other conditions of their existence. In some cases, indeed, these variations appear to be wholly anomalous; but in others the normal number of parts is so strictly adhered to, as to be absolutely without any known exception in a whole group.

Amongst these, one of the most obvious and remarkable is the restriction of the cervical *vertebræ* in the whole of the class of *mammiferous animals*, to the number seven. That this number should be found equally in the short interval between the *cranium* and the *thorax*, scarcely deserving the name of a neck, which we see in the *Cetacea*, and in the long flexile neck of the *Camel* and the *Giraffe*, is indeed a striking and interesting fact, and may be viewed as an important illustration of that law which provides for the most considerable variations in the offices or functions of a part, rather by a modification, in form or size, or even situation, of organs already existing and essential to the type of the group, than by the production of new organs on the one hand, or, on the other, by the abstraction of any which appertain to the normal form.

To this normal number, however, the *Aï*, *Bradypus tridactylus*, Linn., has for many years been considered as an exception; as by the examination of numerous specimens, the neck was found to possess nine *vertebræ*, which were all believed to belong to the cervical class.

An isolated exception to a rule so general, and obtaining in cases of such diversified forms as those to which I have alluded, presents itself to the mind of every one accustomed to look at the general harmony of the established laws of formation, as a violation of that unity of design which constitutes one of the most interesting objects of our investigation, especially as the exception itself is abrupt and sudden, and without any of those intermediate gradations of structure by which the mind is prepared, as it were, for considerable diversities of form, and which so generally soften the transitions which the different offices of the same organ in different groups may render necessary. It was from this consideration, rather than as merely correcting a generally received error, that I found, with feelings of no ordinary satisfaction, that in truth this numerical law is not departed from in the present instance, and that the animal in question forms no such exception to the general rule as had been asserted; the two *vertebræ* which have hitherto been considered as the eighth and ninth cervical, being in fact the first and second dorsal, each of them bearing a pair of rudimentary ribs, moveably articulated to their transverse processes by a true articular surface. This fact I have ascertained by the examination of two skeletons in my possession, one of which is an adult, and is artificially articulated, the other very young, and preserved as a natural skeleton in spirit.

In the adult animal we find the eighth and ninth *vertebræ*, which I shall now call the first and second dorsal, having the transverse processes longer and narrower than those of the cervical, and each terminated with a perfect articular surface, which is slightly depressed; and to these are attached the heads of the rudimentary ribs just mentioned. The first of these rudiments is small and slender, about $\frac{4}{10}$ths of an inch in length, having a distinct rounded head at the articular extremity, becoming then abruptly smaller, and tapering to the *apex*. The second is considerably larger, and assumes more of the character of a short rib. It is about 6 lines in length, and nearly 2 in breadth. Its head is oblong and rounded, and there is a tubercle on the upper and anterior side. Towards the extremity it becomes broader and flatter, with an excavated surface inwards, and a convex rough prominence on the outer side, apparently the point of muscular attachment. Immediately behind and beneath the head of the bone is a minute *foramen* for the passage of intercostal vessels.

The character of the transverse processes of these two *vertebræ* differs very materially, as might be expected, from that of the true cervical. In the superior *vertebræ* this process is transverse and slightly bifid. In the seventh cervical it stands obliquely forwards, and the *apex* is broad and oblong. In the first dorsal each transverse process is completely divided into an anterior flattened process, which is turned forwards, and a true lateral or transverse one, which supports the little rudimentary rib. The transverse process is smaller, but considerably longer than those of the true cervical, and stands more in a lateral or transverse direction. In the second dorsal *vertebra* the anterior processes do not exist, and the body assumes the form of the succeeding ones. The transverse processes are simple and obtuse, and the articular surface is slightly excavated.

In the natural skeleton to which I have referred, the rudimentary ribs are very obvious, though, from the early age of the subject, they are of course much smaller than in the former. The first, indeed, consists only of a minute particle of bone, not much larger than a pin's head, but connected with the *vertebra* by a capsular ligament, and perfectly moveable; the second is of more considerable size, and, like the former, has its capsular ligament inclosing its head, and holding it on to the articular cavity of the transverse process of the *vertebra*.

Cuvier appears to have seen the moveable costal rudiment in the young animal; he has, however, evidently confounded it with the long transverse process in the adult, and has wholly passed over the obvious analogy which I have here endeavoured to trace. He says, "Les apophyses transverses du cou sont courtes, larges au bout, qui est oblique, se baissant un peu en avant, et y rentrant un peu en dedans. La huitième a la sienne un peu fourchue. La neuvième l'a prolongée en une petite pointe qui se porte en avant et en dehors. Dans le jeune individu cette partie n'est pas soudée à la vertèbre ; seroit-ce un petit vestige de côte ?"[1]

In the second edition of the 'Règne Animal' occurs the following observation, showing what were the latest views of Cuvier on this subject. "C'est le seul mammifère connu jusqu'à ce jour qui ait neuf vertèbres cervicales."[2]

The nearest approach which has hitherto been made to the true bearing of the fact, is contained in the following passage from Meckel. Speaking of the points of ossification or *nuclei* in the cervical *vertebræ*, he says, "In the last are found a fourth and a fifth [*nucleus*], constituting, as it were, rudiments of ribs, projecting from the sides. In *Man* this elongated bone forms the anterior root of the transverse process, and extends from the body to the posterior root of that process. In the *Aï* a very considerable bony *nucleus* is articulated by means of a broad cartilage to the end of the transverse process of the ninth cervical *vertebra* ; by means of which this *vertebra* becomes suddenly much broader than the rest. In the other *Mammalia* which I have examined, this bony *nucleus* is wanting. It is remarkable that in the *Aï* an analogous but much smaller bony *nucleus* is found attached to the same situation in the eighth cervical *vertebra* ; so far as this goes, these two *vertebræ* become similar to dorsal, and thereby the exception which the *Aï* makes in this particular to other *Mammalia* is lessened."[3]

From this passage it is evident that Meckel still considered the two *vertebræ* in question to be truly cervical, though approaching to the character of dorsal *vertebræ*. The fact, however, that the rudimentary ribs remain permanently moveable, of which it would appear that both Cuvier and Meckel were ignorant, at once proves that these *vertebræ* are not only approaching to the dorsal form, but are essentially dorsal, if it be a true character of a rib, as distinguished from a transverse process, that it is permanently moveable. This is a question certainly of considerable interest, but one into which it is not necessary on the present occasion to enter, as the fact of the permanent mobility of the rudimentary ribs in the *Aï*, the perfect construction of the capsular ligament, and the cartilaginous surfaces of the joint are sufficient, joined with the existence of a *foramen* for the passage of vessels and other circumstances in their structure and situation, to establish their character beyond all doubt. The rule therefore which assigns seven cervical *vertebræ* to the whole of the *Mammalia*, is thus left without a single exception.

The interesting paper of Professor Buckland on the habits of the *Sloth*, lately read at the Linnean Society, precludes the necessity of my entering into any lengthened speculations on the utility of this singular structure ; I may, however, remark, that the fact

[1] Ossemens Foss., tom. v. p. 83.
[2] Règne Anim., (ed. 2.) tom. i. p. 252.
[3] Syst. der Vergleich. Anat., B. ii. pl. 2. p. 294.

that these *vertebræ* are dorsal instead of cervical, does not in the least affect the question of their office. The object of the increased number of *vertebræ* in the neck is evidently to allow of a more extensive rotation of the head; for as each of the bones turns to a small extent upon the succeeding one, it is clear that the degree of rotation of the extreme point will be in proportion to the number of moveable pieces in the whole series. When the habits of this extraordinary animal are considered, hanging, as it does, suspended from the under surface of boughs with the back downwards, it is obvious that the only means by which it could look down towards the ground must be by rotation of the neck; and as it was necessary, in order to effect this without diminishing the firmness of the cervical portion of the vertebral column, to add certain moveable points to the number possessed by the rest of the class, the necessary additional motion was acquired by modifying the two superior dorsal *vertebræ*, and giving them the office of cervical, rather than by infringing a rule which is thus preserved entire, without a single known exception.

PLATE XVII.

Fig. 1. The two last cervical and four first dorsal *vertebræ* of *Bradypus tridactylus*. *a*. the first rudimentary rib; *b*. the second rudimentary rib.

Figg. 2 and 3. The two rudimentary ribs enlarged to three times their natural magnitude.

Fig 1

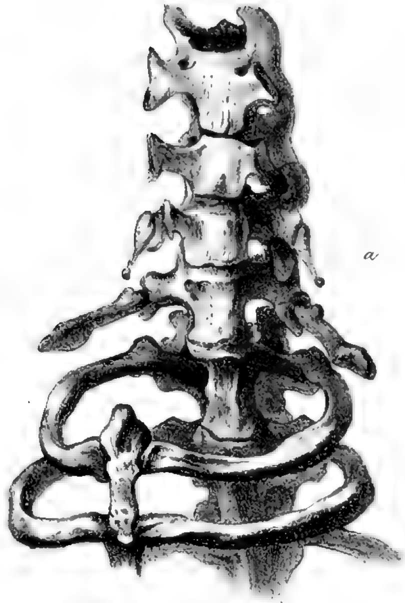
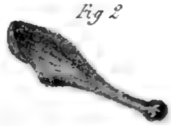


Fig 3

Fig 2



Jane S Bell del.

Bradypus tridactylus

XIII. *On the Anatomy of the* concave Hornbill, Buceros cavatus, *Lath.* *By* Richard Owen, *Esq.*, *F.Z.S.*, *Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated August 27, 1833.

The bird on which the following observations were made had been exhibited at the Society's Gardens for about eight weeks, and died on the 15th of August last. It had attained nearly its full size, but had neither the plumage nor the configuration of the bill which characterize the adult; the large quill-feathers of the wing and tail were in progress of development, while the warm and downy covering which defends the young bird had been in great measure lost by moulting: its death may therefore be attributed to the exhaustion consequent on the unfavourable circumstances, as to climate and captivity, in which it was placed, while undergoing a process so extensive and important in its economy as the acquisition of the adult plumage.

It measured from the end of the bill to the vent 2 feet 2 inches; the length of the bill was 7 inches.

On the mandibles being separated the tongue is seen at the back part of the mouth; its tip being 6 inches distant from the extremity of the jaws. It is of a triangular form, with the posterior angles produced backwards on either side of the laryngeal aperture; measuring in length 1 inch, and in breadth at the base 8 lines. Its *apex* and surface are smooth. In texture, in configuration and in size, it consequently differs considerably from that of the *Toucan*, in which bird the tongue can be protruded from the mouth, and from its peculiar structure is evidently adapted for more extensive and varied actions than in the *Hornbill*.

The air-cells are remarkably developed in the *Hornbill*. They may be observed extending along the under side to the extreme point of the bones of the wings. The entire neck is occupied by a large cell, in which the *œsophagus* and *trachea* are contained. The air-tube is connected throughout its whole length with the *œsophagus* by a duplicature of the membrane of the air-cell, resembling a mesentery. This duplicature varies in breadth from 1 to 2 inches, allowing a free motion of the *trachea* from side to side. The *nervi vagi*, the cervical arteries and veins, and the *œsophagus*, are as clearly exposed by the simple opening of this air-cell, as if they had been displayed by an elaborate dissection. At the upper part of the neck the cervical air-cell communicates with others, partly surrounding the joint of the lower jaw and continued into the interior of that bone, and extending also to the back of the *occiput* to communicate with the *cranium* and cellular structure of the superior mandible.

The *œsophagus*, when inflated, is 1 inch in diameter, and is continued, as in the *Toucan*, of nearly the same width to the gizzard. Two inches of its termination are occupied by the zone of gastric glands, composed of two closely aggregated oval groups which are continuous with each other. The glands are simple cylindrical follicles, about a line and a half in length.

The gizzard is thicker in its coats, and of a more elongated form than in the *Toucan*. It measured, when distended with fluid after death, $2\frac{1}{4}$ inches in length, and $1\frac{1}{2}$ in its greatest diameter. Its cuticular lining is very tough, and disposed in longitudinal ridges. The muscular coat is 3 lines in thickness at the middle of the gizzard, but this thickness does not prevail over more than a third part of the cavity; the rest of this tunic is less than a line in thickness.

The duodenal fold extends 7 inches from the *pylorus*. The remainder of the intestinal canal is disposed in two similar folds, and then extends along the middle line of the back part of the *abdomen* to the *cloaca*. There are no *cæca*. The coats of the intestinal canal are stronger than is usual in *Birds*, and the diameter more considerable. The *ileum* at its commencement measures 2 inches 2 lines in circumference: it gradually narrows to the commencement of the straight portion, or *rectum*, which again becomes wider to its termination.

The whole length of the intestinal canal is 5 feet.

The *villi* are very long and numerous, but diminish in both respects as they approach the *rectum*, where they degenerate into small obtuse *papillæ*. A great part of the lining membrane appeared to have been in a state of subacute inflammation.

The liver is composed, as usual, of two lobes, the right being the larger. The duct of the right lobe emerges from the right side of the transverse portal fissure, and becomes attached to the *fundus* of the gall-bladder; after running upon it for half an inch it receives the cystic duct by an oblique aperture directed downwards or distad. The common or cyst-hepatic duct then passes onwards, and terminates in the *duodenum* at the extremity of its fold, 14 inches from the *pylorus*. The duct of the left lobe of the liver terminates separately in the *duodenum* about half an inch from the preceding. The gall-bladder is $1\frac{2}{3}$ inch long, and 1 inch in diameter.

The *pancreas* commences from the lower end of the spleen by a small oval enlargement, which soon contracts to the size of a crow-quill. This attenuated portion of the gland passes down within the duodenal fold, gradually enlarging, and terminates in a flattened oblong mass, forming the head of the *pancreas*: from this part a second elongated lobe is continued upwards, ascending along the opposite side of the fold of the *duodenum* to within an inch of the *pylorus*. The *pancreas* is thus seen to correspond with the form of the *duodenum*, being, as it were, similarly folded upon itself; but not occupying the whole fold of the *duodenum*. Its secretion is conveyed into the intestine by three ducts, one from the head of the *pancreas*, which enters the *duodenum* at the bend of the fold; and a second and third from the elongated lobes, which ducts terminate close together at the end of the fold between the insertions of the hepatic ducts. On referring to the table of the insertions of these ducts in Cuvier's 'Anatomie Comparée'[1], the arrangement in the *Hornbill* will be found to correspond with that in the *Heron* there given, and may be expressed thus: 1st p. — H. — 2nd and 3rd p. — C. H.

The spleen is situated at the right side of the upper end of the gizzard.

The *trachea* has a single pair of muscles.

The heart and kidneys present the usual peculiarities of the class.

The ureters emerge from the inner side of the lower end of the third lobe. Where they emerge, a large vein from the tail enters a deep groove, which continues along the inner sides of each lobe, receiving the renal veins by large orifices. A vein from the posterior extremity enters the third lobe on its outer aspect, and ramifies in the gland. This I conclude to be the vein from which, as Jacobson has shown, the urine is in part secreted.

The supra-renal glands, of the usual bright yellow colour, are closely attached to the coats of the inferior *vena cava*. The *testes* are situated anterior to the above glands, and were of minute size, not exceeding that of a grain of rice.

On laying open the *cloaca* anteriorly, the division into which the ureters open, or rudimentary bladder, is seen to be formed by two transverse semilunar folds about a line in breadth, and gradually lost on the anterior part of the *rectum*. The space between these ridges is little more than a line. The *bursa Fabricii* (which I regard as analogous to the anal glandular scent organs of the *Mammalia*,) opens into the back part of the outer vestibule. It is of a triangular form, two thirds of an inch in length, and is surrounded by a capsule of muscular fibres. The common vestibule is half an inch in length; and closed as usual by a strong sphincter.

The mechanism by which the movements of the immense mandibles of this singular bird are effected, was next examined. The *os quadratum* and the other bones forming the articulation of the jaws, are accurately described by Cuvier[2]. The *digastricus*, or its analogue, which in *Birds* has no middle tendon, arises from the whole occipital depression, and descends vertically to be inserted into the angle of the lower jaw, which projects posteriorly to the articulation. We occasionally find a similar simple disposition in the *Mammalia*, even in the *Orang Utan*.

The temporal muscle does not exceed half an inch in breadth; it arises from the temporal *fossa*, passes within the *zygoma*, and is inserted into the slightly developed coronoid process immediately anterior to the articulation. The *pterygoidei externi* and *interni* are proportionately more developed than the *temporalis*: they assist that muscle in closing the bill, whilst they draw the inferior mandible forwards, and perform the lateral motions: these and the muscles of the *os quadratum* have the usual attachments. A strong ligament occupies the place of the *masseter*; it passes from the *zygoma* to the outer side of the condyle of the lower jaw, immediately in front of the

[1] Tom. iv. p. 55.

[2] Anat. Comp., tom. iii. pp. 63, 64.

quadrato-maxillary articulation; and would at all times, when not drawn over the centre of motion by the backward movement of the lower jaw, contribute materially to support that part, and relieve the temporal muscle. Another strong ligament is destined to prevent dislocation backwards; its origin from the *zygoma* is concealed by the preceding; it passes directly backwards to the posterior part of the condyle, or articular depression, of the lower jaw.

On contemplating the maxillary muscles *in situ*, the first impression that arises is surprise at the disproportion they seem to bear to the vast apparatus they have to move; but this disproportion is more apparent than real. The jaws, notwithstanding their magnitude, are rendered extremely light by the air-cells which are continued into them; their bony *parietes* do not exceed a line in thickness, except at the points, and the delicate columns by which these *parietes* are supported are themselves hollow. The disposition of these columns is remarkably beautiful; they are always perpendicular, or nearly so, to the part of the outer *parietes* in which they are implanted; and at the expanded base of the mandibles they radiate from a central cylinder, which is formed by a delicate osseous net-work; and thus while the requisite strength is gained, lightness is combined with magnitude. With respect to the attachments of the muscles, we may conclude that any apparent disadvantage in their insertion is sufficiently compensated by the superior energy of contraction with which the muscular fibres of birds are endowed.

The bones and muscles of the cervical region of the spine have, however, an obvious adaptation in their development to the bulk of the entire head.

The apparatus for flight[1] is more perfect than in the *Toucan*. The clavicles, which are separate in that bird, are here joined, forming a complete *furculum*, which, however, is slender, being about a line in thickness at the junction. The *sternum* has two notches posteriorly, one on either side the keel, as in the *Corvidæ*, but they are shallower than even in that tribe: the greatest depth of its keel is an inch; the inferior margin of this part forms an almost straight line, and is not expanded laterally.

I have already alluded to the extension of the air-cells among the soft parts; and on an examination of the skeleton it appears that every bone, from the mandibles to the last of the coccygeal *vertebræ*, from the clavicles and *scapulæ* to the last *phalanx* of the wings, from the *femora* to the last joint of the toes, and even every rib, is permeated by air.

On comparing the anatomy of the *Hornbill* with that of the *Toucan*, we find a close resemblance in the structure of those organs which relate to the assimilation of nutriment. In both birds a simple gullet corresponds in its diameter with the capacity of the beak; the *proventriculus* and gizzard in both equally manifest their adaptation to an omnivorous diet, the latter being neither so membranous as in the carnivorous birds, nor so muscular as in the granivorous. The short but ample intestines deprived of

[1] The noise of this action is heard from a considerable distance.

cæca, appear to be adapted only for birds which, like the *Hornbill* and *Toucan*, live in the midst of plenty, and can select their food from both kingdoms of organized nature, so abundant and so prolific in a tropical clime.

With respect to the differences observable between these remarkable genera, the principal instances are met with in the locomotive organs; and their affinities to other tribes, indicated by the obvious modifications of these parts, are confirmed by the differences observable in the internal organs. The *Toucan* resembles the *Psittacidæ* and other *Scansores* in the absence of a gall-bladder, while the *Hornbill*, in the capacity of that receptacle, manifests its affinity to the *Corvidæ*. I may also observe, that the same disposition of the intestinal canal in long and narrow loops, is met with in the *Raven* as in the *Hornbill*. It is well known that in treating of the modifications of the tongue in *Birds*, comparative anatomists derive their most remarkable examples from the *Scansorial* order: its superior organization for the sense of taste, from the *Psittacidæ*; its remarkable structure as an organ of prehension, from the *Picidæ*; and a third modification, equally curious, is presented by the *Toucan*, although the purposes for which this structure is adapted are less understood. The *Hornbill*, however, in the simplicity of this organ, resembles the carnivorous birds.

The individual from which the preceding description was taken, was fed at the Gardens with small birds, mice, and pulpy fruits; but it showed a decided preference for the animal diet, and would leave any kind of food if a dead mouse was thrown to it. This, after two or three squeezes with the beak, was gorged entire. It was never seen to regurgitate any castings; but I once observed it bring up repeatedly a portion of apple, which it endeavoured to crush with the points of the mandibles, and then again swallowed. Petiver gives direct testimony as to its regurgitating habits, for which, as in the *Toucan*, the structure of the *œsophagus* is well adapted. "Calao *vel* Cagao *Indorum*, Volucris & Montana est *Avis*, vivens fructibus *Baliti* s. ficûs Ind. Sylv. *Pilis*, s. Amygdalo-Pistaceis, Volvuli *Colyat*, et aliis, quos integros ingurgitat; confecto verò cortice carnoso, putamina ossea illæsis nucleis egerit."[1] In sleeping, the bill is not disposed as ordinarily beneath the wing, but lies along the middle of the back with its point directed forwards, the cervical *vertebræ* being acutely bent upon the dorsal: the *Pelican* disposes in a similar manner of its huge beak when asleep. The part of the wings corresponding to the carpal joints overlap and defend the bill from cold.

The *Hornbill* accommodates its habits and diet to the country in which it lives; being frugivorous in the Tropics, and feeding, like the *Vultures* and *Crows*, on carrion in the desert plains of Abyssinia. We are told by MM. Quoy and Gaimard, that in the Papou Islands the *Hornbill* sits on the summit of the Nutmeg-tree, and with its large beak seizes the fruit, and swallows it entire. The length and wedge-like form of the mandibles are well adapted for pushing through thick and interwoven foliage without endangering the eyes and other soft parts about the head. I should consider

[1] Phil. Trans., vol. xxiii. p. 1394.

the beak, both from its form and size, and from the disposition of the articular ligaments, to be more especially destined to overcome the resistance offered to its progress in the last-mentioned action, which the *Hornbills* must often be stimulated to practise, both to reach fruit, and, like the *Toucans* of South America, to get at the eggs and callow young of other birds: and it is highly probable that these singular genera perform in the continents which they inhabit the same office of restraining the increase of the smaller frugivorous birds, which the *Jays* and *Pies* do in more temperate climes, but in a manner more effectual, inasmuch as they are better provided with the means of penetrating to the retreats and hiding-places selected for the purposes of nidification.

PLATE XVIII.

Fig. 1. Posterior view of the biliary and pancreatic organs of the *concave Hornbill*. *a. œsophagus*; *b. proventriculus*; *c.* gizzard; *d. d.* duodenal fold; *e.* left, *é.* right, lobe of the liver; *f.* gall-bladder; *g.* right hepatic duct; *h.* termination of the cystic duct; *i.* cyst-hepatic duct; *k.* left hepatic duct; *l. l. pancreas*; *m. m. m.* pancreatic ducts; *n.* spleen, drawn aside.

Fig. 2. Gastric glands. *a.* a section of one, magnified.

Fig. 3. *a.* fold at the termination of the *rectum*; *b.* rudimentary urinary bladder; *c.* vestibule; *d.* orifice of the *bursa Fabricii.*

Fig. 4. Posterior view of the *cloaca*; *a. bursa Fabricii.*

Fig. 5. Outline of the *cranium* (young), two thirds of the natural size. *a.* the temporal muscle which closes the bill; *b.* the analogue of the *digastricus* of *Mammalia* which opens the bill; *c.* a ligament which assists in supporting the lower mandible; *d.* a ligament which prevents dislocation backwards.

Owen del G Scharf lithog

Printed by C Hullmandel.

Buceros cavatus

XIV. *Description of a New Genus of* Acanthopterygian Fishes. *By the Rev.* R. T. Lowe, *B.A.*, *Corr. Memb. Z.S.* (In a Letter to the Secretary.)

Communicated August 27, 1833.

My dear Bennett,

I HAVE been so fortunate as to procure a second specimen, this year, of my *Alepisaurus*. It was captured off the town in the bay on the 21st of May by some fishermen, and appears, by its violence and ferocity when taken into the boat, to have well substantiated its title to the specific appellation I had before given it. I owe to the kind attention of my friend G. B. Leacock, Esq., both the acquisition of the specimen, and an opportunity of seeing it very shortly after death, while still perfectly fresh, and with the colours unchanged and vivid. Though it has suffered considerable injury from the blows the fishermen affirm they were obliged to inflict in self-defence,—for it attacked them furiously when pulled into the boat,—the dorsal fin was fortunately in such good condition, as to enable me to correct a little inaccuracy as to this organ in my former sketch of last year. When first brought on shore, yet scarce dead, this fin remained for some time erect and completely extended, presenting a very fine appearance from the beautiful iridescent dark steel-blue hues of the connecting membrane. This last is of such extreme tenuity and delicacy, that in drying it very quickly loses all its beauty; and the rays are at the same time so long, and so strong in proportion, that it is susceptible of injury, when once out of the water, from almost the slightest touch. I do not feel, therefore, fully confident that the rays are really not prolonged beyond the membrane in the fish while living and perfectly uninjured; though such is my impression from an examination of the present specimen apart from other considerations.

I am indebted to the able pencil of Miss Young for the beautiful coloured drawing which accompanies my letter, taken from this specimen, while fresh, in its general tints, and reduced to one sixth the natural size, from measurements made by myself. The injured parts, chiefly the anal fin and the lower jaw (in which some teeth were broken), are restored from a careful sketch taken last year by me from the former specimen now in the collection of the Zoological Society. The lobes of the tail are left unfinished; for in both specimens they were too much injured to decide whether they are properly rounded or pointed at the tips.

In the idea that the accompanying drawing well deserves a place in your Transactions, I subjoin the essential characters of this curious new genus, and remain, dear Bennett,

Yours ever sincerely,

Madera, June 23, 1833. R. T. Lowe.

Ordo. ACANTHOPTERYGII, *Cuv.*

Fam. VIII. Tænioides, *Cuv.*

Genus. Alepisaurus.

Rostrum productum, cum capite compressum: rictus magnus, pone oculos longè diductus: maxillæ dentibus uniseriatis, validis, subrecurvis, quibusdam prælongis, armatæ.

Corpus elongatum, attenuatum, cum capite omninò nudum.

Pinnæ dorsales duæ; prima alta, a nuchâ longè per dorsum producta; secunda parva, trigona, adiposa: *ventrales* parvæ, abdominales: *analis* parva, anticè alta: *caudalis* magna, furcata.

Membrana branchiostega sex- vel septem-radiata.

Alepisaurus ferox.

Hab. in Mari Atlantico, Maderam alluente, rarissimus.

This new and very singular genus appears, notwithstanding some anomalies, to belong to Cuvier's eighth family of *Acanthopterygian Fishes*, the *Poissons en ruban ou Tænioides*. In habit, shape of body, smoothness of skin, compressed head and muzzle, wide gape, and long formidable teeth,—which are both pointed and have their edges sharp and keen almost as lancets,—it approaches so near to *Lepidopus*, Gouan, or *Trichiurus*, Linn., that the propriety of its collocation in the same group seems unquestionable. Its relation of affinity thus established, a very remarkable one of analogy remains to be indicated; namely, its relation to the *Salmonidæ* in general by the small adipose second dorsal fin. A curious link of analogy hitherto unnoticed is thus supplied between an *Acanthopterygian* and a *Malacopterygian* group, in other respects so widely separated.

In respect to its relations of affinity, *Lepidopus* and *Trichiurus* are the only two genera from which any particular discrimination can be necessary. From the former it differs chiefly in the regularly well-formed and perfect, though rather small, ventral fins (which are placed far behind the pectorals, close before the *anus*), and in the smaller number of rays in the branchial membrane:—from *Trichiurus*, (with which it agrees in the number of branchial rays,) it differs by the presence of ventral fins, a regular and well-formed anal, and a large forked caudal fin. From both it is remarkably distinct in the large high first, and small fatty second dorsal fin.

It is a fierce, voracious fish, of very rare occurrence.

[The entire fish is destitute of scales, much elongated, thin, slender, and tapering from the gills both backwards and forwards. The head and face are produced, and measure one seventh of the total length: the height of the head is one half of its length. The head is compressed on the sides and flat above. Its upper surface is narrow, the breadth of the *cranium* behind the eyes being scarcely one fifth of its length: from behind the eyes it becomes gradually narrower as it advances forwards to the nose, which is almost pointed. This surface is irregularly striated by ridges of bone, covered only by a thin skin, which radiate on each side from a point above the orbit. At the junction of the upper surface with the flattened sides of the head a strong keel or ridge is formed. In the small space intervening between this keel and the orbit the bone is cavernous, forming at its lower part, just behind the eye, a remarkable prominence. From behind this prominence there pass downwards to near the angle of the mouth, a series of small bones, producing on the smooth skin the appearance of a double row of lengthened tubercles. The *præoperculum* is simple, forming a right angle with the upper line of the head. The *operculum* and *suboperculum* are strongly striated in a radiating manner. From the lower part of the series of small bones above noticed, the suborbital bones extend forwards to the nose in a narrow two-ridged line. The maxillary bone forms a line nearly parallel to the last; is situated, like it, beneath the skin; and borders the intermaxillary which constitutes the edge of the mouth.

The intermaxillary bone on each side is slender and slightly toothed throughout its whole length: the anterior teeth, about six in number, are conical and stronger than the remainder; those immediately succeeding are very small and very numerous; they are followed by others of a larger size (but smaller than the anterior ones), to the number of about one hundred and ten, forming a single series, and resembling the teeth of a fine saw. The palatine bones, extending forwards to the front of the mouth and lying immediately within the intermaxillaries, are armed with very large and powerful lancet-shaped teeth, all of which have their points directed backwards. The anterior of these teeth are the largest: they equal in length one sixth of the entire length of the head. Of these there remain two on one side and one on the other; and it is probable that their number has been two only on each side. Behind these, at an interval nearly equal to their length, succeed two teeth on each side, about half the size of the preceding. These are followed by six others of much smaller size, of which the anterior is the least; they gradually increase in size, and the last of them is about one third of the length of the tooth immediately preceding the series. The posterior unarmed portion of the palatine bone in advance of the gape is about one eighth of the length.

The lower jaw ceases to be armed nearly at the corresponding point. Its teeth, like those of the upper, are lancet-shaped. The anterior tooth is somewhat conical and is sharply pointed. It is succeeded by six others, of more compressed form, and of smaller size. These are followed by three large lancet-shaped teeth, increasing in size backwards, the hindermost equalling the largest of the two intermediate ones of the upper jaw. These three larger teeth correspond, when the mouth is closed, with the interval between the anterior and middle palatine teeth of the upper jaw: their points are equally directed backwards. A range of similarly shaped but much smaller teeth, to the number of eleven, immediately succeeds them.

The *vomer* is devoid of teeth.

The lower jaw is radiately striated externally from its angle: its plate is longitudinally striate: and oblique *striæ* occupy its lower part anteriorly.

The branchiostegous membrane is narrow and free: it is supported in one individual by six, and in the other by seven slender short rays. It opens forwards as far as the middle of the lower jaw.

The cheeks are covered with smooth skin.

The eye is very large; its diameter being one sixth of the length of the head, and more than one third of the depth at the part at which it is situated. It is placed midway between the nose and the extremity of the *operculum*, and close to the upper margin of the head.

The pectoral fins immediately adjoin the head, and almost equal it in length. They are placed so low down as to be nearly on the ventral surface. They have each at their base, externally and posteriorly, a small pouch. Their form is lengthened and acute, and somewhat falcate. Their rays are fifteen in number: of these the first is the longest. It is simple, compressed, and somewhat serrated along its anterior margin.

The first dorsal fin commences immediately over the edge of the *operculum*, and is continued for more than two thirds of the length of the body. It is very high, being at its middle, which nearly corresponds with the situation of the ventral fins, three times as high as the body at that part. Its outline is regularly rounded, the anterior ray being about one fourth of the greatest height, and the posterior gradually diminishing to less than one half of the length of the first. The termination of this fin corresponds with the commencement of the anal. The rays supporting it are forty one in number, and the whole of them are simple. They are comparatively slender, but appear to be also very brittle: they do not terminate in stiff points. The anterior ray is somewhat serrated along its front edge.

The second dorsal fin is placed midway between the termination of the first and the caudal. It is destitute of rays, and is entirely fatty. Its base is narrow, and it becomes much wider outwardly; its length at its external part exceeding its height. Its termination is a little anterior to the termination of the anal fin.

The caudal fin is very large and powerful. It is forked nearly to the base, and is supported by nineteen rays, of which ten are in the upper and nine in the lower division. Besides these there are numerous smaller rays both above and below, which do not reach to the extremity of the fork. The lobes are mutilated at the tips, but they must have exceeded one eighth of the total length of the fish.

The anal fin equals at its base one tenth of the total length. It is supported by seventeen rays, the three anterior of which are simple. The first seven exceed very considerably in length those which succeed them, and the fin at this point decreases suddenly in height; the remaining rays are all nearly of equal length with each other, and little more than one fourth of the length of the first ray.

The ventral fins are placed rather nearer to the pectoral than to the anal. They resemble the pectoral in form; but are not quite one half of their length. Each is supported by nine rays, the first of which is simple and slightly scabrous.

The *anus* is situated a short distance behind the ventral fins, and is exactly intermediate between the pectoral and the commencement of the anal.

The lateral line commences near the base of the anterior ray of the first dorsal fin; descends gradually to the middle of the side; and is continued to the base of the caudal fin. Its hinder portion, and consequently the tail, is destitute of any particular armour.

The above description is taken from the specimen first captured, which is now in the Museum of the Zoological Society, with occasional reference to the second specimen (the one figured) for parts which are in the other more or less mutilated. The length of the original specimen, which is somewhat the largest, is nearly 5 feet.

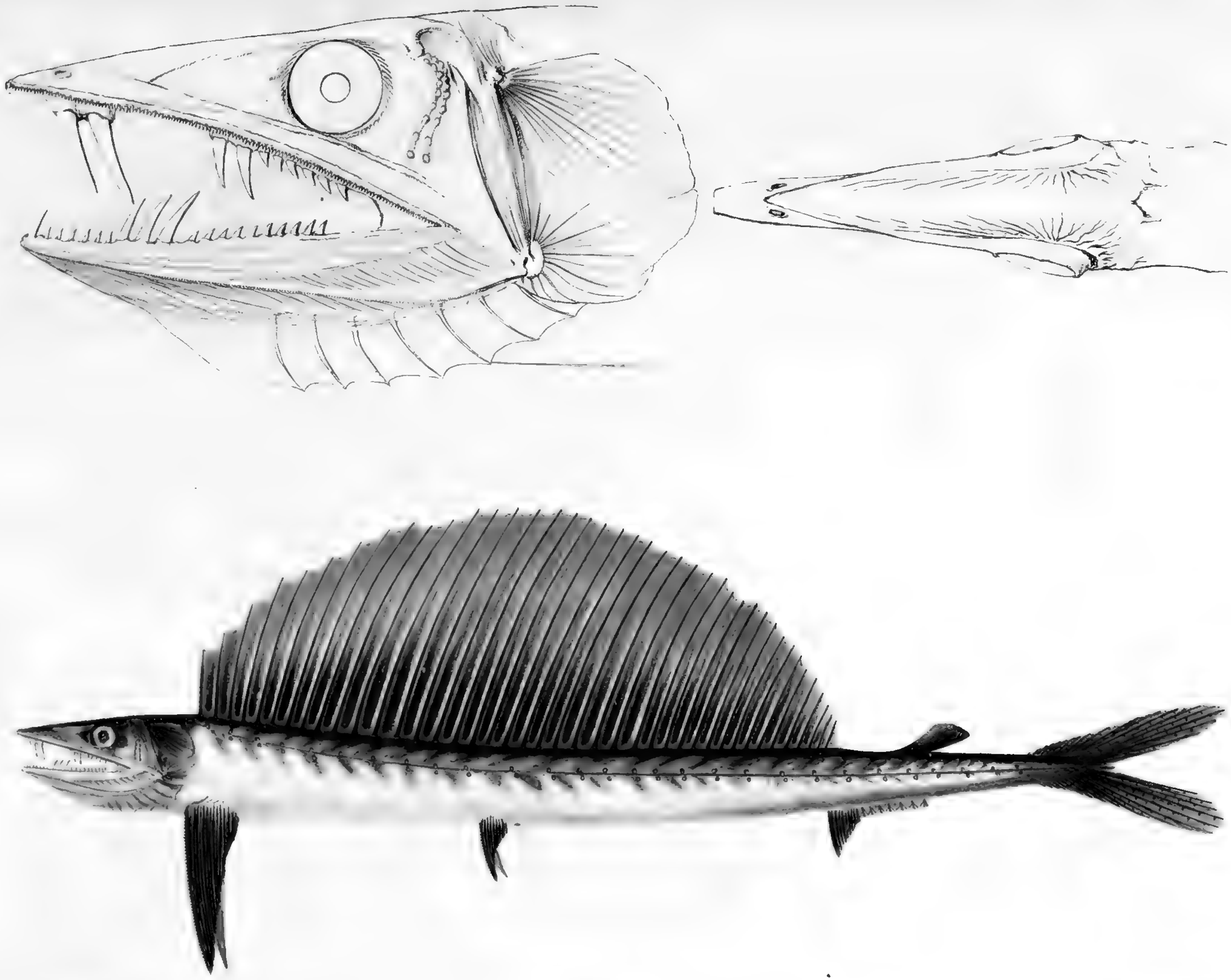
Between the two individuals there are some differences in the number of the teeth, which it is desirable to mention. The posterior series of palatine teeth, which in one consists of six, is extended in the other to eight on each side; and in this latter specimen there is, on one side, a single small tooth remaining in the hinder portion of the palatine bone which in the first is altogether unarmed. In the lower jaw of this second individual the number of the smaller teeth immediately succeeding the anterior one is also greater than in the first, the series consisting of nine, instead of six, on each side. These differences may be regarded as of minor importance, and as probably dependent on the accidental removal of some of the teeth, to which (from their extremely penetrating character and retral direction) these organs must be peculiarly liable in a fish of such ferocious habits.

A second difference between these individuals has been already mentioned in the description: it seems, however, deserving of more formal notice, as it has hitherto been generally considered by ichthyologists that the number of the rays of the branchiostegous membrane might be regarded as offering a fixed character, even in a natural genus: its fixity in a species ought consequently to be looked upon as altogether unquestionable. In the present instance, however, the number differs in the only two specimens yet seen. In one there are six, and in the other seven, rays of the branchiostegous membrane. On comparison of the specimens it would seem that in the one which has the smallest number of rays, the deficiency occurs among the anterior of them, the extent of the membrane supported by its first two rays being about equal to that which is supported in the other by three. The occurrence is probably to be regarded in the light of a monstrosity merely.—E. T. B.]

PLATE XIX.

Alepisaurus ferox, one sixth of the natural size.

Fig. 1. Head, seen laterally, one half of the natural size.
2. Head, seen from above, reduced similarly with Fig. 1.



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Alepisaurus ferox

XV. *On the Anatomy of the* Cheetah, Felis jubata, *Schreb.* *By* Richard Owen, *Esq., F.Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated September 10, 1833.

NATURALE, si ullum, genus felinum est, is the expression of Hermann when about to enter upon the relations of this group in his 'Affinitates Animalium'; and yet the number of species which were then known was very considerable. Forster[1], who had ascertained the existence of twenty one distinct species of the *feline Carnivora,* attempted to arrange them in three subdivisions; but the characters which he selected for that purpose were too artificial to ensure their adoption. Thus, for example, he associated the *Cheetah,* the subject of the present communication, with the *Lion,* on all hands acknowledged to be the type of the genus, and to manifest the peculiarities of the feline structure in the highest and noblest degree: but if we trace the deviations from this type as manifested by the gradual weakening of the legs and feet, and the deterioration of the claws as destructive and prehensile weapons, the *Cheetah* will be furthest removed from the *Lion.* If, on the other hand, we consider the deviation from the same type in the form of the ears, in the form of the pupil, and in the proportions of the tail, the *Lynces* of Forster are farther removed than the *Cheetah,* and indicate in these particulars the passage to the *Genets.*

In their internal structure the differences of the *Feles* one from another are less easily appreciable than in their outward form. Perhaps the most marked among the anatomical variations obtains in the mode of attachment of the *os hyoides* to the *cranium*; and this difference is evinced in the living animal by a difference in the variety and power of the voice. In the *Lion* an elastic ligament, about 6 inches in length, connects on each side the lesser *cornu* of the *os hyoides* with the styloid process: the ligament can be stretched to 8 or 9 inches. The *larynx* is consequently situated at a considerable distance from the posterior margin of the bony palate; but the soft palate is prolonged backwards to opposite the aperture of the *glottis,* and the tongue is proportionately increased in length; thus a gradually expanding passage leads from the *glottis,* where the air is rendered sonorous, to the mouth; and it is not unlikely that the strong transverse ridges upon the bony palate may contribute, with the preceding trumpet-like structure, to give to the voice that intonation which is so aptly denominated "the roar of the lion."

[1] Phil. Trans., vol. lxxi. p. 1.

In the *domestic Cat*, in *Felis planiceps*, Vig. and Horsf., and in *Felis Caracal*, Schreb., the *os hyoides* is connected to the *cranium*, as in the *Genet* and the *Dog*, by an uninterrupted chain of bones: this structure, indeed, has afforded Professor Geoffroy one of his illustrations of the essential composition of an *os hyoides*. The same structure obtains in the *Cheetah*. From the difference in the voice, the feline animals might have been expected, *à priori*, to present some differences in that part of their anatomy which relates to it.

A vertical elliptic pupil (which is so well calculated to exclude a too strong light from a *retina* adapted to crepuscular vision, and at the same time to admit of a rapid and sufficient expansion for the exercise of sight in the gloom of the evening,) is that form which is met with in all the smaller and weaker species of the feline genus: but in the more powerful and bolder species, which dare to attack a larger prey in the face of day, the pupil is of a circular form. The *Cheetah* agrees in this respect with the *Lion*, the *Tiger*, the *Leopard*, and the *Jaguar*; and, from its natural docility and habits, may be regarded as the most strictly diurnal of the whole genus.

The soft parts of living prey forming the food of the whole tribe, a consequent correspondence prevails in the structure of the digestive organs. The *œsophagus* is remarkable for its width and its loose mode of connexion in the chest, both of which facilitate the passage of the coarsely divided flesh. The lower half of this tube is characterized by transverse *rugæ*; and the muscular fibres, which are at first disposed spirally,—the two layers in opposite directions,—assume at this part a disposition analogous to that in the human subject, the outer layer being longitudinal, the inner one transverse. I have also discovered at this part of the *œsophagus* a third layer of muscular fibres, which is longitudinal, and more internal than the transverse: this layer does not extend beyond that part of the *œsophagus* in which the transverse *rugæ* of the lining membrane exist; and as it adheres closely to the membrane, I am inclined to believe that it produces the rugous disposition peculiar to that part: a preparation demonstrating this muscular layer in the *Lion*, is in the Museum of the College of Surgeons. A similar structure exists in the *Cheetah*.

The *œsophagus* is not prolonged into the *abdomen* in any of the feline tribe, but terminates at once in the stomach. This *viscus*, compared with the human stomach, presents a less extent of the left blind extremity, or *saccus cæcus* of Haller; the pyloric half is more tubular, and is more abruptly bent upon the cardiac; the lining membrane presents fewer *rugæ*; and the disposition of these, when the stomach is contracted, is more regularly in the longitudinal direction. But the most marked characteristic of the feline stomach is the mode in which the lesser *omentum* is continued upon it: this duplicature is not attached in a regular line to the lesser curvature, but extends in a scolloped form upon the anterior surface, upon which the branches of the coronary artery are further continued before penetrating the muscular coat. The *Cheetah* agrees in all these particulars with the rest of the genus; but as far as I could judge of the form of the stomach, which had been laid open, it was narrower, longer, and less bent upon itself than in the *Lion*. The *duodenum* has an entire investment of *peritoneum* throughout its whole course, and makes a gentle sweep or curve before passing behind the root of the mesentery. The *cæcum* and large intestines have also a looser connexion to the abdominal *parietes* than in man, so that it is difficult to assign a precise situation to the *cæcum*. The whole intestinal canal varies in its proportion to the length of the body from twice to four times, being, so far as I know, longest in the *Lion*, and shortest in the *Lynx*: in the *Cheetah* it measures 10 feet 3 inches, the length of the small intestines being 8 feet, of the large 2 feet 3 inches, and that of the *cæcum* $1\frac{1}{4}$ inch. The large intestines in all the *Feles* are about two thirds of the length of the body, exclusive of the tail. In the *Genets*, the *Civets*, and the *Suricate*, they are much shorter. In the *Dog* the *cæcum* is convoluted, and the large intestine equals or exceeds the length of the body: but in the *Cheetah* the *cæcum* is simple and the *colon* short, as in the rest of the genus *Felis*[1]. Two round follicles open within the verge of the *anus*; the diameter of each is about an inch. The *anus* is retracted and protruded by two muscles, one arising from the middle of the *os sacrum*, and inserted into the sides of the *anus*; the other coming from the third and fourth caudal *vertebræ*, and passing forwards to expand on the posterior surface of the *rectum*. This structure I believe to be common to the *Cat* tribe, but do not know how far it is peculiar to them.

The liver in all the *Cat* tribe is composed of four principal divisions: a left lobe, which is entire; a middle or cystic division, which is deeply cleft in two places, the left fissure containing the coronary ligament, the right the gall-bladder; a third or right division, which is also partially cleft; and in addition to these, a small *lobulus Spigelii*, fitting into the lesser curvature of the stomach, and making in all seven lobes: occasionally, however, the middle and right divisions are further subdivided. The gall-bladder is elongated, and more or less bent or tortuous, especially at the neck. Occasionally in the *Cat* its *fundus* is buried in the substance of the cystic lobe, and appears through a cleft on the convex surface: Mr. Martin found this structure in the *Jaguar* also. I am informed by my friend Mr. Kiernan, who has so successfully investigated the intimate structure of this important gland, that the constituent lobules of the liver are more angular and distinct from each other in those of the genus he has examined than in the *Hare* or *Rabbit* among the *Rodentia*: they are remarkably distinct in the *Cheetah*, and for the most part six-sided. The gall-bladder in this species has a complete investment of *peritoneum*, is disposed in three flexures, and the cystic duct is tortuous

[1] I may here observe that in the *Cheetah* which I dissected the small intestines were much contracted, containing only a grey inodorous mucus, apparently in consequence of an ulcerous opening in the *duodenum*, which prevented the passage of chyme into them. The force of the contraction of the muscular fibres was such, that they were drawn into a wavy form, and the longitudinal fibres were observed to form a strong band along the attachment of the mesentery.

before joining the hepatic. The common duct enters the *duodenum* 1 inch from the *pylorus*, joining the pancreatic between the coats of the intestine. The form and divisions of the liver are as above described.

The *pancreas* in the feline tribe is composed of two parts, both having an entire investment of *peritoneum*. One passes from the spleen to the *duodenum* behind the stomach, lodged between the layers of the posterior part of the great *omentum*; the other follows the curve of the *duodenum*, describing a circle, and inclosed between the layers of the duodenal mesentery. The gland is conformable to this type in the *Cheetah*.

The spleen in the *Cats* is invariably of a compressed elongated form, of nearly uniform breadth, and its cells are much smaller than in herbivorous *Mammalia*. In the *Cheetah* this part is 7 inches in length, and 1½ inch in breadth, with the lower end bent out of the long axis.

The kidneys in the *Cheetah* are prominent, with the same proportion of the venous blood returned by arborescent superficial veins as in the rest of the feline tribe: a structure which is also found in the *Suricate*, *Genets*, *Civets*, and *Hyænas*, (and in connexion with the feline form of *cæcum*); but which does not exist in the *Dog*.

The chest in the *Cheetah* has not the same proportionate size as in the *Lion*. The lungs are on the right side divided into three lobes and the *lobulus impar*; on the left into three: the superior cleft on this side varies in depth in the different species. The *trachea* is large, as in all the *Cat* tribe, with the cartilages dilated and sometimes bifid at their posterior extremities; the muscular and membranous interspace in the *Cheetah* is an inch in breadth; and the number of cartilages 41. The heart is 3½ inches in length, and 2½ in breadth. The *aorta* gives off the left carotid with the right carotid and subclavian by a common trunk, the left subclavian coming off separately. This disposition I have found in all the feline animals which I have examined at the Society's Museum; but it is not peculiar to the genus *Felis*. There is one superior *vena cava*.

The *testes* in the *Cheetah* are situated in a sessile *scrotum* 4 inches from the *anus*: they are each 10 lines long, and 7 lines broad: the *epididymis* is large in proportion to the gland. The *penis* in the unretracted state is 4 inches in length, the *glans* pointed and armed with retroverted *papillæ*, as in all feline animals, and without any bone.

The tongue is beset with retroverted cuticular *papillæ*, occupying its anterior third, but not extending to the margin. The *lytta*, or rudiment of the lingual bone, so conspicuous in *Dogs*, is here reduced, as in the other feline animals, to a small vestige.

The elastic ligaments of the ungueal *phalanges* exist in the same number and relative position as in the *Lion*, but are longer and more slender: if the last joint is forcibly drawn out, they retract it to a certain extent; but this, as is well known, is insufficient to preserve the claws so sharp as in the rest of the *Feles*.

It will thus be seen, that in the circulating, respiratory, digestive, and generative systems, the *Cheetah* conforms to the typical structure of the genus *Felis*.

In the nervous system the same correspondence appears also to exist; but with respect to the brain of the *Cheetah*, I am disposed to offer my remarks somewhat more in detail.

A remarkable uniformity in the structure of this organ prevails throughout the genus *Felis*, so far as I have yet had the opportunity of observing it; and this uniformity obtains not only in the general form of the cerebral hemispheres and of the *cerebellum*, and in the relative proportions of these parts to the bigeminal bodies and *medulla oblongata*, but in the number and disposition of the convolutions of the *cerebrum*. The brains which I have compared for this purpose, are those of the *Lion*, *Tiger*, *Puma*, *Cheetah*, and several of the *domestic Cat*.

The hemispheres of the brain cover about the anterior half of the *cerebellum*, having an osseous *tentorium* intervening: the mass of *cerebrum* posterior to the *corpus callosum* exceeds that which is anterior to the same by about one fifteenth part of the longitudinal diameter of the *cerebrum*. The superior vermiform process occupies a little more than one third of the transverse diameter of the *cerebellum*. Of the bigeminal bodies the posterior pair is the largest, while, as Tiedemann has observed, the contrary is the case in the *Rodentia*, *Ruminantia*, and *Solipeda*. The *corpora candicantia* are blended into a single mass, as in most of the *Mammalia* inferior to *Man*. The transverse tract posterior to the *tuber annulare*, and bisected by the *corpora pyramidalia*, from which the seventh and auditory nerves arise, called *corpus trapezoideum*, is of remarkable size in all the species of the genus *Felis* above mentioned. The outer root of the olfactory nerve is of great size, and emerges from a remarkably prominent natiform protuberance.

After premising these leading characters in the feline brain, I shall proceed to describe in detail the disposition of the superimposed cerebral matter of the hemispheres: and as this is extended from before backwards in the process of growth, I shall begin with the fissures on the anterior part. In the *common Cat* the principal fissures, or anfractuosities, are less obscured by fissures of the second degree, and by vascular grooves, than in the higher *Feles*.

The first or most anterior anfractuosity on the superior surface of the brain is longitudinal, and being the continuation and termination of the principal one on the inferior surface, it extends a very short distance from before backwards[1]. The next anfractuosity behind this is a transverse one[2], extending from the middle line about two thirds across the hemisphere. At a short distance behind this fissure an anfractuosity commences, which extends backwards parallel with the *falx cerebri*, and which follows to a greater or less extent the outline of the posterior lobe of the hemisphere. The anterior end of this anfractuosity[3] is crossed by an oblique fissure, which varies in extent.

Parallel to the mesial longitudinal anfractuosity, and at the same distance from it as the latter is from the *falx*, a second longitudinal anfractuosity[4] is seen, which does not extend so far forwards or backwards, but bends outwards and downwards at both extremities. The mass of *cerebrum* external to the second longitudinal anfractuosity is

[1] 8. Figg. 1—5, Plate XX. [2] 1. Figg. 1—6. [3] 2. Figg. 1. 2. 4. & 5. [4] 3. Figg. 1. 2. 4. & 5.

traversed perpendicularly or transversely by three principal anfractuosities[1], so that each hemisphere posterior to the first transverse fissure is composed of two mesial longitudinal convolutions with their deflected extremities (*a.* & *b.*), and four lateral perpendicular convolutions (*c. d. e.* & *f.*), which may be called principal or primary convolutions.

In the *Cheetah* the first longitudinal convolution *a.* is traversed longitudinally by an interrupted fissure[2], which, in the individual examined, extended further in the right than in the left hemisphere; and I have observed that these secondary fissures are in general less symmetrical than the primary ones. In the *Cat* there is no increase of the surface of the brain by a secondary fissure of this kind. In the *Lion* there is a slight trace of it at the middle, and again at the posterior end of convolution *a.* In the *Cheetah, Lion, Tiger* and *Puma*, there are a few irregular transverse intersections[3], extending about half way across this convolution from both sides.

The convolution *b.* in the *Cheetah* differs from that in the *Lion, Tiger, Puma*, and *Cat*, chiefly in its elevation above the plane of the hemisphere. In both the *Cheetah* and *Lion* it is broader in proportion to *a.* than in the *Cat.* The mass formed by the blending together of the convolutions *a.* and *b.* posteriorly, presents more partial fissures in the *Cheetah* than in the *Lion* or *Cat*; the continuation outwards of the secondary fissure 7 is constant in all the *Feles.*

Of the lateral convolutions the middle ones *d.* and *e.* are the smallest in all the *Feles*, and do not project so far out as *f.* In the *Cat* the difference is but slight; in the *Lion* it is greater; and in the *Cheetah* the proportionate size of these convolutions is a little more increased.

The small convolution *g.* is of about the same proportionate size in all the *Feles*; but the brain at the part where *b.* and *c.* meet is broader in the *Cheetah*[4] than in either the *Lion* or the *Cat.* The *cerebrum* is also proportionately broader than the *cerebellum* in the *Cheetah* than in any of the *Feles* which I have examined.

At the base of the *hemispheres* the principal and most constant anfractuosity is longitudinal, extending along the outside of the olfactory nerve, and terminating anteriorly in 8. Fig. 1.

Another longitudinal fissure, posterior to the preceding, separates the natiform protuberance from the blended convolutions *e.* and *f.*

On the mesial surface of the *hemispheres* the anfractuosities are the same in number in the *Cat* and *Cheetah*, but are of greater extent in the latter. The transverse anfractuosity[5] extends in both species downwards and backwards, to opposite the middle of the *corpus callosum.* I have found the same disposition of this convolution in the brains of two *Lions*; but Tiedemann, in his view of the brain of the *Lion*[6], does not represent it

[1] 4. 5. & 6. Figg. 2. & 5. [2] 7. Fig. 1. [3] 9. Fig. 1.

[4] This difference is expressed in the form of the *cranium*, which, as Cuvier has observed (*Ossemens Foss.*, tom. iv. p. 446.), is the shortest, most convex, and proportionately the broadest, of any of the species of *Felis.*

[5] 1. Figg. 1. & 3. [6] Icones Cerebri Simiarum, &c. Tab. iii. fig. 5.

as extending so far backwards. The mass of *cerebrum* anterior to this anfractuosity is slightly indented with a fissure, which is of greater extent in the *Cheetah* than in the *Cat*.

Posterior to anfractuosity 1. a second[1] commences in the *Cheetah* and *Lion* from the anterior intersection of convolution *a.*, and extends downwards and backwards to the posterior part of the hemisphere. In the *Cat* this anfractuosity does not extend so far at either extremity, but its direction is the same.

The posterior anfractuosity[2] runs parallel with and above the preceding; it terminates at the posterior part of the hemisphere, but does not extend to the upper surface at its anterior extremity in any of the *Cat* tribe.

The general disposition of the convolutions in the brain of a *Dog* is sufficiently similar to that in the brain of the *Cat* tribe for the purposes of comparison.

In the brain of the *Jackal* the convolutions *a.* and *b.* occupy nearly the same extent and position, but *b.* is half as broad again as *a.*, so that the *Cheetah* in the difference manifested by the superior bulk of this convolution, approximates to the *Dog*, although it is but in a slight degree. A further difference is observable, and more especially in the domesticated *Dog*, in the additional cerebral matter anterior to the transverse fissure 1, and in the greater extent to which the *cerebellum* is covered by the posterior part of the *cerebrum*; but with reference to these differences, the *Cheetah* strictly adheres to the feline type.

That the disposition of the superimposed mass of the *cerebrum* varies in the different orders of *Mammalia*, and in some of the orders is found to vary also in the different genera, is now well known to comparative anatomists. In the great work of Gall and Spurzheim, the disposition of the hemispheric substance is in part delineated as it appears in the brains of the *Sheep*, *Kangaroo*, *Lion*, *Tiger*, *Cat*, *Rhesus Monkey*, *Guenon*, *Elephant*, and *Orang-Utan*: and different examples from the *Quadrumana*, *Carnivora*, *Marsupiata*, *Rodentia*, and *Edentata*, are given by Tiedemann in his 'Icones Cerebri Simiarum *&c.*', all of which sufficiently prove this fact.

Of the constancy of the disposition of the convolutions represented by Gall and Spurzheim in the *Lion* and *Tiger* as characteristic of the brain of the feline genus, I was first assured by our fellow Member H. H. Holm, Esq., Lecturer on Phrenology[3], whose attention has long been directed to this part of anatomy.

[1] 9. Figg. 3. & 6.

[2] 10. Figg. 3. & 6.

[3] The following note contains Mr. Holm's opinions of the functions of the different convolutions in the brain of the *Cheetah*, after a comparison of it with the human brain and that of some other animals.

"In the human brain the convolutions of the posterior lobe appear formed in three longitudinal masses meeting behind, and diverging in their progress forwards:

The internal mass	contains—Philoprogenitiveness	Inhabitiveness, Self-esteem.
The middle mass		Adhesiveness, Love of Approbation.
The external mass		Combativeness, Destructiveness, Alimentiveness.

These masses have very frequent interconnexions, are much convoluted in their course, and have great numbers of subconvolutions.

"In the common *Cat* we see the same type prevails, but the masses are simple. The internal mass dilates

In the description of the outward configuration of the cerebral hemispheres in the *Cheetah* and other feline species, I have limited myself to noting those convolutions only which, after a careful comparison of the materials at my disposal, appeared to be subject to least variety. But even with this limitation a very small portion of the cerebral surface remains undescribed; and the constancy manifested in the disposition of the remainder, as to the form, extent, and symmetrical arrangement of the convolutions, argues strongly in favour of the conclusion that the folding of the hemispheric substance in the progress of its development, follows a determinate law; and that the tracing of the additional convolutions, as they successively present themselves in succeeding complexities of the *cerebrum*, may not only tend to advance zoology by bringing to light additional instances of affinities between the different groups of *Mammalia*, but ultimately lead to the determination both of the amount and locality of the convolutions in the human brain which are analogous to those of the inferior animals.

PLATE XX.

Fig. 1. Superior view of the brain of the *Cheetah*.
2. Side view of the same.
3. Mesial surface of the right hemisphere of the same.
4. Superior view of the brain of the *domestic Cat*.
5. Side view of the same.
6. Mesial surface of the right hemisphere of the same.

A. The *cerebrum*; B. the *cerebellum*; C. the *medulla oblongata*; D. the spinal cord.
The smaller letters and figures are explained in the text.

anteriorly, and forms a large portion of the anterior lobe: the middle one turns outwardly, and joins particularly the external lateral mass, which does not extend farther forwards than about two thirds of the whole extent of the *cerebrum*: the external or lateral mass is subdivided by two transverse perpendicular fissures into three convolutions, of which probably the posterior may be Combativeness, the middle Destructiveness, the anterior Secretiveness and Alimentiveness; these three all unite below.

"The under surface of the anterior lobe is divided by a fissure extending nearly in the direction of the outer margin of the olfactory nerve, as in *Man*, in whom the mesial convolution contains Individuality: this in the *Cat* may perhaps include other organs.

"The brains of the whole genus *Felis* are similar as to these general divisions, though the convolutions vary as to their relative proportions in each species, and frequently in individuals of the same species.

"In comparing the genus *Felis* with the *Dog* tribes, the posterior internal longitudinal mass is much smaller than the middle; and in the *Jackal* the middle mass is half as much more voluminous as the internal mass, while in most of the *Cats* these parts are nearly equal, and in some the internal preponderates. The posterior division of the external lateral mass, Combativeness, is smaller than the middle one, Destructiveness, in the *Cats*, while the opposite fact appears in the *Dogs*: in this respect the *Lion* approaches more to the *Dog* tribe than any of the genus *Felis*."—H. H. H.

Fig 1

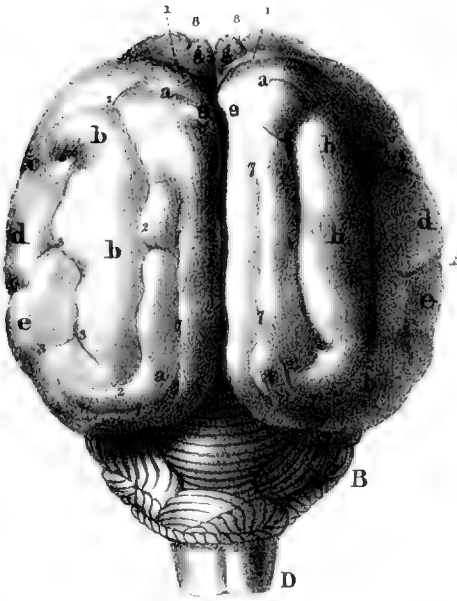


Fig 4

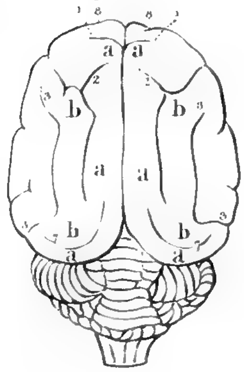


Fig. 2

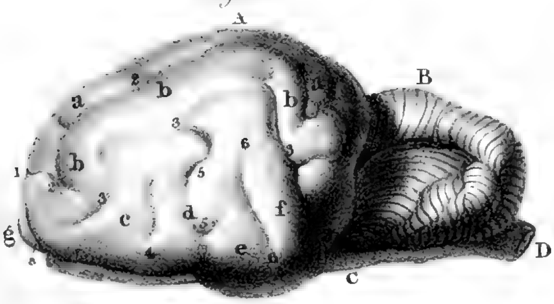


Fig 5.

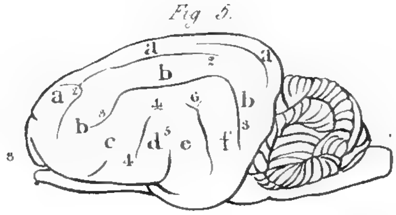


Fig 3

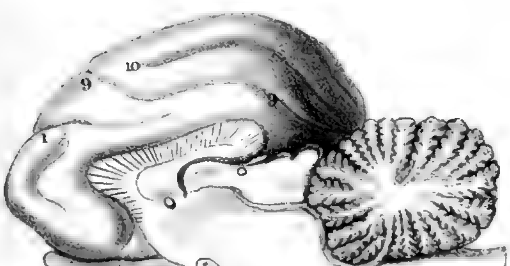


Fig 6

T.R. Jones del. G. Scharf lithog. Printed by C. Hullmandel

1–3 Felis jubata 4–6 Felis domestica

XVI. *Notice of a Mammiferous Animal from Madagascar, constituting a New Form among the* Viverridous Carnivora. *By* E. T. Bennett, *Esq., F.L.S., Sec. Z.S.*

Communicated April 9, 1833.

Mr. TELFAIR, the President of the Mauritius Natural History Society, and a most active and liberal Corresponding Member of our body, has recently presented to us an animal obtained by him from Madagascar, which exhibits a combination of characters hitherto unnoticed. I hasten, therefore, to lay before the Society some account of it, although, owing to the youth of the individual, my description of it must at present be in some respects incomplete.

It belongs to the family of *Viverridæ* among the *Carnivorous Mammalia*, having the prickly tongue, the two tubercular molar teeth in the upper jaw, and the other characters by which the *Civets* are distinguished from the *Cats* on the one side, and from the *Dogs* on the other. It approaches more nearly than most of the other forms of this family to the *Felidæ*, having the claws on both feet truly retractile, and furnished with the retractile ligaments; those of the anterior limbs being also acute both at their points and edges. In these respects it agrees with *Paradoxurus*, F. Cuv., as it does also in the nakedness of the soles of its feet, and in the union of the toes almost to their extremities by an interdigital membrane. From *Paradoxurus*, however, it differs by its short, smooth, and adpressed fur, giving it an appearance remarkably distinct from animals covered by loose, spreading, and soft hairs; by the uniformly haired coat of its slender cylindrical tail, the equal covering of which on all its surfaces appears to indicate that this organ is not capable of being curled in the manner so remarkable in the *Paradoxuri*; and especially by the possession of a pouch surrounding the *anus*, which does not exist in that genus. In *Paradoxurus Typus*, F. Cuv., there are instead of anal pouches two bare patches in the female; one surrounding the *anus*, composed of numerous small follicles; the second, surrounding the *vagina*, and of the size of a crown piece, barer, and of a similar glandular nature. In the Madagascar animal there is, on the contrary, no naked space surrounding the *anus* or the *vagina*; the skin covering the intervening space is equally hairy with the adjoining parts; and there is a pouch surrounding the *anus*, of moderate depth, and of half an inch in diameter. The posterior margin of this pouch is more distant from the *anus* than the anterior; and the anterior edge is united to the *anus* by a fold of the naked skin of the pouch, forming a *frænum*. On account of its possessing an anal pouch, I propose to designate the genus, of which this animal may be regarded as the type, by the name of *Cryptoprocta*. The species may be named *Cryptoprocta ferox*.

The body is slender, and the limbs robust and of moderate length; the head narrow and slightly elongated; the glandular muzzle small; the nostrils with a deep lateral sinus; the moustaches numerous and stiff, the longest exceeding the head in length; the eyes rather small, and placed above the angle of the mouth, the opening of which is not much prolonged backwards; the ears unusually large, rounded, with a fold on the posterior margin and one or two sinuosities within, hairy both within and without, except in the auditory passage; neck slender; anterior limbs somewhat shorter than the posterior; tail, which appears to be mutilated at the extremity, as long as the body, reaching when retroverted to between the ears, perfectly cylindrical, and uniformly hairy; soles of the anterior feet naked to the whole extent of the *carpus*, of the posterior nearly to the heel; claws retractile, five on each foot; on the anterior sharp pointed and edged, compressed, curved, short, and cat-like; on the posterior rather larger, compressed, less curved, and obtuse. The toes are united nearly to the tips; on the fore feet the middle is the longest; those on each side are scarcely shorter, and nearly equal to each other; the innermost and outermost also nearly equal to each other, but still shorter than the adjoining ones: on the posterior feet the third and fourth toes are nearly equal and somewhat longer than the second and fifth, the thumb being considerably shorter.

The colour of the whole upper and outer surfaces is of a somewhat light brownish red, resulting from a mixture of brown and straw colour, in rings of greater or less extent, on each hair; below and internally on the limbs it is less deep, the individual hairs being of a more uniform colour.

The hairs are short, smooth, and even soft to the touch, and slightly crisped; measuring on the body and tail from three quarters of an inch to an inch in length, and becoming shorter on the head and limbs. The moustaches are black at the base and become lighter at their tips. At the base of the ears externally the hair is rather long and somewhat darker coloured, but shorter and thinner at their tips; the anterior part of their inner surface has a tuft of much longer hairs than the rest.

The measurements are as follows:

	Inches.
Length from the tip of the nose to the root of the tail	$13\frac{5}{10}$
of the tail (probably not quite entire)	$11\frac{5}{10}$
head	$3\frac{3}{10}$
longest moustache	$3\frac{5}{10}$
ear	$1\frac{5}{10}$
Breadth of the ear	$1\frac{4}{10}$
head at the base of the ears	$1\frac{7}{10}$
Length of the neck	$2\frac{2}{19}$
arm	2
fore-arm	$2\frac{2}{10}$

		Inches.
Length of the anterior foot to the end of the longest claw	. . .	$1\frac{7}{10}$
thigh	. . . .	$2\frac{6}{10}$
leg	. . . .	$2\frac{7}{10}$
posterior foot to the end of the longest claw	. .	$2\frac{6}{10}$

In its internal anatomy, as in many of its external characters, the *Cryptoprocta ferox* approaches the *Cats*. The stomach is a long pouch, strongly bent upon itself at its posterior third, and slightly contracted at its first third, where it lies upon the trihedral elongated spleen. Its rounded end extends left of the *œsophagus* about half an inch, the diameter of the stomach being three quarters of an inch at the œsophageal entrance; it then contracts to about five eighths of an inch, becomes again dilated to its previous dimensions, and bends upwards, gradually narrowing to the *pylorus*: the length of the first portion is two inches and a quarter, of the second, one and three quarters: following the middle line of the stomach, its length is three inches and a half. Along its first or descending portion the stomach is furnished externally, both dorsad and ventrad, with strong longitudinal muscular fibres: these scarcely extend to the curved part, and are not visible on the ascending portion. The length of the small intestines is four feet and three inches; of the *cæcum*, an inch and a sixth; of the large intestines, five inches and a half. The *cæcum* at its base is broader than the small intestine adjoining it, the two together about equalling the *colon* in capacity of tube: from its base it narrows gradually to its extremity, which is only slightly obtuse; its direction is parallel to the small intestine.

The teeth in the individual examined are of the deciduous class only, and consequently cannot furnish permanent characters. It may, however, be desirable to describe them. They consist, in the upper jaw, of six closely set incisors, of which the four intermediate are small, with their crowns a little flattened and somewhat impressed transversely; the outer incisors are much larger than the intermediate ones, and have on their external surface somewhat the appearance of canines; they have an internal process, against which the crowns of the corresponding teeth of the upper jaw close. The canines are distant from the incisors, and project from the jaw about twice the length of the outer incisors; they are curved backwards. Immediately adjoining to the canine on each side are two small false molars; the first nearly cylindrical, with a slight process on the outer and posterior part of its crown; the second having a slender lengthened crown, and two roots. A space, equal in length to the second molar, intervenes between it and the third, which is large and composed of three sharp, longitudinally disposed, tubercles; the anterior having a small process behind; the second, twice the length of the preceding one, is simple and directed somewhat backwards; the third forms a long transverse ridge: the middle tubercle is, at its base, somewhat lengthened inwards, but is without process or spur in this direction. The fourth molar, adjoining the third, is irregularly triangular; its outer and broadest portion is flat, the inner is much smaller, and is considerably lower in the crown than the outer. Behind this is a closed cavity in the jaw, evidently containing the rudiment of a fifth, or second tubercular, molar tooth. In the lower jaw the six incisors are nearly of equal size, the outer one on each side being acute at its top. The canine adjoins the external incisor; is more than twice its length, strong and broad at the base, narrower upwards, and curved somewhat backwards. Two false molars succeed, placed close to each other, similar to those of the upper jaw, and separated by a small interval from the canine anteriorly and the third molar posteriorly. The third molar has four acute tubercles succeeding each other longitudinally; the first is small and short, ranging scarcely higher than the second false molar; the second, much stronger, and twice the length of the first; the third, corresponding nearly with the first, and separated by a notch from the fourth, which is small and much lower. The fourth molar has also four sharp tubercles, of which the first two are strong and cutting, the second being the largest, and having behind it and somewhat internally the third, which is small and acute; the fourth resembles the fourth tubercle of the third molar. An enlargement of the bone behind this tooth shows that the pulp of a fifth molar is inclosed within the jaw.

Mr. Telfair states that this animal was sent to him lately from the interior and southern part of Madagascar, and that he has not seen in Mauritius any of the Madagascar people that were acquainted with it. He remarks, "It is the most savage creature of its size I ever met with: its motions and power and activity were those of a tiger: and it had the same appetites for blood and destruction of animal life. Its muscular force was very great, and the muscles of the limbs were remarkably full and thick. It lived with me for some months."

In conclusion I may add, that it is not impossible that the *Cryptoprocta ferox* may be identical with the animal described and figured by M. F. Cuvier, in the 'Mémoires du Muséum d'Histoire Naturelle'[1], as a species of *Paradoxurus*, with the trivial name of *aureus*; the anal pouch, which distinguishes it from *Paradoxurus*, having, perhaps, been overlooked by that distinguished zoologist. The colours, form, and proportions appear to be the same. M. F. Cuvier's specimen was young, though not so young as the one in the Society's Museum: the country from which it was obtained was not recorded.

[1] Tom. ix. p. 46. tab. 4, fig. inf.

PLATE XXI.

CRYPTOPROCTA FEROX.

Cryptoprocta ferox.

Lear del.

XVII. *Descriptions of some new Species of Cuvier's Family of* Brachiopoda. *By* W. J. Broderip, *Esq., Vice-Pres. of the Geological and Zoological Societies, F.R.S., L.S., &c.*

Communicated November 26, 1833.

AMONG the great additions to our zoological information contributed by Mr. Cuming, some of the species about to be described will hold a distinguished place, in consequence of the opportunity which their preservation in spirit has afforded to my friend Mr. Owen for giving the details of the anatomy of Cuvier's family of *Brachiopoda*, with that acuteness and accuracy which mark his researches.

This family is, moreover, very interesting from its geological relations. The different species of *Terebratula* assist in the identification of strata from the supracretaceous group to some of the lowest formations in the grauwacke series, both inclusive; *Orbicula* is said to have been found in the lower green-sand of Sussex, in the Speeton clay of Yorkshire, in both the great and the inferior oolite, in the carboniferous limestone, and in the Ludlow rock below the old red sandstone; and *Lingula* in the inferior oolite of Yorkshire, in the old red sandstone formation, and in other old fossiliferous beds. That the organization of the recent animals is the same with that of those species which lived and died thousands of years ago, there can be no doubt; and we may thus form some conclusion as to the nature of those most ancient seas wherein the fossils existed.

Genus. Terebratula, *Brug.*

1. Terebratula Chilensis.

Tab. XXII. Fig. 1.

Ter. testâ suborbiculari, gibbâ, albente, radiatim striatâ, striis latioribus, margine subcrenulato, subflexuoso.

Long. $1\frac{2}{8}$ poll., lat. $1\frac{2}{7}$, crass. $\frac{5}{8}$.

Hab. in sinu Valparaiso.

Mus. Cuming.

This species varies much in size and appearance. In the older shells the radiated *striæ* almost disappear; and very young individuals are nearly smooth and oblong; while those of intermediate growth have the *striæ* strongly marked. The specimen of which the anatomy is given is a very young one, and the dimensions above recorded are those of the largest which I have seen. The length is taken from the extreme end of the perforation to the opposite rim, the breadth from an imaginary line bisecting it, and the thickness from another imaginary line, supposed to be drawn through the middle of the two valves and the included space.

Mr. Cuming found this *Terebratula* in the Bay of Valparaiso, at a depth ranging from sixty to ninety fathoms. The older shells were attached to rocks, and the younger to *Corallines* and *Fuci*.

2. Terebratula Uva.

Tab. XXII. Fig. 2.

Ter. testâ ovato-oblongâ, ventricosâ, subglabrâ, subdiaphanâ, lineis concentricis substriatâ; valvâ perforatâ subelongatâ.

Long. 1 poll., lat. $\frac{5}{8}$, diam. $\frac{7}{12}$.

Hab. in sinu Tehuantepec.

Mus. Cuming.

This *Terebratula* was found by Captain Dare, while dredging for *Meleagrinæ margaritiferæ*, attached to a dead sea-worn bivalve, at a depth of from ten to twelve fathoms, and on a bottom of sandy mud.

Genus. Orbicula, *Cuv.*

1. Orbicula lamellosa.

Tab. XXIII. Fig. 2.

Orb. testâ corneâ, fuscâ, suborbiculari, subdepressâ, lamellis concentricis elevatis rugosâ.

Long. $1\frac{1}{10}$ poll., lat. 1.

Hab. ad Peruviæ oras. (Iquiqui.—Bay of Ancon.)

Mus. Cuming.

This species was found by Mr. Cuming in groups, the individuals being in many instances piled in layers one over the other on a sandy bottom, at a depth ranging from five to nine fathoms. At Ancon they were found attached to dead shells, and also clinging to the wreck of a Spanish vessel of about 300 tons, which went down in the Bay about twelve years ago. The sunken timbers (for the sheathing was gone to decay,) were covered with these shells, much in the same way that beams on land are sometimes invested with flat parasitic *Fungi*. At Iquiqui they were taken adhering to a living *Mytilus*.

It is to be observed, that the bearded appearance round the border of many of the specimens is produced by the dried remains of the *cilia* of the mantle. The lower valve varies very much according to circumstances, being thinnest and smoothest when it is least exposed: in those instances where the adhesion is co-extensive with the surface, it is very thin. Generally it is convex where it rises from the depressed area of the perforated part; but this convexity depends so much on position and other accidental circumstances, that it cannot be relied on with any safety as a character.

The measurement merely relates to the extent of surface of the upper valve, the length being taken from the extreme edge of the border above the perforation to the opposite rim; and the breadth following an imaginary line, bisecting the former at right angles.

2. Orbicula Cumingii.

Tab. XXIII. Fig. 1.

Orb. testâ subconicâ, suborbiculari, crassiusculâ, striis ab apice radiantibus numerosis; epidermide fuscâ.

Long. $\frac{7}{10}$ poll., lat. $\frac{8}{12}$.

Hab. ad Paytam Peruviæ, ad Sanctam Elenam, et ad Panamam.

Mus. Cuming.

The concentric lines of growth in this species are crossed by the numerous *striæ* which radiate from the *apex* of the upper valve. The under valve, which varies from convexity to flatness, is much the thinnest, and is only marked by the concentric lines.

Found by Mr. Cuming at the localities above given, attached to the lower sides of stones in sandy mud at low water, and in some instances at a depth of six fathoms. The remains of the *cilia* give a bearded appearance to the border of the shell in many of the dried specimens, as in *Orb. lamellosa.*

Orb. Cumingii approaches nearest to *Orb. striata*, described by Mr. G. B. Sowerby in the 'Transactions of the Linnean Society'.

3. Orbicula strigata.

Tab. XXIII. Fig. 1*.

Orb. testâ crassiusculâ, subrotundâ, substriatâ, radiatim castaneo strigatâ; epidermide tenui, fuscâ.

Long. $\frac{7}{12}$, lat. vix $\frac{7}{12}$, crass. $\frac{2}{12}$ poll.

Hab. ad Guatemalæ oras. (Isle of Caña.)

Mr. Cuming dredged two individuals of this species at the depth of eighteen fathoms. They were attached to rocks. The dimensions are taken from the largest specimen; but the smallest is figured on account of the superior brilliancy of the stripes.

Genus. Lingula, *Brug.*

1. Lingula Audebardii.

Tab. XXIII. Fig. 14.

Ling. testâ oblongâ, glabrâ, corneâ, pallidè flavâ, viridi transversim pictâ, limbo anteriore rotundato, viridi.

Long. $1\frac{3}{8}$ poll., lat. $\frac{5}{12}$.

Hab. ad Insulam Punam. (Bay of Guayaquil.)

Mus. Cuming.

The rounded anterior edge of this shell is green, and the transverse lines of that colour are produced by the progressive increase of the shell, which is smooth and parchment-like. In all the dried specimens the thin anterior edge is contracted into a square form, so as to produce a resemblance to a very square-toed shoe; but in its natural state this edge is rounded. A general contraction, moreover, gives the dried shells a narrower and more ventricose character than they really possess; and the remains of the *cilia* of the *branchiæ* give to their anterior edges a bearded appearance. The dimensions above given were taken from the largest specimen which I have seen: the individual dissected by Mr. Owen is comparatively small.

Mr. Cuming found this species, which bears the name of the Baron de Férussac, at about half-tide, in an extensive bottom of hard coarse sand, from four to six inches below its surface. The extent of the sand was about twelve miles long, and two miles wide.

2. Lingula Semen.

Tab. XXIII. Fig. 17.

Ling. testâ ovato-oblongâ, crassiusculâ, planâ, albidâ, lævissimâ, politâ, limbo anteriore rotundato.

Long. $\frac{9}{12}$ poll., lat. $\frac{4}{12}$.

Hab. ad Insulam Platam.

Mus. Cuming.

This shell, the only one I have seen, was dredged by Mr. Cuming in fine coral sand from a depth of seventeen fathoms. It may be a young individual; but the shell is so much firmer than it usually is in *Lingula* (so firm, indeed, as not to have contracted at all in drying), that I cannot but look on it as an undescribed species. In size and appearance it bears a near resemblance to a melon seed.

Mr. Cuming informs me that he found another specimen, about a line longer, at the same time and in the same place, but that he has unfortunately mislaid it.

PLATE XXII.

Fig. 1. Terebratula Chilensis.
2. Terebratula Uva.

PLATE XXIII.

Fig. 1. Orbicula Cumingii.
1*. Orbicula strigata.
2. Orbicula lamellosa.
14. Lingula Audebardii.
17. Lingula Semen.

XVIII. *On the Anatomy of the* Brachiopoda *of Cuvier, and more especially of the Genera* Terebratula *and* Orbicula. *By* Richard Owen, *Esq., F.Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated November 26, 1833.

It is to Cuvier that we are indebted for the knowledge of that interesting form of the respiratory organ of the *Bivalve Mollusks*, by which the mantle, in addition to its secreting the shelly defence of the *viscera*, and constituting their immediate covering, is made subservient also to the renovation of the circulating fluids. The dissection of *Lingula anatina*, Brug., which first brought to light this structure, is among the early labours of that great anatomist, and forms the subject of his first paper in the 'Annales du Muséum.' He observed in *Lingula* that in the situation occupied by the *branchiæ* in ordinary *Bivalves*, there were instead two fringed and spirally disposed arms, and that the *branchiæ* themselves were arranged in oblique parallel lines along the internal surface of both lobes of the mantle; that the lobes of the mantle were further characterized by large vessels returning the blood from the respiratory organs; and that these vessels (the branchial veins) terminated in two systemic hearts, which were symmetrically disposed, thus forming a new type of circulation, corresponding to the modification of the respiratory system.

For the *Mollusks* possessing these important modifications of structure, Cuvier founded a distinct class, which, according to his system of orismology for that division of the animal kingdom, he denominated *Brachiopoda*, considering the fringed arms as being in place of the foot in the *Cockle, Muscle*, &c.

From the analogy of *Terebratula* to *Lingula* in its pedicellate mode of attachment to foreign substances, and from such notices of the construction of the soft parts as he had then met with, he concluded that its organs of respiration were similarly situated, and that what had been taken for *branchiæ* by Lamanon[1] and Walsh[2], were in fact the analogues of the fringed arms of *Lingula*.

It is remarkable that Cuvier in no part of his Memoir, nor in either of the editions of the 'Règne Animal,' should allude to the concise description which Pallas has given of the animal of *Terebratula* in the 'Miscellanea Zoologica'[3]. Under the old name of *Anomia*, which, since the Linnæan character is applicable only to the modern *Terebratulæ*, ought to have been retained for them, Pallas notices the limited situation of the *viscera*. He describes the arms with his usual minuteness and accuracy, but considers them as *branchiæ*, comparing them to those of a fish (*piscium branchiis*

[1] Voyage de la Pérouse, p. 146. [2] Naturforsch., tom. iii. p. 88. [3] P. 182. (Anomiarum Biga.)

simillima). He enumerates three pairs of muscles belonging to the shell, and notices the situation of the mouth and stomach, but not that of the *anus*. The cloak, probably from its close adherence to the valves, he calls *periosteum*.

Another account of the organization of *Terebratula* is given by M. de Blainville in the 'Dictionnaire des Sciences Naturelles'[1]. After noticing the symmetrical character of the soft parts, and their general relation to the valves, he proceeds to speak of the arms, and, preferring the opinion of Pallas to that of Cuvier, considers them as the respiratory organs. With respect to the intestinal canal and liver, nothing is added to the description given by Pallas. The *branchiæ* M. de Blainville supposes to have the power of projecting outwardly, though not to the same extent as the arms in *Lingula*, and thus to contribute to open the shell. Of the muscular apparatus of *Terebratula* he conjectures part to belong to the visceral mass, and was unable to distinguish more than two pairs belonging to the valves. The extremities of both these pairs he describes as attached to the valves, but considers it very probable that some of the fibres may pass through the orifice of the perforated valve, or be attached to the membrane which closes that orifice. From the particulars he was enabled to ascertain concerning the organization of *Terebratula*, and with the conviction that the *branchiæ* are not attached to the mantle, he considers that genus as intermediate to the true *Palliobranchiata* (*Lingula*, *e. g.*,) and the *Lamellibranchiate Bivalves*.

In the latest edition of the 'Règne Animal' Cuvier retains his original opinion respecting the nature of the fringed or pinnate labial processes of *Terebratula*, still calling them *arms*: his description, however, of the muscles of the valves is liable to the same objection as those of the preceding authors, since, with the exception of one pair, they do not go from one valve to the other. He describes the ovaries as ramified productions adherent to each valve, but is doubtful as to the position of the *branchiæ*.

On account of the peculiar interest attached to this genus, both from its anatomical and geological relations, and from the contrariety of opinions entertained respecting some of its most important organs, I felt considerable pleasure at receiving from Mr. Cuming a small, recent, and well preserved specimen of *Ter. Chilensis*, Brod.; and I am much gratified in having this opportunity of acknowledging the liberality with which he has submitted to me the numerous specimens of the animals of rare and interesting species of shells collected by him.

From observations on the young specimen of *Ter. Chilensis*, I was at first inclined to suppose that the coagulated contents of the branchial veins might have been mistaken for the *ova*; but having subsequently received three full-grown specimens, containing two distinct species of *Terebratula*[2], through the kindness of Capt. P. P. King, and having more recently dissected a well preserved *Ter. psittacea*, Brug., taken by

[1] Tom. liii. p. 130.

[2] *Ter. dorsata*, Brug., and *Ter. Sowerbii*, King, Zool. Journ., vol. v. p. 338.

that gallant and scientific officer Commander James C. Ross, R.N.[1], I find that the situation of the *ova* in dried specimens when the mantle-lobes adhere to the shell, would be such as Cuvier has described.

It is from the above-mentioned materials that the following account of the anatomy of *Terebratula* has been derived.

On separating and removing the valves of *Terebratula*, the soft parts of the animal appear as in Figg. 5., 6., 14. & 15. Plate XXII. The arms and *viscera*, as in *Lingula*, are inclosed between the lobes of the mantle, which are precisely adapted to the inner surface of their corresponding valves, and are in such close contact with them as to require great care in separating the valves from them. That lobe of the mantle which corresponds to the perforated valve, is traversed longitudinally by four large vessels[2]; the opposite lobe is similarly traversed by two such vessels[3]. These appearances were constant in the four specimens examined.

The margins of the mantle are thickened, as is commonly observed in the *Lamellibranchiate Bivalves*; but which in this case results less from contraction than from a peculiar structure, presently to be described. In *Lingula* and *Orbicula* the same margins are distinctly and beautifully ciliate; but in *Terebratula* the marginal *cilia* are so minute, as only to be perceptible by means of a lens.

At the posterior part of each of the lobes the expanded fleshy extremities of the muscles are seen; those which were attached to the perforated valve being nearer the hinge by their whole length, than the anterior pair of the opposite valve. Each of the oval muscular disks is composed of an anterior larger muscle, and a posterior smaller one. Through the transparent mantle may also be seen the green-coloured follicular liver intervening between and surrounding the muscles, and the folded ciliate arms.

As the visceral mass occupies but a small space near the hinge, the lobes of the mantle can be reflected to a greater extent than in *Lingula*. On examining in this way the inner surface of the lobes of the mantle, another important difference between *Terebratula* and *Lingula* is perceived. In the latter genus the *branchiæ* consist, as described by Cuvier, of narrow elongated vascular productions, which are attached to the inner surface of the lobes of the mantle; whereas in *Terebratula* there only appear the venous trunks above mentioned. These vessels I first perceived in Mr. Cuming's small specimen, where they were sufficiently conspicuous from the outside of the mantle, owing to their being distended with coagulated blood; but on the inner side they are more distinctly seen, commencing by numerous branches from the margins of the pallial lobes, from the union of which, at about two lines distance from the

[1] This gentleman, having learned from my friend Mr. Broderip that I was engaged in the investigation of the anatomy of *Terebratula*, submitted for my examination, in the most liberal manner, the largest of the few specimens which the untoward circumstances attending the late perilous expedition permitted him to bring safely to this country. It was fished up from a depth of twenty-two fathoms near Felix Harbour, in lat. 70° N. on the east side of Boothia Peninsula.

[2] *m. m.* Figg. 5. 7.

[3] *m. m.* Figg. 6. 8.

margin, are formed the large trunks above described. The size of these vessels at once suggests their subserviency to other purposes than that of merely returning the blood necessary for the nutrition of the mantle. The four vessels of the perforated lobe of the mantle form two trunks near the visceral mass, which pass exterior to the muscular disks, and joining those of the opposite lobe, enter the two hearts, or dilated sinuses, which are situated exterior to the liver, and, in *Ter. Chilensis* and *Ter. Sowerbii*, just within the origins of the internal calcareous loop. Corresponding to the large branchial veins there appear under the microscope much smaller vessels, which I regard as the branchial arteries; these run parallel with the middle of the branchial veins, and terminate in the margins of the mantle from which the veins commence. These margins present the following appearances when viewed with a high magnifying power:—they are puckered at regular distances, the puckerings being apparently caused by the insertions of delicate *cilia*, which pass as far within the mantle as they project beyond it: in the interspaces of the *cilia* the margin of the mantle is minutely fringed: and within this fringe is a canal, which extends along the whole circumference of the lobe, and from which the branchial veins appear to take their origin: the marginal canal is contracted where the *cilia* are inserted into it, which gives it a sacculated appearance, like that of the canal of Petit in the human eye.

The uniform results of repeated observations on all the specimens of *Terebratula* which I had at my disposal, convinced me that the vascular mantle was the chief, if not the sole respiratory organ; and the utility of the marginal *cilia* in reference to this function can now be readily appreciated, in consequence of the discovery of the remarkable property which *cilia* possess of exciting determinate currents in the surrounding water,—a discovery for which the scientific world is indebted to the observations of Dr. Grant[1], Dr. Sharpey[2], and M. Raspail[3].

The imperforate valve in many species of *Terebratula* is characterized, as is well known, by a peculiar, complex, and extremely delicate testaceous apparatus, attached to its internal surface: now, as in those recent specimens with the soft parts which I have examined, and in which this structure existed, it was found to give attachment to the arms, it becomes necessary to describe it before speaking of those parts.

The principal part of this internal skeleton, as it may be termed, consists of a slender, flattened, calcareous loop, the extremities of which are attached to the lateral elevated ridges of the hinge; the *crura* of the loop diverge, but again approximate to each other as they advance for a greater or less distance towards the opposite margin of the valve; the loop then suddenly turns towards the perforate valve, and is bent back upon itself for a greater or less extent in different species. When the loop is very short and narrow, as in *Ter. vitrea*, Brug., there is but a small tendency towards a reflected portion; but where the loop is of great length and width, as in *Ter. Chilensis*,

[1] Edinburgh Phil. Journal, vol. xv. p. 150. Brewster's Journal, vol. vii. p. 121.

[2] Edinburgh Journ. of Nat. and Geogr. Science, vol. ii. p. 334.

[3] Chimie Organique, p. 247.

Ter. dorsata, *Ter. dentata*, Lam., and *Ter. Sowerbii*, the reflected portion is considerable. The loop, besides being fixed by its origins or *crura*, is commonly attached to two processes going off at right angles from the sides, or formed by a bifurcation of the extremity, of a central process, which is continued forwards to a greater or less extent from the hinge; but it is sometimes entirely free, except at its origins, as, *e. g.*, in *Ter. vitrea*. This reflected loop, forming two arches on either side the mesial plane, towards which their concavities are directed, I have figured as it exists in *Ter. Chilensis*[1] and *Ter. Sowerbii*[2]. It is represented of a similarly perfect form in *Ter. dentata*, by M. de Blainville in his 'Malacologie'[3]: and the same apparatus in *Ter. dorsata* is very well figured by Chemnitz[4]; by Sowerby[5]; and more recently by G. Fischer de Waldheim[6]. A similar form is also figured in another species of *Terebratula* by Poli[7].

The arches of the loop are so slender, that, notwithstanding their calcareous nature, they possess a slight degree of elasticity, and yield a little to pressure; but, for the same reason, they readily break if the experiment be not made with due caution. The interspace between the two folds of the calcareous loop is filled up by a strong but extensile membrane, which binds them together, and forms a protecting wall to the *viscera*: the space between the bifurcated process in *Ter. Chilensis* is also similarly occupied by a strong aponeurosis. In this species the muscular stem of each arm is attached to the outer sides of the loop and the intervening membrane. They commence at the pointed processes at the origins of the loop, advance along the lower portion, turn round upon the upper one, and are continued along it till they reach the transverse connecting bar, where they advance again forwards, and terminate by making a half spiral twist in front of the mouth. It is these free extremities which form the third arm mentioned by Cuvier[8]. These arms are ciliate on their outer side for their entire length; but the *cilia* are longer and much finer than the brachial fringes of *Lingula*; and except at the extreme ends, which have a slight incurvation, they are uniformly straight. There is thus an important difference between *Lingula* and those species of *Terebratula* which resemble *Ter. Chilensis* in the powers of motion with which the arms are endowed; since from their attachment to the calcareous loop they are fixed, and cannot be unfolded outwards as in *Lingula*. Owing to this mode of connexion, and their ciliated structure, their true nature was much more liable to be mistaken by the early observers, though it appears not to have escaped the discrimination of Linnæus, who, as Cuvier has observed, founded his character[9] of the animal of *Anomia* on the organization of one of the *Terebratulæ*, which he included in that genus.

[1] Fig. 4. [2] Fig. 16. [3] Pl. li. 1 *a*. [4] Conchyl. Cabinet, band viii. tab. lxxviii. fig. 711.

[5] Genera of Shells. [6] Notice sur le Charpente Osseux des Térébratules, fig. 3.

[7] Testacea utriusque Siciliæ, vol. ii. pl. 16. [8] Règne Anim., (nouv. ed.) tom. iii. p. 171.

[9] ANOMIA. *Animal* Corpus Ligula *emarginata ciliata, ciliis valvulæ superiori affixis*. Brachiis 2, *linearibus, corpore longioribus, conniventibus, porrectis, valvulæ alternis, utrinque ciliatis, ciliis affixis valvulis utrisque.*—Syst. Nat., (ed. xii.) vol. i. pars 2. p. 1150.

The arms in *Ter. Chilensis*, when detached from the supporting processes and unfolded, exceed the length of the shell by two thirds of that length; and their length is to their breadth as eight to one. Their stem, from which the *cilia* arise, as it has not to execute the movement of *Lingula*, so it is much more slender. The *cilia*, therefore, are proportionately increased, in order to excite the necessary currents in the water; which, being directed between the folds of the arms towards the mouth, as to a focus, carry thither the nutrient molecules, which are retained by the natural sieve formed by the decussating *cilia* of the terminal processes in front of the mouth; and though this apparatus be apparently less perfect than in *Lingula*, it is evidently adjusted in due relation to the support of so small a mass of body as exists in *Terebratula*. The muscular stem, by means of its attachment to the calcareous loop, has the power of acting upon that part to the extent its elasticity admits of, which is sufficient to produce such a degree of convexity in the reflected part of the loop, as to cause it to press upon the perforated valve, and separate it slightly from the opposite one. This elastic internal apparatus thus compensates for the absence of the thick protruding arms which push open the valves in *Lingula*, and for the want of the elastic fibres which constitute the ligament of the hinge in ordinary *Bivalves*; and it is apparently the only means this and similar species of *Terebratula* possess of divaricating the valves.

In other species in which the loop is wanting, as in *Ter. rubicunda*, Sow., there is a compensating structure; the furcated extremity of the central calcareous process is developed to a great size, and the forks can be approximated and separated from each other to a small extent, to effect the same purpose as the loop in the normal *Terebratulæ*. In *Ter. vitrea*, however, the loop, though perfect, is too small to be capable of being made to press upon the perforate valve in the way in which I suppose it to act in the more depressed species, as *Ter. dorsata*, *Ter. dentata*, *Ter. Sowerbii*, and *Ter. Chilensis*, in all of which it is largely developed for that purpose. It is probable, therefore, that the arms in this species have a different disposition, and possess greater powers of extension to compensate for the small development of the internal skeleton.

It is by such a modification of the structure of the soft parts that the opening of the shell is effected in *Ter. psittacea*. The internal skeleton in this species is reduced to two small processes, curved slightly outwards, which are continued from the sides of the hinge of the imperforate valve. From these processes arise two spiral arms[1], fringed on their outer margin, as in the other species, but quite free, excepting at their origins. When contracted they are disposed in six or seven spiral gyrations, decreasing towards their extremities; and when completely unfolded they extend beyond the shell twice its longitudinal diameter. The *cilia* are more curved than in *Ter. Chilensis*, and the stem which supports them is more muscular. The mechanism by which the arms are extended is simple and beautiful: the stems are hollow from one end to the other, and are filled with fluid, which, being acted upon by the spirally disposed muscles com-

[1] Fig. 14*.

posing the *parietes* of the canal, is forcibly injected towards the extremity of the arm, which is thus unfolded and protruded outwards.

My opinion of the uses of the complex internal testaceous apparatus of *Ter. Chilensis* and its congeners, was at first shaken by observing that it was wanting in the more globose species, as *Ter. vitrea*, *Ter. rubicunda*, and *Ter. psittacea*, where it ought rather to have been proportionately developed, in order to act upon the valves. But the relations of the soft parts to the loop, as exhibited in *Ter. Chilensis*, showed that the increase of that part requisite to perform the same office in the globose species, would have been incompatible with the limited proportion of the soft parts which characterizes the genus *Terebratula*, and the opening of the shell is therefore effected by other means. It is interesting to observe that the globose figure is assumed by those species which have the weakest valves, in order to enable them to resist surrounding pressure, while in *Ter. dentata*, *Ter. dorsata*, *Ter. Sowerbii*, and *Ter. Chilensis*, in which the imperforate valve is more or less flattened, the whole shell is characterized by its superior thickness and strength.

Under the microscope the brachial *cilia* are seen to be of a transparent horny texture; and the muscular stem to have no vascular trunk accompanying it, which would certainly be the case if the blood of the animal was distributed through this part for its renovation: so that the absence of the adequate organization in the *brachia*, together with the above-described structure of the mantle-lobes, leaves no doubt as to the true position of the *branchiæ*.

Although the pedicle is the fixed point to which the muscles are attached, I shall consider the extremities going to that part as the insertions. Two pairs of muscles arise from each valve. Those of the imperforate valve arise at a distance from each other: the anterior pair come off just behind the middle of the valve, fleshy; they soon diminish to thin shining tendons, which converge and unite below the stomach, and then again separate and pass through the *foramen* of the perforated valve to be inserted in the pedicle. The posterior pair are very short, and wholly carneous; they arise from the lateral depressions in the base of the central process of the hinge, and are inserted into the pedicle. The muscles of the perforated valve arise close together, so as to leave only a single muscular impression on either side[1]. The anterior pair soon diminish to slender tendons, which are inserted into the base of the imperforate valve; the posterior pair pass exclusively to the pedicle.

The pedicle is surrounded, except where it is attached to foreign substances, by a tubular prolongation of the superior lobe of the mantle. When this membrane is detached, the surface beneath is found to be smooth; and the fibres, when separated, exhibit some of the lustre of the tendons of which it seems to be composed. At its extremity these become partially decomposed, are of a black colour, and separated irregularly from each other, so as to form an expanded base of attachment.

[1] Fig. 3.

The alimentary canal commences by a small puckered transverse mouth[1], which is situated, as before mentioned, immediately behind the folded extremities of the arms, and opens opposite the middle line of the perforated valve. The *œsophagus*, after having passed through the membrane inclosing the *viscera*, makes a slight turn upon itself, and advances straight towards the opposite valve; it then suddenly expands into a large oval stomach, from the sides of which the canals branching out into the hepatic follicles are continued. The intestine returns in a direction towards the perforated valve, inclines to the right side, and makes a slight bend forwards before perforating the circumscribing membrane, in order to terminate between the mantle-lobes on that side. The whole alimentary canal thus forms a loop, whose convexity is turned towards the imperforate or upper valve. This description is taken from *Ter. psittacea.*

The liver is a bulky gland, of a green colour and minute follicular texture; it is disposed in two principal masses, which lie on each side the alimentary canal, and between the two lateral arches of the testaceous loop in those species of *Terebratula* which possess that appendage. In none of the specimens dissected could I perceive any trace of a salivary gland; all the glandular structure in connexion with the alimentary canal bore the green tint characteristic of the liver. In *Ter. psittacea* the ramifications of the hepatic follicles resemble those of *Gorgonia flammea*; the ultimate sacs, when viewed with a high magnifying power, exhibited plainly the net-work formed upon their *parietes* by the minute hepatic arteries and veins.

In two of the larger specimens of *Ter. Sowerbii*, the *ova* were lodged external to the liver, and had also insinuated themselves between the layers of the mantle-lobes, in close proximity to, and partly surrounding the branchial vessels. They are probably discharged in this way from the mantle, having previously been exposed to the influence of the branchial currents. It is their situation, when so far advanced, which has tended to prevent the discovery of the organization of the mantle that adapts it to the office of respiration; but if sufficiently young specimens are obtained[2], the branchial vessels are seen unobscured by the *ova*. In *Ter. psittacea* the *ova* were very distinct, and arranged in elongated loops, but did not extend so far along the mantle as in *Ter. Sowerbii*. They projected from the external surface of the mantle. No structure that could be supposed to be distinct male or fecundating organs was present; and the generation of *Terebratula*, therefore, as in the ordinary *acephalous Bivalves*, must be regarded as the simplest kind of hermaphroditism.

In dissecting a *Terebratula* I have found it most convenient to cut transversely through the perforated valve, so as to leave the orifice and the pedicle connected to the opposite valve, by which means the disposition of the muscles is satisfactorily seen, and the delicate parts within are less liable to be disturbed than by attempting to separate the entire valve.

[1] *a*. Fig. 12.

[2] As in Figg. 5 to 9.

On the Anatomy of Orbicula.

I have not been able to find any account of the anatomy of this *Brachiopod*, beyond the statement of its possessing the spiral arms peculiar to the order. Cuvier, indeed, refers the soft parts to Poli's genus *Criopus*[1]; but the animal so denominated belongs, as Mr. Sowerby observes[2], to a species of *Crania* (*Cran. personata*, Sow.), a genus, however, which, in its internal organization, is without doubt closely allied to *Orbicula*.

Four recent and well preserved specimens of the species which Mr. Broderip in the preceding Memoir has termed *Orb. lamellosa*, were submitted to me for examination.

The margin of the shell is of a soft texture and thickened, and the edges of all the layers of increase are more horny than calcareous. The layers of increase are large in proportion to the size of the shell, and are very irregular in their contour; the inside of the shell is smooth and polished. The flattened valve is perforated by a longitudinal fissure, measuring nearly three lines in length, and about half a line in width, and situated in the middle of an oval depression. Through this fissure the organ of adhesion, or the foot, passes, and immediately expands into a round sucker or disk, which fills up the whole of the depression, and conceals the margins of the slit. Immediately anterior to the fissure a longitudinal plate, about a line in length, projects into the interior of the shell for the extent of half a line; beyond this a broader elevated ridge is continued to within two lines of the anterior margin of the valve[3]. Along the whole circumference of the valves shining *cilia* are seen projecting for an extent varying from two to four lines. These arise all round the margins of both lobes of the mantle; they are much longer than in *Terebratula* and *Lingula anatina*, and are rather longer than in *Ling. Audebardii*, Brod., a new species discovered by Mr. Cuming.

On carefully removing the imperforate valve, the vascular mantle is seen with the margin entire in the whole of its circumference. The muscles and *viscera* form a rounded mass, situated in the posterior half of the shell. First are seen the extremities of two muscles[4], of an oblong figure, converging anteriorly, and measuring two lines by nearly one: in the triangular space between these muscles is situated the green liver[5], behind which is the grey ovary[6]; and at the posterior part of the circle are the extremities of two smaller muscles[7]. The four impressions of these muscles are observable on the interior of the shelly valve.

On removing the lower valve, which should be cut through from either side as far as

[1] Testacea utriusque Siciliæ, vol. ii. pl. xxx. Figg. 21–24. [2] Linn. Trans., vol. xiii. p. 471.

[3] This I regard as a rudimentary form of the internal calcareous apparatus of *Terebratula*; it represents the central process of support (*c*. Fig. 4. Plate XXIII.). The mantle-lobe with two vessels, and the position of the alimentary canal, prove that the flattened valve of *Orbicula*, although perforated for the organ of adhesion, is really analogous to the imperforate valve of the *Terebratulæ*.

[4] *f. f.* Figg. 5. 7. 8. Plate XXIII. [5] *v.* Figg. 5. 11. [6] *w.* Figg. 5. 11. [7] *g. g.* Figg. 5. 7. 8.

the fissure in order to avoid disturbing the soft parts, the vascular lobe of the mantle with similar free margins is exposed, but the *viscera* are quite concealed by the dilated disk or foot[1].

Each lobe of the mantle can be reflected from before backwards to the extent of five lines, and from behind forwards to the extent of half a line, but they adhere too closely to the visceral mass to be detached without laceration. When so reflected, the branchial vessels may be seen in rich profusion on their inner surface.

On the lobe[2] of the mantle which lines the imperforate valve, these vessels are seen converging from the respiratory margin to four trunks, which are much shorter than the corresponding ones in *Terebratula*: on the opposite mantle-lobe[3] the branchial vessels form only two such trunks[4].

The principal trunks in both mantle-lobes unite, and terminate in two sinuses or hearts[5], situated close to two strong tendinous membranes[6], which circumscribe the visceral mass, and to which the mantle-lobes firmly adhere. The arteries continued from the hearts pass obliquely through the membrane, and may be plainly seen distributing *ramuli* over the liver and ovary. In one of the specimens I succeeded in injecting the vessels of one lobe of the mantle from one of the ventricles in the retrograde course of the circulation: the solution of carmine which I used pervaded the numerous small *ramuli* given off from the larger branches of the veins, to the extent shown in the magnified view (Fig. 11.) of the recent preparation, which is now in the Museum of the Royal College of Surgeons.

In subjecting this injected preparation to high magnifying power, there evidently appeared a small uninjected line[7], as in the *Terebratulæ*, accompanying each of the larger branchial veins, running along the centre of every trunk; and these lines I conclude to be branchial arteries: if they were retractile muscles of the mantle, they might be expected to have a straighter course. At the margins of the lobes, near the roots of the *cilia*, lateral ramulets are given off at right angles, which form a chain or circular vessel all round the margin.

The *cilia*, besides being longer and more closely set than in *Terebratula*, are seen under a high magnifier to be themselves beset with smaller *setæ*, a structure which probably gives them greater power in exciting the respiratory currents[8].

In this profuse distribution of vessels over a plain membranous expansion, we perceive the simplest construction of the water-breathing organ, or *branchia*; and, while it proves the close affinity of the *Brachiopoda* to the *Ascidiæ*, it presents, at the same time, a beautiful analogy with the elementary forms of the air-breathing organ, as it exists, for example, in the *pulmoniferous Gasteropods*.

The muscular system of *Orbicula* differs in some respects from that of *Terebratula*. Eight distinct muscles may be perceived, without including the labial arms. The four

[1] Fig. 6. [2] *c*. Fig. 5. [3] *a*. Fig. 6. [4] *n*. Figg. 7. & 8.
[5] *o*. Fig. 11. [6] *z*. *z*. Figg. 7. 8. [7] *n'*. Fig. 13. [8] Fig. 13.

thick and strong muscles which form the anterior and posterior pairs above noticed, do not decussate each other, but pass a little obliquely from one valve to the other. On the lower valve they are attached to the margin of the elevation caused by the oval depression noticed on the exterior of the shell. Some of the fibres of the large anterior pair pass through the chink in the perforated valve, and expand into the organ of adhesion. Within the space included by the above pairs of muscles, there are two slender pairs of muscles which decussate each other. The superior pair[1] take their origin from the anterior part of the strong membrane that circumscribes and protects the *viscera* below the stomach, and between the insertions of the anterior shell-muscles; they then ascend, diverge on either side the alimentary canal, and are inserted into the opposite valve outside the posterior shell-muscles. The inferior pair[2] arise from the sides of the membranous circle, and converge, as they pass below the preceding, to be inserted into the perforated valve on the inner side of the posterior shell-muscles. While, therefore, the larger muscles have the more important office of guarding the animal by closing the shell, the smaller muscles would admit the water by sliding the margin of one valve over the other; and they are also calculated to produce a compression of the *viscera*.

The labial processes, or *brachia*, are scarcely more adapted to protrude externally than in *Terebratula Chilensis*, the only parts that are free being the short spiral extremities; but in the more muscular character of their basis or stem, they exhibit a closer affinity with *Lingula*. Considering the arms as a pair, the stems are then joined below the mouth, forming on that aspect a transverse semilunar fleshy basis, fringed and convex anteriorly. This is attached to the anterior part of the tendinous belt of the *viscera*[3]. At the sides of this basis the arms make a sudden bend upon themselves towards the mouth, above and in front of which the extremities make a spiral turn and a half[4]. The bent portions are closely adherent to each other, not free as in *Lingula*. These parts of the arms, by contracting from the angle of flexion towards the mouth, would necessarily become thicker, and so press upon and open the shell a little way, in a manner analogous to what I have supposed to take place in the calcareous loop of *Ter. Chilensis*; the arms in *Orbicula* are not, however, supported by an internal calcareous process. The muscular basis, when cut into, exhibits on each side a well-defined cylindrical cavity[5], which commences near the mesial plane in the transverse part below the mouth, and is continued into the spiral extremity. I injected these canals, but could not in that way perceive that they had any connexion with the vascular system: no part of the fluid entered the filaments composing the fringe. The parts being hardened by long maceration in spirits, prevented the unfolding of the arms by any force I could use; but I conclude, nevertheless, that the canals serve to extend outwards the free spiral extremities, by being forcibly distended with fluid propelled along them,—a

[1] *h*. Figg. 7. 8. [2] *i*. Fig. 7. 8. [3] *k'*. Fig. 8. [4] *l*. Figg. 9. 10. [5] *m*. Figg. 9. 12.

species of animal motion of which we find examples in the erectile tissues of higher organizations.

The brachial filaments, when viewed through the lens, presented an equal cylindrical figure, and an entire surface; they are less transparent, and of a more muscular texture than those of *Ter. Chilensis*; they are also thicker and shorter, and more incurvated. Their bases are covered on the inner side of the arms by a small fold of membrane[1].

The mouth, a small puckered orifice[2], is best seen by dissecting away the transverse base of the arms. The *œsophagus*[3] passes obliquely through the tendinous wall of the *viscera*, in a direction towards the upper or imperforate valve; having then passed between the anterior shell-muscles, it becomes slightly dilated, and surrounded by the liver, forming a less capacious stomach than in *Terebratula*[4]. The intestine[5] is continued straight to the opposite end of the visceral cavity, and is there again contracted, and making a sudden bend upon itself, passes in a slight sigmoid curve to the middle of the right side of the visceral belt, which it perforates obliquely, and terminates between the lobes of the mantle about half a line below the bend of the arm[6]. The liver[7] is of a beautiful green colour; it is a congeries of elongated follicles closely compacted together, which communicate by numerous orifices with the stomach. There is no gland, analogous to a salivary gland, anterior to the liver; nor was any gland but the liver perceptible in *Terebratula*; and in this respect they resemble the ordinary *Bivalves*, the mouth being, as in them, destitute of any hard parts for comminuting or seizing alimentary substances, and therefore not requiring the superaddition of salivary glands. The coats of the stomach and intestines are thick and pulpy, and apparently glandular.

Posterior to the liver the whole of the visceral cavity not occupied by the muscles and vessels is filled with grey masses of *ova*. In these masses the distinct granules could not be seen; but between the membranes circumscribing the *viscera*, *ova* of a browner colour could be more distinctly made out. These, I suspect, were on their passage to the mantle-lobes, where probably in older specimens they would be seen. Poli has beautifully figured the *ova* of *Crania personata*, following the course of the branchial vessels and obscuring them. He consequently calls these the ovaries, and observes that they agreeably ornament the mantle[8].

In *Terebratula* all my attempts to trace the nervous system were unsatisfactory; but in one of the *Orbiculæ*, dissected expressly for that purpose, I succeeded in detecting two small *ganglia* on the side of the *œsophagus* next the perforated valve, from which two filaments accompanying the *œsophagus* through the membranous wall immediately diverge and pass exterior to the anterior shell-muscles, accompanying corresponding

[1] Fig. 12. [2] *q*. Figg. 9. 11. [3] *r*. Fig. 11. [4] *s*. Figg. 7. 8. 9. 11.
[5] *t*. Figg. 7. 8. 9. 11. [6] *u*. Figg. 9. 10. 11. [7] *v*. Figg. 5. 11.
[8] Testacea utriusque Siciliæ, vol. ii. pl. xxx. fig. 24. *Criopus*.

arteries to near the hearts, beyond which I could not trace them. I can speak positively that there is no longitudinal ganglionic cord on either aspect of the *viscera*, corresponding to the nervous system of the *Cirripeds*. A single small *ganglion* is situated on the opposite side of the *œsophagus*, but on a plane posterior to the preceding. This, however, I suspect to be the cerebral *ganglion*, and believe it gives off the nerves to the free spiral extremities of the arms, close to the base of which it is situated.

Some Observations on the Anatomy of Lingula Audebardii, *Brod.*

The structure of this species corresponds in all essential particulars with that of *Ling. anatina* as given by Cuvier. The differences appear first in the length of the *cilia*, which in the present species are three or four times longer than those of *Ling. anatina*. The subdivisions of the branchial vessels project from the inner surface of the mantle, in linear series similar in their direction to those of *Ling. anatina*: but the lines are not continuous; they are composed of distinct and separate folds of the mantle, of a minute size, along the convexity of each of which a single vascular loop is extended without giving off lateral ramulets, the whole structure affording a beautiful example of the first stage in the composition of a complex lamellated gill[1].

All the glandular masses communicating with the alimentary canal bear the green colour characteristic of the liver, especially that central one surrounding the stomach, which Cuvier has marked as the salivary gland in *Ling. anatina*. Now as the specimens examined by that great anatomist had been long preserved in spirit, one of them having in fact formed part of the collection of Seba, the colour of the parts had probably been discharged. I am therefore inclined to think that *Ling. anatina* agrees in this respect both with the newly added species of the same genus, and with the other *Brachiopodous* genera, and indeed exhibits, in the absence of salivary glands, as of dental organs, a correspondence with all the *Acephalous Mollusks*. With respect to *Ling. Audebardii*, I shall only add, that the distal end of its pedicle is dilated and rounded, and in the small specimen dissected did not present any appearance of having been attached to a foreign substance.

General Remarks.

On comparing together the three genera of *Brachiopoda* above described, we find that although *Orbicula* in the muscular structure of its arms, and the proportion of the shell occupied by its *viscera*, is intermediate to *Lingula* and *Terebratula*, yet that in the structure of its respiratory organs, its simple alimentary canal, and its mode of attachment to foreign bodies, it has a greater affinity to the latter genus. The modifications that can be traced in the organization of each of these genera, have an evident reference to the different situations which they occupy in the watery element.

Lingula, living more commonly near the surface, and sometimes where it would be

[1] See Fig. 16.

left exposed by the retreating tide were it not buried in the sand of the shore, must meet with a greater variety and abundance of animal nutriment than can be found in those abysses in which *Terebratula* is destined to reside. Hence its powers of prehension are greater, and Cuvier suspects it may even enjoy a species of locomotion from the superior length of its peduncle. The organization of its mouth and stomach indicates, however, that it is confined to food of a minute description; but its convoluted intestine shows a capacity for extracting a quantity of nutriment proportioned to its superior activity and the extent of its soft parts. A more complex and obvious respiratory apparatus was therefore indispensable, and it is not surprising that the earlier observers failed to detect a corresponding organization in genera destined to a more limited sphere of action.

The respiration, indeed, as well as the nutrition of animals living beneath a pressure of from sixty to ninety fathoms of sea water, are subjects of peculiar interest, and prepare the mind to contemplate with less surprise the wonderful complexity exhibited in the minutest parts of the frame of these diminutive creatures. In the stillness pervading these abysses they can only maintain existence by exciting a perpetual current around them, in order to dissipate the water already loaded with their effete particles, and bring within the reach of their prehensile organs the *animalcula* adapted for their support. The actions of *Terebratula* and *Orbicula*, from the firm attachment of their shells to foreign substances, are thus confined to the movements of their brachial and branchial filaments, and to a slight divarication or sliding motion of their protecting valves; and the simplicity of their digestive apparatus, the corresponding simplicity of their *branchiæ*, and the diminished proportion of their soft to their hard parts, are in harmony with such limited powers. The soft parts in both genera are, however, remarkable for the strong and unyielding manner in which they are connected together: the muscular parts are in great proportion, and of singular complexity as compared with ordinary *Bivalves*; and the tendinous and aponeurotic parts are remarkable for the similarity of their texture and appearance to those of the highest classes. By means of all this strength they are enabled to perform the requisite motions of the valves at the depths in which they are met with. *Terebratula*, which is more remarkable for its habitat, has an internal skeleton superadded to its outward defence, by means of which additional support is afforded to the shell, a stronger defence to the *viscera*, and a more fixed point of attachment to the brachial *cirri*.

The spiral disposition of the arms is common to the whole of the *Brachiopodous* genera whose organization has hitherto been examined; and it is therefore probable that in that remarkable genus *Spirifer* the entire *brachia* were similarly disposed, and that the internal calcareous spiral appendages were their supports. If, indeed, the *brachia* of *Ter. psittacea* had been so sustained, this species would have presented in a fossil state an internal structure very similar to that of *Spirifer*.

In considering the affinities of the *Brachiopoda* to the other orders of *Mollusca*, I shall compare them in the first place with the *Lamellibranchiate Bivalves*, to which they present the most obvious relations in the nature and forms of their organs of defence. To these they are in some respects superior. The labial arms are more complex prehensile organs than the corresponding vascular *laminæ* on either side the mouth of the *Lamellibranchiata*. The whole muscular system is more complex; and the opening as well as the closing of the shell being regulated by muscular action, indicates a higher degree of organization than where the antagonizing power results from a property of the cardinal ligament, which is independent of vitality, viz. elasticity. With respect, however, to the respiratory organs, the modifications which these have presented in *Orbicula* and *Terebratula* show the *Brachiopods* to be still more inferior to the *Lamellibranchiata* than was to be inferred from the structure of the *branchiæ* in *Lingula*: and notwithstanding the division of the systemic heart, I consider that there is also an inferiority in the vascular system. Each heart, for example, in the *Brachiopoda* is as simple as in *Ascidia*, consisting of a single elongated cavity, and not composed of a distinct auricle and ventricle, as in the ordinary *Bivalves*: for in these even when, as in the genus *Arca*, the ventricles are double, the auricles are also distinctly two in number; and in the other genera, where the ventricle is single, it is mostly supplied by a double auricle. The two hearts of the *Brachiopoda*, which in structure resemble the two auricles in the above *Bivalves*, form therefore a complexity or superiority of organization more apparent than real.

Having been thus led to consider the circulating as well as respiratory systems as constructed on an inferior plan to that which pervades the same important systems in the *Lamellibranchiate Bivalves*, I infer that the position of the *Brachiopoda* in the natural system is inferior to that order of *Acephala*.

Among the relations of the *Brachiopoda* to the *Tunicated Acephala*, and more especially to the *Ascidiæ*, we may first notice an almost similar position of the extended respiratory membranes in relation to the mouth, so that the currents containing the nutrient molecules must first traverse the vascular surface of that membrane before reaching the mouth; the simple condition also to which the *branchiæ* are reduced in *Orbicula* and *Terebratula* indicates their close affinity to the *Ascidiæ*. But in consequence of the form of the respiratory membranes in the *Brachiopoda*, which is so opposite to that of the sacciform *branchiæ* of the *Ascidiæ*, the digestive system derives no assistance from that part as a receptacle for the food, and the superaddition of prehensile organs about the mouth became a necessary consequence. The *Brachiopods* again are stationary, like the *Ascidiæ*, and resemble the *Bolteniæ* in the pedunculated mode of their attachment to foreign bodies.

With the *Cirripeds* their relation is one of very remote analogy; their generative, nervous, and respiratory systems being constructed on a different type, and their *brachia* manifesting no trace of the articulate structure. In all essential points the *Brachiopoda* closely correspond with the *Acephalous Mollusca*, and I consider them as being intermediate to the *Lamellibranchiate* and *Tunicate* orders; not, however, possessing, so far as they are at present known, distinctive characters of sufficient importance to justify their being regarded as a distinct class of *Mollusks*, but forming a separate group of equal value with the *Lamellibranchiata*.

PLATE XXII.

Anatomy of *Terebratula*.

Fig. 1. *Terebratula Chilensis*, Brod., natural size.

2. *Terebratula Uva*, Brod., natural size.

3. Perforate valve of *Terebratula Chilensis*.

   a. The perforation, or groove, through which the tendons of the muscles pass to form the pedicle.

   b. The teeth of the hinge, which are locked in the depressions *b. b.* of fig. 4.

   c. The muscular impressions.

4. Imperforate valve of the same specimen.

   a. The middle depression of the hinge.

   b. b. The lateral depressions.

   c. The mesial process, or ridge continued from the hinge.

   d. The lateral processes of the same, which are attached to the bends of

   e. e. The elastic calcareous loop.

   f. f. Small processes at the origins of the *crura* of the loop.

   g. g. Impressions of the anterior pair of muscles.

   h. h. Impressions of the posterior pair.

Figg. 5. to 9. are dissections of a smaller specimen of *Ter. Chilensis* magnified two diameters.

5. The soft parts corresponding to the perforate valve.

6. The soft parts corresponding to the imperforate valve. The branchial vessels, brachial filaments, and liver, may be distinguished through the semitransparent mantle.

7. The soft parts viewed from the same aspect as in Fig. 5, with the mantle-lobe reflected, showing more distinctly the branchial vessels, and exposing the arms in their natural position.

8. The soft parts viewed from the same aspect as in Fig. 6., with the mantle-lobe reflected, exposing part of the visceral mass, and the bend of the arms following the bend of the calcareous loop.

9. The mantle-lobes further separated, the calcareous loop broken through and removed, and the arms dissected off and displaced, to show the decussation of the muscles, and the small visceral mass.

Fig. 10. A small portion of one of the arms, magnified.

11. A small portion of the edge of the mantle, highly magnified.
    - α. The branchial *cilia.*
    - β. The marginal fringe.
    - γ. The marginal canal.
    - δ. The branchial artery.
    - ε. The branchial vein.
    - ζ. *Ova.*

12. The alimentary canal, as seen from above or behind, and a portion of the liver of *Terebratula psittacea*, Brug., magnified.
    - α. The mouth.
    - β. The *œsophagus.*
    - γ. The stomach, with the *parietes* imperfect where the liver has been removed: it is turned towards the left side, to show
    - δ. The intestine.
    - ε. The *anus.*
    - ζ. A portion of the liver.

13. A few of the hepatic follicles, highly magnified, showing the vascular network upon their *parietes* formed by the hepatic vessels.

14. *Terebratula psittacea,* with the greater part of the imperforate valve removed to show the soft parts.

14*. *Terebratula psittacea,* with the perforate valve and lobe of the mantle removed to show the arms, one of which has been artificially unfolded.

15. *Terebratula Sowerbii,* King, natural size: the greater part of the perforate valve has been removed to show the *ova* accompanying and obscuring the branchial vessels, seen through the mantle.

16. The separated valves of *Terebratula Sowerbii*: in the imperforate valve the arms, and one lobe of the mantle have been removed, to show the calcareous loop, visceral mass, muscles and *ova,* surrounding the vessels of the opposite mantle-lobes.

The following letters indicate the same parts in each figure.

a. The mantle-lobe of the imperforate valve.
b. The mesial fissure, corresponding to the mesial process of that valve.
c. The mantle-lobe of the perforate valve.
d. d. The fringed margins of the mantle.
e. The tubular prolongation accompanying the pedicle.
f. f. The anterior pair of muscles arising from the imperforate valve.
g. g. The posterior pair of muscles arising from the imperforate valve.
g′. g′. Fig. 16. The insertion of these muscles into the pedicle.
h. h. The anterior pair of muscles arising from the perforate valve.

h'. h'. Fig. 16. The insertions of these muscles into the opposite valve.
i. i. The posterior pair of muscles of the perforate valve.
k. k. The fringed *brachia*, or labial arms.
l. l. Their free spiral extremities.
m. m. The branchial vessels ramifying upon the mantle-lobes.
n. n. The two systemic hearts.
o. The mouth.
p. The stomach.
q. The liver.
r. The *ova*.

PLATE XXIII.

Anatomy of *Orbicula*.

Fig. 1. *Orbicula Cumingii*, Brod., natural size.
1*. *Orbicula strigata*, Brod.
2. Group of *Orbicula lamellosa*, Brod., natural size.
3. External surface of the lower or flattened valve of *Orbicula lamellosa.*
4. Internal surface of the same.
a. a. The muscular impressions.
b. The fissure through which the pedicle passes.
c. The central process, or ridge of the perforated valve.
5. The soft parts of *Orbicula lamellosa, in situ*, after the removal of the convex valve; showing the ciliated and vascular mantle, the shell-muscles and visceral mass.
6. The soft parts of *Orbicula lamellosa*, exposed by the removal of the flattened and perforated valve, showing a similarly organized mantle-lobe, and the expanded base of the pedicle, or foot.
7. The soft parts, as in Fig. 5, farther exposed by reflecting the mantle-lobe. The stomach and decussating visceral muscles are shown by the removal of the liver and ovary.
8. The soft parts, as in Fig. 6, similarly exposed by the reflection of the mantle-lobe, and the removal of the liver and ovary. The whole course of the intestinal canal is here seen.
9. The visceral mass and reflected portions of the arms, with their spiral extremities, and the cavities in the muscular stem exposed. The alimentary canal, with the mouth and *anus*, and the liver and ovary, are shown.
10. A side view of the soft parts, with the mantle-lobes separated to show the *anus* just below the bend of the right arm, the spiral extremity of which is unfolded.

Fig. 11. A magnified view of the superior mantle-lobe injected, with the hearts, ovary, digestive and nervous systems.

12. A highly magnified view of a small portion of the brachial tentacles and stem.

13. A highly magnified view of a small portion of the edge of the mantle, showing the terminal divisions of the branchial vessels, and the setose *cilia*.

The same letters indicate the same parts in each figure.

a. The mantle-lobe of the flattened or lower valve.
b. The mesial fissure corresponding to the mesial process of the valve.
b'. The shell-secreting edge prolonged beyond the roots of the *cilia*.
c. The mantle-lobe of the convex or upper valve.
d. d. The fringed margins of the mantle.
d'. The long setose *cilia*.
d''. The shorter *cilia*.
e. The expanded peduncle.
f. f. The anterior pair of shell-muscles.
g. g. The posterior pair of shell-muscles.
h. h. The anterior superior visceral muscles.
i. i. The posterior inferior visceral muscles.
k. k. The fringed *brachia*, or arms.
k'. The transverse basis.
l. l. The free spiral extremities.
m. m. The canals in the fleshy basis of the arms.
n. n. The branchial vessels. These are figured as injected at fig. 11. the dark lines *n'*. being the arteries.
o. o. The two hearts. (The letters are placed in the orifices of communication with the veins of the opposite mantle-lobe.)
p. p. The arteries going to the liver, ovary, &c.
q. The mouth.
r. The *œsophagus*.
s. The stomach.
t. The intestine.
u. The *anus*.
v. The liver.
w. The ovary.
x. The subœsophageal *ganglia*.
y. The filaments from them.
z. The circumscribing *aponeurosis* of the *viscera*.

14. *Lingula Audebardii*, Brod.

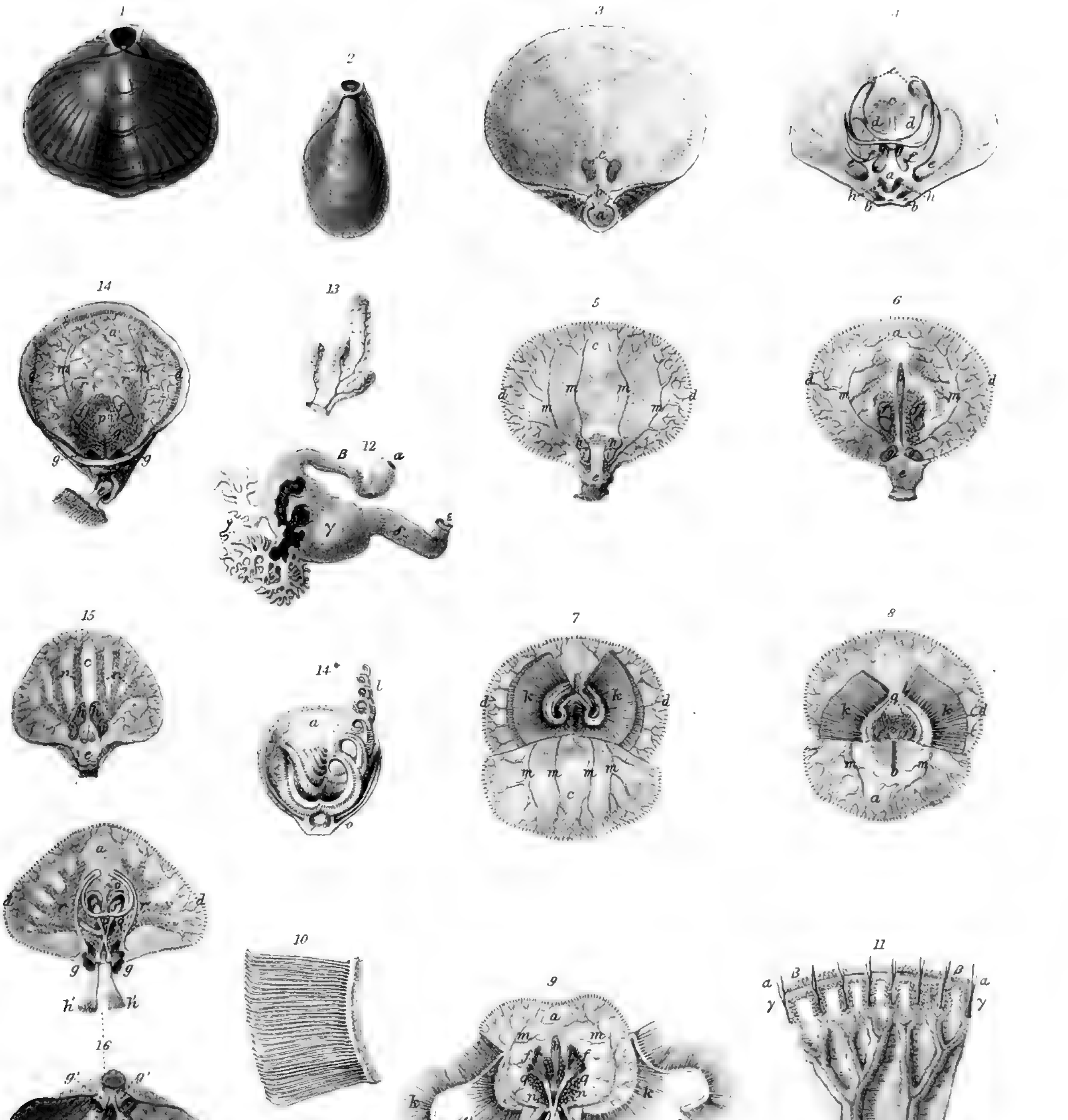
15. The soft parts of the same species, exposed by the removal of the upper

valve, or the one which corresponds to the imperforate valve of *Orbicula*, and to the perforate valve of *Terebratula*.

a. The shell-secreting margin of the mantle.
b. The cavity containing the roots of the *cilia*.
b'. The same laid open.
c. The *branchia*.
d. The branchial vein.
e. The interbranchial space of the mantle, which is also vascular.
f. The anterior muscles, attached at one extremity only to the shell.
g. The anterior pair of shell-muscles analogous to the anterior shell-muscles of *Orbicula*.
h. The third pair of muscles analogous to the decussating muscles of the *viscera* in *Orbicula*.
i. The posterior shell-muscle.
k. k. The liver seen through the mantle.
l. l. The straight portion of intestine.
m. m. The ovaries.

Fig. 16. A magnified view of the respiratory organs of one of the mantle-lobes.
a, *b*, *b'*, *c*, *d*, *e*, signify the same parts as in the preceding figure.

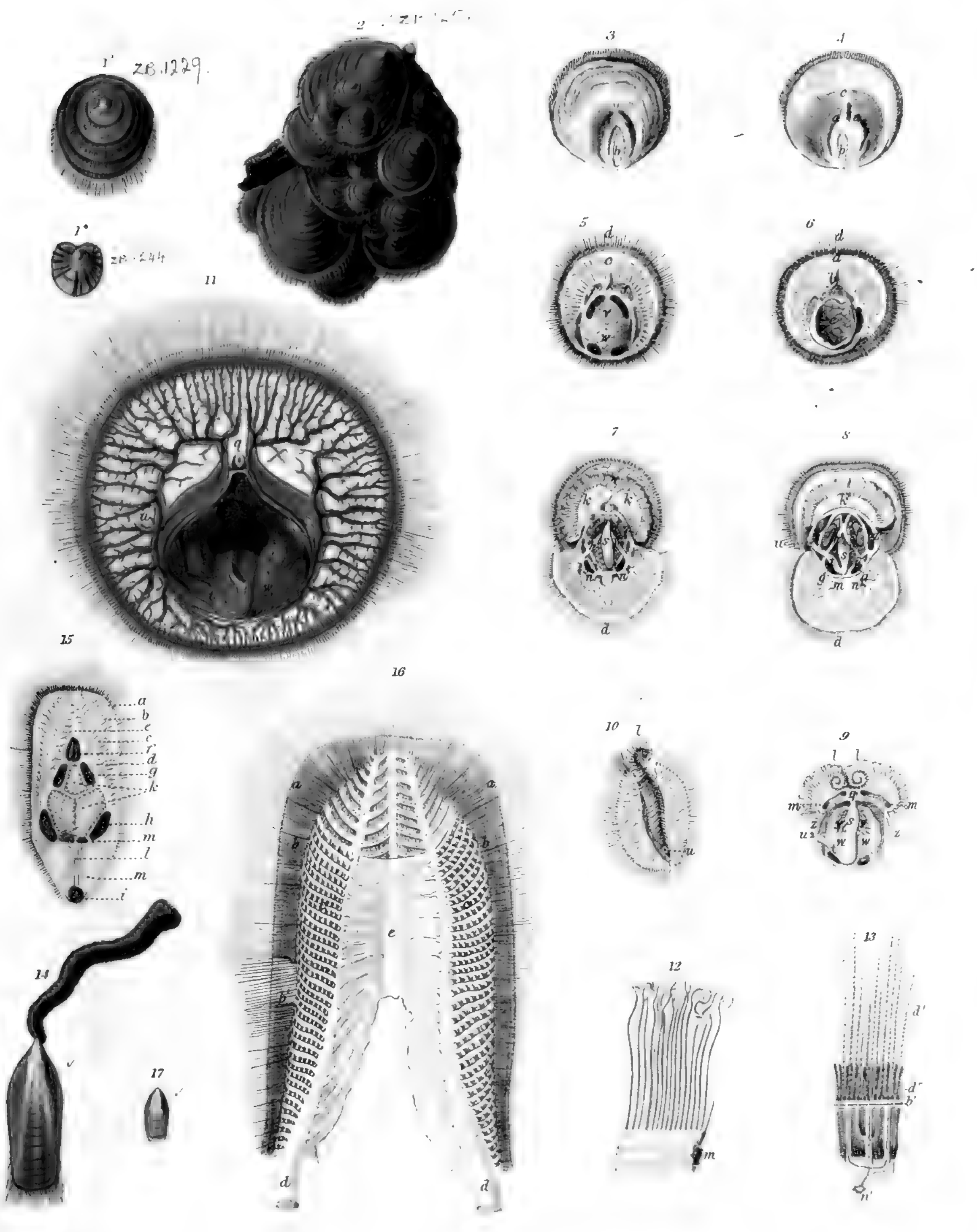
17. *Lingula Semen*, Brod.



R. Owen, & G. Sowerby. del. Zeitter. sc.

Terebratula.

1 & 3-11. Ter. Chilensis. 2. Ter. Uva. 12-14*. Ter. psittacea. 15-16. Ter. Sowerbii.



R. Owen. & G. Sowerby. del.

Zeitter. sc.

Orbicula & Lingula.

1. Orb. Cumingii. 1. Orb. strigata. 2-13. Orb. lamellosa. 14-16. Ling. Audebardii. 17. Ling. Semen.*

XIX. *Some Account of the* maneless Lion *of Guzerat.* *By Capt.* Walter Smee, *of the Bombay Army, F.Z.S.*

Communicated December 10, 1833.

In bringing under the notice of the Society the accompanying skins of a *Lion* and *Lioness* killed by me in Guzerat, I esteem myself fortunate in being enabled to demonstrate, by their exhibition, that there exists a race in which the king of beasts is destitute of the flowing mane which constitutes the most remarkable of his regal ornaments. That such a race existed in ancient times, and that in more modern days it was still to be met with, has, I am aware, been very generally believed by zoologists: but the belief has hitherto rested on the testimony of authors, and has not until now been confirmed in Europe by the only evidence which can, in such cases, be regarded as conclusive,—the production of the animal itself, or of its skin. The skins now before the Society are selected from among eight which I have brought to England: the total number of such *Lions* killed by me in the district in which they were obtained having been eleven. In none of them was the mane more extensive than in the male now exhibited; and in none of them was it in any degree pendent.

The epithet of *maneless*, as applied to this *Lion*, is, however, rather comparative than positive: it is maneless as compared with the *Lion* of Africa, in which the long and dense and flowing hairs that spring from the hinder part of the head, from the neck, and from the shoulders, conceal completely the form of these parts, and envelope the whole of the anterior part of the animal except its face: it is maned as compared with the *Tiger*, the *Leopard*, and other large species of the genus *Felis*,—maned even in a greater degree than the *hunting Leopard* or *Cheetah*, to which the designation of *jubata* has been specially appropriated. As in the last-named animal so in the *Guzerat Lion* is the back of the neck ornamented by a broad longitudinal line of erect hairs of greater length than those of the adjoining parts; as in it the sides of the neck are also furnished with longer hairs; but the throat has in addition hairs of still greater length, which hang downwards in loose silky locks. It is therefore only as a *Lion* that it can be regarded as maneless, but as a *Lion* it is well entitled to this distinction.

The nature and appearance of the mane will be best understood by describing with some little detail the covering of the anterior part of the body. On the top of each shoulder there is a point from which the hairs diverge in all directions in a whorled manner: adjoining to this point they are all equally short with those on the body generally. Those which pass from the whorl downwards and backwards have the usual direction over the anterior limbs and sides, and are uniformly short, close, and adpressed. Those which pass from the whorl forwards become gradually lengthened, but still remain adpressed on the side of the neck; along the middle of the side of the neck they are straight and directed forwards, while both the lower and the upper ones are curved, the former downwards and the latter upwards. The lower ones in passing downwards are very much elongated, soft, and not closely set; they consequently hang loosely in silky tufts along the lower part of the sides and the whole under surface of the neck. The upper ones, curved in an upward direction, are somewhat less elongated and are much more firm and closely set than the lower ones; along the middle line of the back of the neck, where they meet those of the opposite side, they are, by the resistance thus offered, directed away from the surface, and they form in this situation a dense longitudinal erected crest, nearly four inches in height, and extending from before backwards through a space of about ten inches in length: the tips of the hairs composing this crest are generally curved backwards, and the crest itself is continued posteriorly into a reclining and gradually disappearing series of lengthened hairs which are also directed backwards. This series is derived from the gradual lengthening of the hairs directed upwards from the whorl on the shoulder, and from their meeting with those of the opposite side, and is terminated (at a distance behind the whorl about equal to that of its commencement from the front of the whorl) by another series of hairs, reversed in their direction, which extends along the middle line of the back from near the shoulders to the loins: on the loins and behind them the hairs of the middle line again resume their usual and backward direction. In front the cervical crest is continued forwards to the interspace between the ears, where it is terminated by the gradual running into it of the short hairs of the upper part of the face, which have the usual backward direction. In front of the ears and below them tufts of loose projecting hairs form a boundary between the face and the neck.

Such is the fur on the anterior part of the body of the *Guzerat Lion*. In the *Lioness* the covering consists of short and almost adpressed hairs, except in front of and below the ears; and there is consequently only a bare vestige of the cervical crest, and no pendent tufts exist beneath the neck. The whorl remains, however, precisely similar to that of the male, and the direction of the hairs from it corresponds exactly in both sexes: both too have equally a reversed direction in the hairs of the middle part of the middle line of the back. In both there occur three ridges of short erect hairs along the face, one of which is abbreviated and mesial, being situated between the anterior angles of the eyes, and the two others extend in a wavy form, one on each side, from the angle of the eye to the nose.

In the *African Lion* the hairs of the anterior part of the body radiate also in a similar manner from a point on the shoulder on each side. In the adult male, whose shoulders and neck are covered with his copious mane, the direction of the hairs in this part can scarcely be traced with certainty: but in the female it is readily observable, though less strongly marked than in either the female or the male of the *Guzerat Lion*. The female of the *African Lion* has along the middle line of the back of her neck a vestige of mane, corresponding with that of the Lioness of Guzerat; and both the male and female have ridges of hair passing down the face, which seem, however, to be less constant and regular than those observed in the *Lion* of *Guzerat*.

In the *African Lion* also the reversed direction of the hairs from behind forwards along the middle line of the back from the loins to near the shoulders, obtains equally as in the *Lion* of *Guzerat*. This latter character is, however, subject to variation; but whether from individual peculiarities or as indicative of the existence of different races, I am not in possession of sufficiently numerous facts to enable me to determine. In a skin, (preserved in the Museum of the East India Company and marked as having been obtained in India,) the reversed direction of the hair is limited to about one half of the usual extent, reaching forwards from the loins no farther than to near the middle of the back, where it is met by the prolonged termination of the ordinary series of backwardly directed hairs[1]. In one other skin which I have had occasion to examine it does not exist at all, there being no reversed hairs whatever along any part of the middle line of the back: the animal from which it was obtained lived formerly in the Society's Menagerie, but I have not been able to ascertain the locality from which it was originally procured.

The sutures and various direction of the hairs which have just been described appear to be peculiar, in the genus *Felis*, to the *Lion*. They do not occur in any other species that I have examined, in all of which the hairs are directed regularly from the head towards the extremity of the body and tail and limbs. This is equally the case in the *Leopard*, destitute of the slightest appearance of mane, and in the *Cheetah*, the maned *hunting Leopard*. In the *Cheetah*, to which I have already compared in these respects the *Lion* of *Guzerat*, the mane of the back of the neck and that of the sides are occasioned solely by the elongation and crispation of the hairs of these parts, by means of which they are thrown off from the skin; but the hairs are all directed backwards, and have in this respect nothing in common with the mane of the *Lion*.

The quality of the fur in the *Guzerat Lion* corresponds generally with that of the *African* race, being short, firm, and adpressed. The under surface in both is furnished with hairs of greater length than the upper; but in the *Guzerat Lion* these are only so

[1] This skin is also remarkable for the beautiful manner in which it displays the whorling of the hairs from the point on the shoulder; the mane is sparing, but the long hairs of which it is composed commence immediately from the whorl and radiate in all directions.

much longer as they are in the *Feles* generally, and have none of that floccose character which is given to the middle line of the belly in the *African Lion* by the extreme length of the hairs on this part,—a length almost equal to that of the hairs composing the lower portion of the mane. In both animals the hairs at the extremity of the tail are lengthened, forming a tuft or brush, which is the more remarkable owing to its colour being different from that of the adjoining parts: but in the *Guzerat Lion* this tuft is considerably larger and more dense than in the *African*. In the latter the brush does not greatly exceed in diameter the tail itself: in the former its diameter is more than twice as great, and its length is increased in proportion to its thickness. In this tuft there existed, subsequently to its arrival in England, in the oldest of my Lions, a short horny claw or nail, similar in form to, but somewhat larger in size than, the one described by Mr. Woods in the 'Proceedings of the Committee of Science and Correspondence' of this Society[1] as having been obtained from the tail of a young Lion from Barbary still living in its Menagerie. My specimen has since been deprived of this appendage, probably in consequence of its having been handled somewhat roughly.

Both the *African* and the *Guzerat Lion* are subject to considerable variation in intensity of colouring. In both the colour is fulvous; but in some individuals this is much paler than in others, and in the darker specimens there occurs a tinge of red. The middle line of the back is the most deeply coloured part, and the under surface is much paler and almost white. Among the hairs there is an intermixture of some which are entirely black, and the greater or less proportion which these bear to the paler ones is the principal cause of the variations in depth of colour that occur in different individuals. Of the *Guzerat Lions* the oldest individual is the lightest in colour. The tail becomes gradually paler towards its extremity, passing into greyish white; its terminal brush consisting of black hairs slightly tinged with brown. Above each eye there is a pale space, in which is included a darker coloured spot for the implantation of the supraciliary *vibrissæ*, from twelve to fifteen in number, and of which the longest reaches nearly to the ears. In the *African Lion* these *vibrissæ* are implanted in a darker spot, but this spot is less defined and is only partially bounded by a paler space. In both the points of insertion of the moustaches are darker than the surrounding parts.

Of the form of the *maneless Lion* of Guzerat, as compared with that of the *Lion* of Barbary, I cannot venture to speak with confidence, from not having possessed an opportunity of observing them together in the living state. The recollection which I retained of the *African Lion* was too indistinct to aid me in this comparison while the *Lion* of Guzerat was before my eyes: my recollection of the *Lion* of Guzerat, as to its form and proportions when entire, may perhaps have in some measure faded before I

[1] Part II. p. 146.

had again the opportunity of observing the various living *Lions* from Africa now or lately to be seen in London. My impression, however, is that the *Lion* of Guzerat is comparatively more rounded and bulky in its body, and rather shorter in its limbs; and that its head especially is shorter, has less of the square form which distinguishes the open face of the male *African Lion*, and is more rounded on the fore-head. But it is by no means impossible that this difference in physiognomy may be chiefly owing to the existence in the one case of long hairs concealing the upper part of the fore-head, which in the other is defined and visible, having on it none beyond the ordinary covering of the animal.

The *cranium* of the *Lion* of Guzerat generally resembles that of the African race, being less rounded in its contour than that of the *Tiger*: its fronto-facial suture has also the form that it possesses in the former, the frontal processes of the nasal and maxillary bones being both prolonged backwards to the same level[1]. But the space between the postorbital processes is flattened only, and not concave; and the facial plane of the bones is comparatively longer than the cranial, and is also somewhat

[1] It is to Mr. Owen that I am indebted for the knowledge of this important distinctive character between the *crania* of the two largest of the *Carnivorous Mammalia*; and he has kindly allowed me to add the following remarks from his pen

"*On the Differences observable in the Skulls of the Lion and Tiger.*

"On comparing together the *crania* of seven *Lions* with those of thirteen *Tigers*, the first character of the *Lion's* skull assigned by Cuvier (the straightness of the outline from the midspace of the postorbital processes to the end of the nasal bones in one direction, and to the *occiput* in the opposite,) is to a certain extent appreciable; the occipital and interparietal crest forms a concave line in the *Tiger*, and is generally straight in the *Lion*: but the difference is so slight on comparing the skull of a large male *Tiger* where the crest is strongly developed, that it would be an unsatisfactory ground of distinction if unsupported by any other character.

"The flattening of the interorbital space in the *Lion*, and its convexity in the *Tiger*, especially in the transverse direction, occasioned by the down-sloping of the supraorbital ridges, is a more constant and appreciable character, and I think would serve alone to distinguish two *crania* of similar dimensions of the *Lion* and *Tiger*.

"But there is in the extent and contour of the nasal processes of the maxillary bones, a difference which is constant and well marked.

"In eight *Lion's* skulls, of which five were accurately certified to be *Lion*, and the remaining three I no longer doubt to be such from their accordance with the other five in this and other distinctive characters, I find that the nasal processes of the maxillary bones extend to the same transverse line which is attained by the coronal or superior ends of the nasal bones, never falling short of this line, and in six out of the eight passing beyond it; the terminal contour of the nasal processes of the maxillary bones being, moreover, rounded, but more or less tending to a point.

"The nasal processes of the maxillary bones in the *Tiger* never extend nearer the transverse plane attained by the nasal bones than one third of an inch, and sometimes fall short two thirds of an inch; terminating broadly in a straight or angular outline, just as if the rounded ends, which we see in the *Lion*, had been cut off.

"This character is so obvious and constant, and the comparison with reference to it is so easily made, that I regard it as the most unfailing and valuable means of distinguishing the skulls of these giants of the *Carnivora*, convex, its highest point being at the upper part of the junction of the nasal with the maxillary bones. These differences, however, it is to be remarked, are deduced from the examination of a young skull only of the *maneless Lion*. In this there exists on one side a double infraorbital *foramen*; and the existence of the same structure in another skull contained in one of the skins has been ascertained. It is interesting to mention this fact, although no great stress can probably be laid on it: but it would seem that the double *foramen*, either on one or both sides, is generally constant in the *Guzerat Lion*, as in two skulls from that country, preserved in the Museum of the Royal College of Surgeons, the same structure occurs which I have found to exist in the two individuals of my own collection that have been examined.

Among the differences which I have endeavoured to describe as existing between the *Lion* of Guzerat and that of Africa, there seem to be none of sufficient importance to authorize their distinction as species originally separate. The variation in the form of the *cranium*, perhaps not sufficiently made out, would probably, even were it certain and constant, be scarcely adequate to establish a specific distinction: and the other differences to which I have adverted are all, as it will have been observed, differences in degree alone. I feel, therefore, unwilling to regard the *maneless Lion* of Guzerat as a species distinct from the *maned Lion* of Africa and India, of which I propose rather to consider it as a variety to be designated

FELIS LEO GOOJRATENSIS.

Jubâ maris cervicali brevi erectâ, ventre ejubato; caudæ flocco maximo.

the *Lion* and the *Tiger*, that has been discovered. My attention was first called to it by a scientific visiter of the Hunterian Collection some months back, whose name I regret that I have been unable to learn, and I am not aware that it has been given to the public in any form.

"There are some minor differences observable in the skulls of the *Lion* and *Tiger*, which may also be noticed.

"The infraorbital *foramina* are proportionally larger, chiefly in their transverse diameter, in the *Lion*.

"In the *crania* of two *Lions*, the only ones known to be Asiatic in the Museum of the Royal College of Surgeons, it is remarkable that this *foramen* is double: in one, which was killed in North Guzerat, this occurs on both sides; in the other, which was killed near Assund, it is found on the left side only.

"Two skulls may be selected out of the twenty *crania*, one of a *Lion* and the other of a *Tiger*, in which the nasal aperture is nearly of the same dimensions; but is, however, perceptibly narrower at the lower part in the *Tiger*. All the other skulls of the *Lion* deviate from the one selected in the enlargement or squaring of the nasal aperture; all the other skulls of the *Tiger* equally deviate from the one selected in the opposite direction, the nasal aperture growing narrower below, or more triangular. On comparing, therefore, the whole together, the nasal aperture is seen to be obviously narrower in proportion to its length, and smaller in relation to the size of the whole *cranium*, in the *Tiger* than in the *Lion*. This, however, can only be regarded as an accessory character, to be noticed after ascertaining the more important ones above mentioned.

"The coronal extremities of the nasal bones of the *Tiger* are sunk deeper in a longitudinal depression than in the *Lion*; and in most of the *Tiger's crania* this depression is bounded above by a small but distinct semilunar ridge, which has its concavity directed forwards. This ridge does not appear in the *Lion's crania*."—R. O.

A male killed by me on May 13th, 1830, measured 8 feet 9½ inches in total length, including the tail: its height was 3 feet 6 inches. A female killed at the same time was 8 feet 7 inches long, and 3 feet 4 inches high. The impression made by the paw of the male on the sand measured 6½ inches across. His weight, exclusive of the entrails, was 35 stone of 14 lbs to the stone: the head and neck weighed 33 seer (the seer being equal to 2 lbs avoirdupois); the body and limbs, 244½ seer; the fore-leg, 24, and the hind-leg also 24 seer. His liver was more subdivided than that of the female: in the former I counted eleven, and in the latter nine lobes.

These *Lions* are found in Guzerat along the banks of the Sombermuttee near Ahmedabad. During the hot months they inhabit the low brushy wooded plains that skirt the Bhardar and Sombermuttee rivers from Ahmedabad to the borders of Cutch, being driven out of the large adjoining tracts of high grass jungle (called Bheers) by the practice annually resorted to by the natives of setting fire to the grass, in order to clear it and ensure a succession of young shoots for the food of the cattle upon the first fall of the rains. They extend through a range of country about forty miles in length, including various villages, and among others those of Booroo and Goliana, near which my finest specimens were killed. They are so common in this district, that I killed no fewer than eleven during a residence of about a month; yet scarcely any of the natives, except the cattle keepers, had seen them previously to my coming among them. The cattle were frequently carried off or destroyed, but this they attributed to *Tigers*: the *Tiger*, however, does not exist in that part of the country. Those natives to whom they were known gave them the name of *Ontiah Baug*, or *Camel-Tiger*; an appellation derived from their resemblance in colour to the *Camel*. They appear to be very destructive to domesticated cattle, and the remains of a considerable number of carcases of bullocks were found near the place at which my specimens were killed: about ten days previously, four donkeys had been destroyed at the village of Cashwah. I could not learn that men had ever been attacked by them. When struck by a ball, they exhibited great boldness, standing as if preparing to resist their pursuers, and then going off slowly and in a very sullen manner; unlike the *Tiger*, which, on such occasions, retreats springing and snarling.

In addition to the district in which I have met with them, these *Lions* are also found on the Rhun near Rhunpor, and near Puttun in Guzerat. Some persons who saw them in Bombay stated that they also occur in Sind and in Persia. How far this latter statement may be correct I cannot determine; but I may remark that the *Persian Lion* which is at present exhibited at the Surrey Zoological Gardens, has none of the characteristics of the *maneless Lion* of Guzerat, and seems to me to differ but little from individuals known to have been brought from Africa.

Although it has fallen to my lot to introduce this animal to the notice of zoologists, I am aware that its existence in Guzerat had been previously, although by no means generally, known. My friend Lieut.-Col. Sykes knew, many years since, that there were found in Guzerat *Lions* destitute of mane; but his information on the subject has never been published. Sir Charles Malet also had seen *Lions* on the banks of the Sombermuttee in Guzerat; and (as I am not aware of the existence of any others in that locality,) they in all probability belonged to this maneless race, although he makes no mention of its most striking peculiarity. It may be remarked in confirmation, that he attributes to his *Lion* the same native name as that which I have mentioned above[1].

I am not aware that any distinct account of a *maneless Lion* has hitherto been published, except by Olivier[2]. His description, however, though clear in this parti-

[1] "This beast was called by the country people oontia-baug, or camel-tiger, and is by them esteemed to be the fiercest and most powerful of that race. His colour was that of a camel, verging to yellow, but without spots or stripes; not high in stature, but powerfully massive, with a head and fore parts of admirable size and strength. He was killed near the village of Coora, on the banks of the Sabermatty, fifteen coss from Cambay.

"Nearly five quarts of oil were extracted from this animal, which the peasants of that country consider to be very efficacious in rheumatic complaints; and it is used externally in those and some other disorders. The oil of the lion was extracted by stewing the flesh, when cut up, with a quantity of spices: the meat was white, and of a delicate appearance, and was eaten by the wangrees, or hunters, who extracted the oil."—Sir Charles Malet, in Forbes, Oriental Memoirs, vol. iii. pp. 94, 95.

Gesner (de Quadr., Ed. 2. Francof. 1620. p. 590,) enumerates at great length the virtues ascribed to the fat of the *Lion* in various disorders by Greek, Roman, Arabic, and more modern European writers.

[2] "Le Lion qui habite la partie de l'Arabie et de la Perse, voisine du fleuve des Arabes, depuis le golfe Persique jusqu'aux environs de Hellé et de Bagdad, est probablement l'espèce de Lion dont Aristote et Pline ont parlé, et qu'ils regardoient comme une espèce différente, sous plusieurs rapports, de celle qui est répandue dans l'intérieur de l'Afrique. Le Lion de l'Arabie n'a ni le courage, ni la taille, ni même la beauté de l'autre. Lorsqu'il veut saisir sa proie, il a plutôt recours à la ruse qu'à la force: il se tapit parmi les roseaux qui bordent le Tigre et l'Euphrate, et s'élance sur tous les animaux faibles qui viennent s'y désaltérer, mais il n'ose attaquer le sanglier, qui est ici fort commun, et fuit dès qu'il apperçoit un homme, une femme, un enfant. S'il attrape un mouton, il s'échappe avec sa proie; mais il l'abandonne, pour se sauver, lorsqu'un Arabe court après lui. S'il est chassé par quelques cavaliers, ce qui lui arrive assez souvent, il ne se défend point, à moins qu'il ne soit blessé, et qu'il n'y ait pour lui aucun espoir de salut par la fuite. Dans ce cas, il est capable de s'élancer sur l'homme et de le mettre en pièces avec ses griffes; car c'est encore plus le courage que la force qui lui manque. Achmed, pacha de Bagdad depuis 1724 jusqu'en 1747, en eut été déchiré après avoir rompu sa lance dans une partie de chasse, si son esclave Suleiman, qui lui succéda au pachalik, ne fût venu promptement à son secours, et n'eût percé d'un coup de yatagan le lion déjà blessé par son maître.

"Nous avons vu dans la ménagerie du pacha de Bagdad cinq individus de cette race; ils y etaient depuis cinq ans, et avaient été pris jeunes aux environs de Bassora: il y avait trois mâles et deux femelles; les premiers étaient un peu plus gros que les autres, et tous ressemblaient beaucoup à l'espèce d'Afrique, si ce n'est qu'ils étaient plus petits, et n'avaient point de crinière. On nous assura qu'ils n'en auraient jamais, et qu'aucun lion de ces contrées n'en obtenait. Nous avons souvent regretté de n'en avoir pas demandé deux au pacha, un mâle et une femelle, pour les comparer de près à l'espèce d'Afrique, et nous assurer si le lion d'Arabie doit être régardé comme une espèce distincte de l'autre, ou comme une race dégénérée."—Olivier, Voyage dans l'Empire Othoman, l'Egypte et la Perse, tom. iv. pp. 391–3.

cular, is far from being sufficiently detailed to allow of the satisfactory identification of his animal with that of Guzerat. Should subsequent inquiries prove that he was correctly informed as to the locality from which the *maneless Lions* seen by him at Bagdad were obtained, and prove also their identity with those of Guzerat, a more extensive geographical range will be established for this curious race than I am at present disposed to regard as probable.

One other notice of a *maneless Lion* remains to be added: it is the latest that has been published, but sufficient time having elapsed since its announcement to have allowed of full details having been given to the world (details which as regards so interesting a subject would scarcely have been deferred), it is by no means impossible that some error may have occurred respecting it. I refer to the announcement in Mr. Griffith's English Edition of Cuvier's 'Règne Animal'[1], that a maneless and brownish coloured species of *Felis*, larger than a *Lion*, had been forwarded from Nubia to the Frankfort Museum.

Having alluded, in the commencement of this communication, to the opinion that a *maneless Lion* was known to the ancients, it might be expected that I should here bring forward and discuss the several passages which have been looked upon as supporting this view. Where, however, the critics are at fault, it would be presumptuous in me to attempt to decide. I own that I do not find in the passages usually referred to any evidence at all satisfactory as regards the existence of *Lions* destitute of mane; and I am even far from willing to admit that the crisped hairs noticed by Aristotle[2] as distinguishing one race of *Lions* from another in which the hairs were either dense or straight, must of necessity be considered as those of the mane rather than of any other part of the body. The language of Oppian is equally obscure, and even the expressions used by him are warmly contested by the critics[3]. Another Greek writer, Agatharchides[4] the peripatetic, speaks of the Arabian, and especially the Babylonish *Lions*, in terms that recall Olivier's description of those of Bagdad, but still with no definite application to the want of a mane. Pliny[5] alone, so far as I am aware, mentions the absence of mane as a distinctive mark of one race of *Lions*; but to this race he attributes a monstrous generation, and he was probably altogether misled with respect to it.

Pliny, however, in many of his fables has had his followers; and it is by no means improbable that the maneless feline beast which occurs in the older armorial bearings may have been intended to represent a Lion leoparded. This term is still in use among the heralds of France, but is employed by them with reference only to the position of the head; if the full face is shown, the animal, whether maned or maneless, is in their

[1] Vol. ii. p. 428. [2] Arist. Hist. Anim., Ed. Scal. Tolos. 1619, p. 1154.

[3] Oppian., Ed. Schneid., pp. 234 & 365.—Ed. Belin., pp. 108 & 318, 319.

[4] Agatharch. Hist., Oxon. 1597, p. 41. [5] Hist. Nat., lib. 8. cap. 16.

language a Leopard; if the side face alone is seen, it is a Lion. Hence, with them, the Lions passant and gardant of the arms of the Kings of England would be either Lions leoparded, or Leopards maned. The omission of the mane, in rude tricking, would indeed reduce them to Leopards, and as such they were originally regarded; for the earliest present to a National Menagerie in England,—that made by the Emperor Frederic II. to Henry III.,—consisted of three Leopards, in allusion, as Matthew Paris expressly states, to the bearing of the royal shield, "in quo tres leopardi transeuntes figurantur." The bearing may, however, have been intended to represent the Plinian and heraldic hybrid between the two races,—a being altogether imaginary, and therefore a fit companion for the griffins and the unicorns, and the rest of that marvellous and monstrous fraternity.

PLATE XXIV.

Felis Leo Goojratensis.

Felis Leo Goojratensis.

XX. *Description of a New Species of the Genus* Eurylaimus *of Dr.* Horsfield. *By Mr.* John Gould, *F.L.S. Communicated by the Secretary.*

Communicated December 10, 1833.

THE genus *Eurylaimus*, established by Dr. Horsfield for the reception of a bird discovered by him in Java, has since received the accession of a second species, obtained in Sumatra by the late Sir T. Stamford Raffles. To these I am now enabled to add a third, derived from a different though neighbouring locality, and especially remarkable for the elegance of its plumage.

M. Temminck has, I am aware, referred to this group two other species; and a third has recently been added to it by M. Lesson, who has, at the same time, proposed the removal from it of one of those placed in it by M. Temminck. On each of these I shall venture to offer a few observations.

The first of M. Temminck's additions is the only species which has at any time been referred to the *Eurylaimi* from among the birds known previously to the researches of Dr. Horsfield and Sir T. S. Raffles in Java and Sumatra: it is the *great-billed Tody* of the first edition of Dr. Latham's 'General Synopsis of Birds'[1], a name translated by Gmelin, shortly after its appearance, into *Todus macrorhynchos*[2]. This trivial name was not adopted by the original describer of the species, who, in his 'Index Ornithologicus'[3], applied to his *great-billed Tody* the appellation of *Todus nasutus*; and *nasutus* appears since to have been employed by all ornithologists, with the exception of M. Desmarest, who has given to the bird the name of *Platyrhynchus ornatus*. With M. Temminck it became the *Eurylaimus nasutus*. But the largeness and convexity of the bill in this bird, the oval form of the nostrils, their position near the middle of the bill, and other characters deviating from the structure of the typical *Eurylaimus*, afford reasons against its being associated with that genus, and in favour of regarding it as constituting a distinct type of form. As such it has been regarded by Dr. Horsfield and Mr. Vigors, who, in the Appendix to the 'Life of Sir T. Stamford Raffles'[4], have characterized under the name of *Cymbirhynchus*, the genus to which it belongs. It is consequently the *Cymbirhynchus nasutus*, Vig. and Horsf.

M. Temminck's second addition to the genus is the *Eurylaimus Sumatranus*, Vig. and Horsf., originally described under the name of *Coracias Sumatranus*, by Sir T. Stamford Raffles in his 'Descriptive Catalogue of a Zoological Collection made in Sumatra', published in the 'Transactions of the Linnean Society'[5]. In figuring this bird M. Tem-

[1] Vol. ii. p. 664. t. 30.
[2] Linn., Syst. Nat. Ed. 13, p. 446.
[3] P. 268.
[4] P. 654.
[5] Vol. xiii. p. 303.

minck has altered its specific name, and has designated it as the *Eur. Corydon.* M. Lesson has remarked on the extraordinary breadth and strength of its bill, on the dilatation and swelling posteriorly of the margins of this organ in such a manner as to render the lower mandible entirely thin at its base, on the keel and the uniform convexity of the bill, on the rounded and indistinct nostrils in some degree hidden by the hairs and the small feathers of the front, on the naked circle surrounding the eyes, &c., as on characters sufficient to distinguish it as the type of a subgenus, for which he proposes the name of *Corydon*; the species being designated by him *Corydon Temminckii*[1]. It would, however, be preferable to retain the original specific name, and to call the bird *Corydon Sumatranus*.

The third addition to the genus to which I have alluded is that by MM. Lesson and Garnot, who have figured and described in their beautiful work, the Zoological Portion of the 'Voyage de la Coquille'[2], a bird obtained by M. Lesson in New Guinea, to which they have given the name of *Eurylaimus Blainvillii*. As I have had no opportunity of examining this bird, and am acquainted with it only through the medium of the figure published in the work just quoted, I must speak with diffidence respecting it: but I cannot venture to regard it as really a *Eurylaimus*, possessing as it evidently does characters at variance with all others of that group. Its lengthened and forked tail, its feeble *tarsi*, and its narrow bill furnished with stiff bristles, appear to indicate its natural position to be among the true *Flycatchers*.

There remain then, in the defined genus *Eurylaimus*, only the *Eur. Horsfieldii*, Temm.[3], the type of the genus, and described as such by Dr. Horsfield in the 'Transactions of the Linnean Society'[4] under the name of *Eur. Javanicus*[5]:—the *Eur. ochromalus*, Raffl.[6], of which *Eur. cucullatus*, Temm.[7], is a synonym:—and the species for which I propose the name of *Eur. lunatus*. The latter presents, it is true, some minute differences from the two previously mentioned birds; but as these differences consist principally in the filamentous termination of the primary and tail-feathers, and in the singular crescent-shaped row of silvery feathers which adorns the neck of the male, they are by no means likely to exercise any influence over the habits of the bird, which may consequently be placed with the true *Eurylaimi*. It may be thus characterized:

Eurylaimus lunatus.

Eur. capite cristato; cristâ genisque brunneis; fasciâ supraciliari nigrâ; gulâ cinerascente; collo, interscapulio, pectore, abdomineque cœrulescenti-cinereis; tergo uropygioque cas-

[1] Manuel d'Ornithologie, tom. i. p. 177.
[2] Atlas de Zoologie, Oiseaux, Pl. 19.
[3] Planches Coloriées, pl. 130, 131.
[4] Vol. xiii. p. 170.
[5] Dr. Horsfield having withdrawn the claim of priority in naming this species, and having allowed another name to be substituted for that originally given, the one substituted by M. Temminck and allowed by Dr. Horsfield will probably be generally adopted.
[6] Linn. Trans., vol. xii. p. 297.
[7] Planches Coloriées, pl. 261.

taneis; parauchenio lunâ albâ notato; scapularibus nigris; alis lazulinis, ad apicem fasciâ latâ nigrâ notatis, remigibus prioribus quatuor albo apiculatis acutis, secundariis abruptis tribus interioribus castaneis; caudâ nigrâ, rectricibus tribus externis apices versus albis.

Fœm. *lunulâ ad colli latera nullâ.*

Long. tot. $6\frac{1}{2}$ unc.; *rostri*, a rictu ad apicem, $\frac{3}{4}$; rostri ad basin lat. $\frac{5}{8}$; long. *alæ*, $3\frac{1}{2}$; *caudæ*, 2; *tarsi*, $\frac{5}{8}$.

Hab. apud Rangoon, Peninsulæ Indiæ ulterioris.

The bill is dark olive, inclining to black, lighter at its edges and along the *culmen* of the upper mandible. The head is furnished with a thick crest, composed of long silky feathers of a dull chestnut brown, beneath which a black band extends to the *occiput*, beginning just above the base of the bill, and passing over the eye; the cheeks and ear-coverts are of the same colour as the crest. The throat is greyish white, passing off into deep bluish grey, which covers the whole of the under surface; on the sides of the neck this grey is interrupted by a beautiful semilunar mark, consisting of silvery white feathers elevated above the rest, and abruptly terminated as if clipped by scissors. The upper part of the back is bluish grey, passing off into bright chestnut, which occupies the rump and upper tail-coverts. The shoulders are black, succeeded by a broad band of lazuline blue, which is the colour of the wings; beyond the blue a black band succeeds, which terminates the wing, with this exception, that the first four primaries are tipped with white: in these feathers the shafts are prolonged in the form of slender filaments, giving them a remarkably pointed appearance. The rest of the primaries, and all the secondary quills, have, on the contrary, a broad, indented, and abrupt termination, barely edged along the tip of the outer vane with white, the inner vane being chestnut, which latter colour occupies the whole of the three last secondaries. The tail is black, with the exception of the three outer feathers, which are white at their extremities, the outermost being nearly altogether white: each feather, like the four first primaries of the wing, has the shaft projecting beyond the lateral vanes. The thighs are black. The *tarsi* are brownish black.

The female resembles the male in her plumage, except that she wants all trace of the beautiful lunated silvery mark, which is so great an ornament to the male.

Several examples of this beautiful bird were shot in the neighbourhood of Rangoon by Major Godfrey, and I am indebted to that gentleman for the opportunity of placing on record the interesting species which he has thus added to science. He informs me that it inhabits the thickest jungles, and that its food was found, upon minute examination, to consist entirely of berries and fruits: he did not ascertain any particulars respecting its nidification. How far its range extends to the southward, or in other words whether it approaches to or actually inhabits either of the islands in which the other *Eurylaimi* are found, cannot at present be stated: it is, however, probable that it may hereafter be met with in Sumatra, or even in Java, especially as the conterminous *Cymbirhynchus nasutus* extends from those islands as far northwards as Rangoon, where specimens of it were shot by Major Godfrey, and always in similar situations to those frequented by *Eur. lunatus*.

The precise position of the genus *Eurylaimus* in the natural system will probably not be determined with certainty until we obtain more complete accounts than we yet possess of the habits of the birds comprised in it. It appears to be almost equally entitled to rank with the *Fissirostres* on the one hand, and with the *Dentirostres* on the other. The compressed form and breadth of the bill, together with its wide gape destitute of bristles at the angles (in the typical species at least), imply a relationship both to the true *Fissirostres* and to the berry-feeders, such as the *Ampelidæ*; while the short and rounded wing, and the strong *tarsi* and claws, militate against habits like those of the exclusive *Flycatchers*, lengthened wings and small feet being essential to their aërial mode of life. Still, however, as in the case of the birds composing the genus *Bombycivora*, which feed at one season of the year almost exclusively on insects, and at other times on mountain berries and fruits, the birds of the present group may partake of the same varied diet, consisting of fruits and such insects as are obtained with little exertion on the wing; as the character of the toes, particularly of the hinder one, which is longer than those in front, and equals the *tarsus* in length, clearly indicates that they seldom quit the branches which constitute their native locality.

PLATE XXV.

Eurylaimus lunatus, male and female.

Eurylaimus lunatus

Printed by C Hullmandel

XXI. *A few Remarks tending to illustrate the Natural History of two Annulose Genera, viz.* Urania *of Fabricius, and* Mygale *of Walckenaer. By* W. S. MacLeay, *Esq., F.Z.S., &c.*

Communicated January 28, 1834.

As the following remarks may possibly be of use in our attempts to solve a problem which has long interested entomologists, I mean the true situation in nature of the genus *Urania*, they are now placed with all due respect at the disposal of the Zoological Society.

Fabricius instituted a genus of *Lepidoptera* under the name of *Urania*[1], a term by no means inappropriate, as it designates perhaps the highest fliers and most richly ornamented insects of that very brilliant order. Before Fabricius these animals had been placed in the great Linnæan group called *Papilio*, although they differ, in fact, from all *Butterflies* in the form of their *antennæ*, which, at least in the American species of the genus, instead of being in any degree clavate, are at the base filiform, and then become gradually setiform or attenuated towards their extremity. Latreille referred these insects to the same section of the Linnæan group *Papilio* as *Hesperia*, and here they still remain. My object at present not being to enter on the investigation of their affinities, I shall with little farther preface give the natural history of one species, which appears to me to be possibly new. But it must be recollected that I have here, in Cuba, no general cabinet for reference, and consequently want the most indispensable of all guides towards the accurate determination of new species.

As far as I have been able to ascertain, the only known *Uraniæ* with which my insect can be confounded are the *Ur. Sloanus* of Godart, a Jamaica species, so called from having been first described by Sir Hans Sloane, and the *Ur. Boisduvalii* of M. Guérin. A figure of this last is published in the 'Iconographie du Règne Animal de M. Cuvier;' but as the *larva* and *imago* of *Uraniæ* vary in their size and colours, the *Ur. Boisduvalii* may very probably be found eventually to be merely a small variety of the well known *Ur. Sloanus*; nay, farther, my insect, of which I am about to give the history, may even turn out to be the same species with both. Unfortunately, as I said before, I have no Jamaica specimens of *Ur. Sloanus* at hand to refer to; but had there been given with the figure a scientific description of the *Ur. Boisduvalii*, distinguishing it from *Ur. Sloanus*, or even had its country been mentioned, we might have been more certain of our facts. Two slovenly practices at present prevail, which threaten to destroy all

[1] *Urania* is also a name given by Schreber to a genus of Monocotyledonous plants, previously called *Ravenala* by Adanson, Jussieu, and Sonnerat, and which belongs to the same natural family with the *Banana*.

accuracy in nomenclature, namely, the attaching a name to a published figure without any description; or, which is quite as bad, giving a loose untechnical description in some modern tongue. Our neighbours, the French, are the most to blame for these doings, which proceed from sheer indolence; for surely it does not require a week's study of the lowest rudiments of Latin to word a precise technical description, that will both determine the species and be intelligible in every part of the civilized world. Let those who approve of the vague diffuseness of their mother-tongue, give, if they please, a description in this also; but the Latin character is indispensable if we wish to secure credit for our labours.

I shall now cite Godart's description of *Ur. Sloanus* from the 'Encyclopédie Méthodique,' tom. ix. p. 709, in order that we may compare it more readily with my insect, which for the present I shall call *Urania Fernandinæ*, in compliment to Her Excellency the Condesa de Fernandina, a lady whose varied accomplishments comprehend the study of natural history.

"URANIA SLOANUS, *Godart.*

" *Uran. alis nigris; anticis utrinquè lineis transversis fasciâque aureo-viridibus: posticis suprà fasciâ serratâ cupreo-rubrâ.*

" *Papilio Sloanus* Cram. pl. 85. fig. E. F.

" *Papilio Sloaneus* Herbst, Pap. tab. 51. fig. 3. 4.

" Sloane Jamaic. Hist. 2. tab. 239. fig. 11. 12.

" Cette Uranie . . . . a entre deux pouces et demi et trois pouces d'envergure. Ses ailes sont noires. Les supérieures ont de part et d'autre six à sept lignes transverses d'un vert-doré brillant, entre lesquelles il y a une bande bifide ou trifide du même vert.

" Le dessus des ailes inférieures est traversé dans son milieu par une bande d'un rouge-cuivreux luisant. Le dessous est d'un vert-doré, avec des mouchetures noires sur la côte et vers l'extremité. Les queues sont noires, ce qui distingue encore cette espèce de l'Uranie Leilus.

" De la Jamaique."

Our Cuban insect may be described as follows:

URANIA FERNANDINÆ.

Ur. alis nigris; anticis utrinque lineis transversis auro-viridibus, suprà undecim septimâ bifidâ, subtùs sex humeralibus latis septimâ bifidâ octavâ longissimâ trifidâ reliquis apicalibus filiformibus: posticis suprà fasciâ haud serratâ et lineis octo brevibus lateralibus transversis auro-viridibus.

This *Urania* attains from four to four and a half inches of expansion of wing. The head is small and black, with a golden green V in the middle, and a narrow short line of the same colour bordering the eye, which has a black coppery lustre. The *tergum* of the *prothorax* is golden green, with the exception of two dorsal spots of velvety black. The *tergum* of the rest of the *thorax* and *abdomen* is also black, but marked by three longitudinal golden green lines, one on each side of a medial one. The *pectus* of the *mesothorax* is black, marked at least by one oblique white *fascia* on each side. The wings are velvety black, with an undulated rim, the hollows of which are more or less slightly tipped with white.

The upper side of the *upper wings* has eleven golden green transverse lines, which are narrowest towards the posterior angle[1]. The seventh of these lines from the humeral angle is bifid towards the anterior margin of the wing; and between the second and third line on the same anterior margin are two golden green linear dots, and a longer one between the ninth and tenth.

The under side of the *upper wings* has the interior margin brown, but all the rest velvety black, with transverse lines of a bluish green colour. Of these the first six from the humeral angle are parallel; and the seventh line, which is somewhat bifid at the anterior margin, meets at the anal angle of the wing the eighth line, which is trifid or even quadrifid at the anterior margin, and is by far the longest. The three or four apical lines are filiform, the ninth generally meeting the tenth at the anterior margin of the wing.

The upper side of the *under wings* is velvety black, with a longitudinal broad discal band of a golden green colour, reaching from nearly the middle of the anterior margin to the anal angle, and which is only interrupted by two or three black spots towards the anal angle. The interior margin, fringed with blackish down, is also lined by a broad obscure green *fascia*, which meets the former band towards the anal angle, and which is interrupted by four, or even more, black transverse spots towards the same angle. The posterior margin has at least eight transverse golden green abbreviated lines, of which the fourth and eighth are the shortest, and the fifth is the longest. The tail of the wing is long, tapering, black, with the central line bluish green.

The under side of the *under wings* is golden green, becoming more bluish towards the tail. The interior margin is fringed towards the scutellar angle with a cinereous down, and has four abbreviated parallel black transverse spots towards the anal angle. The anterior margin has eight abbreviated transverse black bands, of which the shortest are the first and sixth, counting from the humeral angle, and the longest the eighth, while the third and fourth, the seventh and eighth, meet each other towards the disc of the wing. The posterior margin has two black bands, of which the superior one is furcated towards the posterior angle of the wing; and four or five large black spots towards the anal angle, which sometimes coalesce into two bands, of which the upper is abbreviated. The tail is bluish green, with the margins black.

[1] For the technical terms expressing the limits of a Lepidopterous wing, I use the nomenclature given by Messrs. Kirby and Spence, Introduction, vol. iii. p. 727. Pl. XIV.

The feet are blackish, with the edges of the *femora* and *tibiæ* more or less tipped with bluish green. The *antennæ* agree in figure and colour with those of *Ur. Sloanus.*

It is therefore evident that my insect differs from Godart's description of *Ur. Sloanus* only in the larger size, in having more transverse golden green lines on the upper[1] wings, in the under wings having no coppery red colour, and in the discal band of these last not being serrated.

From *Ur. Boisduvalii,* which I only know by M. Guérin's figure, my insect differs also in being of larger size, in having the *tergum* of the *abdomen* with longitudinal green bands, and in the seventh bifid line of the upper side of the upper wings not meeting the sixth line at the anal angle. The under wings, and the whole under side of the wings, are wholly different.

For the present, therefore, and deprived as I am of the power of referring to any cabinet, I think I am to a certain degree justified in considering the insect I have so fully described under the name of *Urania Fernandinæ* to be a distinct species, and I shall now give its economy.

On approaching from the sea any open sandy part of the coast of Cuba, it will appear girt, close above the coral reefs, with a copse wood composed of almost one species of tree. This is the *Coccoloba uvifera* of Linnæus, or *Uvero*[2] of the Spaniards, which instantly attracts a European eye by the novelty of its aspect, the large thick leaves being almost orbicular, or, to speak more accurately, shaped somewhat like a horseshoe, while their shining green is beautifully relieved by blood-red veins. This tree produces an astringent fruit called, from its colour and growing in racemes, the *seaside Grape*; and a close and nearly impenetrable belt of it, which is merely varied by a few *Chrysobalani*[3], almost touches high-water mark. At the base of this belt grow the genera *Cactus, Euphorbia, Heliotropium, Tribulus, Coreopsis, Pancratium, Crinum, &c.*; the leaves of these various genera becoming more thick and fleshy as they approximate the sea. *Convolvuli* with succulent leaves and with large red[4] and white[5] flowers, creep around on the sand, mingling themselves with the *Dolichos roseus* of Swartz[6], so conspicuous for its immense pods and lovely pale purple blossom.

[1] However, in *Ur. Fernandinæ* we find the size to vary considerably, as also the number of transverse golden green lines on the upper wings.

[2] Oviedo, in his admirable 'Coronica de las Indias,' describes this tree under the Indian name of *Guiabara,* and gives even a good figure of one of the leaves, which, he says, being written on with a pin or needle, often served the first Spanish settlers instead of paper. The leaf of the *Copey* (*Clusia rosea,* Linn.), another sea-side tree, serves this purpose still better, as it will preserve the writing for years.

[3] *Chrysobalanus Icaco,* Linn., from the fruit of which, or *sea-side Plum,* a favourite sweetmeat is made in Cuba, and exported under the name of '*Dulce de Icaco.*' The fruit itself is insipid, but the kernel has an exquisite flavour.

[4] *Convolvulus Brasiliensis,* Linn., or the *Aguinaldo de la playa* of the Spaniards.

[5] *Convolvulus repens,* Jacq.

[6] *Canavalia rosea,* De Cand.

Immediately behind such a belt as I have described, which may be from ten to twenty yards broad, we find amidst a variety of smaller plants, such as *Russelia sarmentosa*, *Sophora Havanensis*, *Plumbago scandens*, *&c.*, many sea-side shrubs growing in the parched sand, of which the most remarkable are the odoriferous *Plumeria alba*, on the bright leaves of which crawls the enormous black and yellow caterpillar of *Sphinx Asdrubal*, Cram.; the curious *Suriana maritima*, Linn., which has its rugged hard red trunk perforated by the *larva* of a *Cossus* (*Cossus Surianæ*, mihi); several species of *Cordiæ*, the bunched flowers of which vary through every shade, from the purest white to the most vivid orange and scarlet; the elegant *sea-side Fan-Palm*, or *Thrinax parviflora*, Swartz; with *Duranta Ellisia*, *Omphalea triandra*, *Cæsalpiniæ* of various species, *Cactus tetragonus*, *Cactus grandiflorus*, and many more humble species of the same Linnæan genus[1], &c. All this variety of foliage is in general festooned with the flowers of different species of *Convolvulus*, *Ipomœa*, *Echites*, *Paullinia*, and other climbing genera; while those leaves more exposed to the sea breeze are each studded with small terrestrial shells[2] inhabited by their native *Mollusca*, and large sea shells[3] brought from their original element by the singular *Paguri*[4] which have usurped them, cluster round the short stunted trunks. Here, when grey lizards[5] of different sizes, with yellow

[1] Oviedo describes three kinds of West Indian *Cardones*, viz. *las Tunas*, *los Cirios* and *las Pitahayas*. Under the name of *Tuna* he certainly meant to designate certain prickly species of De Candolle's genus *Opuntia*; and *los Cirios* (so called "porque parescen cirios o hachas de cera excepto en las espinas,") certainly coincide with De Candolle's subgenus *Cereastri* of the genus *Cereus*. The *Pitahaya* of Oviedo appears to have been the *Cereus tetragonus*, whereas the *Pitahaya* of the Spanish creoles of the present day is certainly the *Cereus grandiflorus*, or *night-blowing Cereus*. This has the ripe fruit yellow, whereas Oviedo describes the fruit of his *Pitahaya* as being of a colour "carmesi rosado." *Nopal* appears to have been a name adopted from the Mexicans, and to have been applied to the smooth species of *Opuntia*, such as *Op. cochenillifera*.

[2] Belonging to the genera *Phasianella* and *Pupa*, but principally the latter.

[3] Chiefly *Turbo Pica*, Linn.

[4] Principally *Pagurus Diogenes*, known in Cuba by the name of *Macao*; on the habits and history of which curious *Crustacea* some most interesting remarks have been published by my friend W. J. Broderip, Esq., in the 'Zoological Journal', vol. iv. p. 200.

[5] There is a rude but sufficiently correct representation of these *Lizards* given by Rochefort, under the name of *le Roquet*. He says, "Les Roquets . . . . ont le peau de couleur de feuille morte, qui est marquée de petis points jaunes, ou noirâtres. Ils sont portez sur quatre pieds, dont ceux de devant sont asses hauts. Ils ont les yeus etincelans et vifs au possible. Ils tiennent toujours la teste élevée en l'air, et ils sont si dispos, qu'ils sautelent sans cesse, comme des oiseaux, lors qu'ils ne veulent pas se servir de leurs aisles. Leur queüe est tellement rétroussée sur le dos, qu'elle fait comme un cercle et demy. Ils prennent plaisir à voir les hommes, et s'ils s'arrétent au lieu ou ils sont, ils leur jettent a chaque fois des œillades. Quand ils sont un peu poursuivis, ils ouvrent la gueule, et tirent la langue comme de petits chiens de chasse."—Hist. Nat. et Mor. des Antilles, p. 131.

This description makes me almost certain that the *Roquet* belongs to the same genus as the Cuban *Lizard* mentioned in the text, although probably it is a different species. It does not change its colour, nor, as far as I know, does it distend the throat like the genus *Anolis*; neither are the toes, as in that genus, supplied with oval disks for climbing, so that it is never seen on trees. Nevertheless Cuvier gives the name of *Roquet* to a bellies, and tails turned up in spiral, peep from under the dusky flat stones, which are generally sea-broken and time-worn pieces of *Madrepores*,—when those beautiful *Land-crabs*, *Gecarcinus ruricola*[1], Desm., and *Grapsus pictus*[2], Desm., are running about over the sea-weed that has been left by the tide,—and finally, when every object to the dazzled eye seems quivering under the broiling sun,—the entomologist will have a tolerably correct specimen of what may be termed the general appearance of a sandy sea-shore in the island of Cuba. The whole scene is harmoniously sultry.

> Here order in variety we see,
> And here, though all things differ, all agree.

In such a situation, for many miles at least on each side of the Havana, not a sound breaks on the ear except the melancholy roar of the surf as it dashes on the iron-bound coast; no quadruped, in short, is to be seen, and scarcely a bird. Here, nevertheless, have I managed to pass several solitary scorching hours with pleasure, as many valuable insects may be collected, and among them *Urania Fernandinæ*.

But to return to the vegetation of such a place. Of all the shrubs above mentioned, perhaps the *Omphalea triandra*, Linn., or *Omphalea nucifera*, Swartz, is the most interesting. It is the *Cob* or *Hog-nut* of Jamaica, and *Avellano* of the inhabitants of Cuba. Although belonging to the poisonous family of *Euphorbiaceæ*, it affords a most delicious and wholesome kernel, from eating which in plenty I have never experienced

species of his genus *Anolis*, which, by the way, is not the *Anolis* of Rochefort, but his *Gobemouche*, so that the confusion is almost inextricable. Our Cuban *Lizard* resembles the genus *Anolis* in no respect farther than having a thick, fleshy, and not extensible tongue, and so belongs to Cuvier's group of *Saurian Reptiles*, which he calls *Iguaniens*. As its toes are free and unequal, it belongs to the group *Stelliones* of Cuvier, or to Mr. Bell's tribe of *Stellionina*; and as it has no teeth in the palate, and the toes are simple, it appears to agree with the last-mentioned naturalist's family *Stellionidæ*. As the tail has very small scales, and there are no femoral pores, while the toes are 5—5, it may be referred to Mr. Gray's genus *Agama*. It appears moreover to connect Cuvier's subgenera *Trapelus* and *Calotes*, having all the scales very minute, and no dorsal crest like the former, yet agreeing with the latter, in that the imbricated scales are slightly carinated, and terminated in point so as to make the body appear to the naked eye as if longitudinally sulcated. Unfortunately I have no book in the Havana that will enable me to determine whether it be a described species; but the following description will probably make it known to those naturalists who are conversant with *Reptiles*. The under side of the belly and legs is of a dirty cream colour, becoming yellowish toward the extremity of the long tail. The under side of the head and breast is marbled-grey, as is the upper side of the head, and about twenty six or twenty eight transverse faint dorsal bands, which on the dirty cream-coloured ground become more conspicuous as they approach the extremity of the tail. Its colouring, in short, is exactly that of the grey *Madrepores* which it haunts, and into the cavities of which it retires when alarmed. The largest I have seen have been more than a foot long.

[1] *Gecarcinus ruricola* I have never seen farther from the sea than two leagues. It never makes its holes in sand, always preferring a muddy soil at some distance from the salt water.

[2] *Grapsus pictus* inhabits an open, sandy, or rocky coast, while *Gecarcinus ruricola* inhabits the muddy mouths of rivers, or mangrove marshes in bays; hence this last species is the true *Crabe des Paletuviers* of the French. Both the species are exceedingly suspicious and active, *Grapsus pictus* running swiftly for shelter to the sea, and *Gecarcinus ruricola* into the holes which it forms in the mud.

the slightest harm. I have somewhere indeed read that its cotyledons preserve a portion of the emetic and purgative power of the nut of a *Jatropha*; but all I can say is, that I never heard of the nuts of *Omphalea triandra* injuring any of the persons whom I have seen eat them; and my mouth, when parched, having many a time and oft derived refreshment from a due discussion of its produce, I shall always view this plant and the *Cacti*, or *Prickly Pears*, with a sort of gratitude, as being among the few hospitable vegetables which adorn that most scorching of all sublunary regions,—a sandy sea coast in the West Indies.

The *Omphalea triandra*[1] is a tree which I have seen as high as fifteen feet, but the trunk is in that case very thick in proportion to its height. This trunk is excessively gnarled, and the branches are also rugged, drooping downwards, and supporting on long footstalks large thick heart-shaped leaves of a leathery texture, and which have a scabrous surface of a pale green colour, and are not in the least degree shining. The young leaves, and the leaves of the young plants, are of a quite different form, being, although of the same texture and colour as those just described, deeply incised, with their divisions long and narrow, particularly the middle one, and all more or less dentated at the sides. As on the same plant we see the two kinds of leaves, the older ones below and entire, and the younger above and incised, it would appear to me that these incisions gradually fill up, and so form the mature and heart-shaped leaf.

Now the upper side of the entire leaves of this tree may often be observed to be coated in the middle by a transparent web, through which appears a caterpillar torpidly reposing under cover. At night, however, our caterpillar, no longer sluggish, quits the silky shed which served to protect it from the powerful rays of the sun, and greedily strips the *Omphalea* of its foliage, so that I have often seen whole trees without a leaf. This caterpillar is also active in the day-time when disturbed from under its web. It can then run about as quick as the *larva* of any *Bombycidæ*, and shows little affinity to the caterpillars of other diurnal *Lepidoptera*, which usually have a slow motion.

Having carried some of these caterpillars home, I supplied them for some days with fresh food, when they spun about the withered or dead leaves in the box an oval cocoon of a loose dirty yellow silk. Within this cocoon, the meshes of which were so few and lax as to allow the inmate to be easily seen, it changed to a *chrysalis*, which, after about three weeks repose in a horizontal position, produced, to my great satisfaction, a beautiful specimen of *Urania*. Since that time I have bred several.

In February, and the ensuing months of spring and summer, that is, as long as the *Omphalea* continues throwing out young shoots, the eggs of *Urania* may be found glued to the tender incised leaves. These eggs have a pearly lustre, and are of a pale green

[1] In Browne's Jamaica it is called *Omphalandria* in the text; and a figure of it is given, which is as unlike to the Cuban plant as anything well can be. May not this Cuban plant, therefore, be a different species? For my own part, however, I doubt it exceedingly.

colour, sometimes turning to yellow, bearing considerable resemblance in form to those of the genus *Catocala* of Schrank, particularly *Cat. nupta*[1]. They vary in shape from an ovate to an oblate spheroid, but in general are truly spherical. A circular space on their summit is smooth, but from the circumference of this circle proceed about twenty four longitudinal ribs, the intervals between which are crossed at right angles by obsolete *striæ*.

The young *larvæ* just emerged from the egg appear of nearly the same pale green colour, and have seven longitudinal black lines, which the microscope shows to be so many rows of long black hairs. The head of these young *larvæ* is of a dirty yellowish colour, but after the first month it assumes its true appearance. This caterpillar scarcely ever rolls itself into a ring, and when full grown is about $1\frac{5}{8}$ to 2 inches long, of a regular cylindrical form, with the more usual sixteen feet. Its head is now red, polished, and sessile, that is, not set on the body by means of a narrow neck, as in the *larvæ* of true *Hesperidæ*. This head has black mandibles, and is besides irregularly sprinkled with some black spots, of which four placed close together nearly at the *apex* of the triangle which crowns the *clypeus*, and one on each side marking the site of the *ocelli*, seem to be tolerably constant. The other spots on the head are merely black points, generally about twelve. The first segment of the *thorax*, or *prothorax*, is, as in many Lepidopterous *larvæ*, of a more corneous texture than the other segments, and more or less of a velvety black colour, which is diversified by a white dorsal line, and two or three white irregular spots at the sides. This, however, is only the typical colouring of the *prothorax*; for in many specimens the white is more predominant than I have described, and is accompanied with a slight red spot on the back of the segment.

The true feet are red; and the ten false feet are of the same, only somewhat paler, tint as the body, which varies from a pale yellowish green to a flesh colour, with five paler longitudinal lines, of which the middle one is dorsal.

The mesothoracic segment is rarely spotted, but all the others are often marked more or less with black spots, particularly the antepenultimate segment, which scarcely ever occurs without two lateral black spots placed immediately above the penultimate *stigma*. These spiracles are usually black, and the whole body moderately hairy, that is, having on each segment about six hairs, which are white and about one fifth as long as the whole body.

It is by no means easy to make a tolerably accurate description of this caterpillar, because there are few *larvæ* of the same species which differ so much from each other in colour, size, and marking, as those of *Ur. Fernandinæ*. It is perhaps most readily

[1] This, in fact, appears to be a very common form of Lepidopterous egg. To this form I assign those eggs figured badly by Reaumur, vol. ii. tab. 3. figg. 6. & 7. These, however, appear to want the clear circular space on the summit, and besides are not so spherical as the eggs of *Urania*.

recognised by its red head and spotted black *prothorax*. In form it agrees very closely with the caterpillar of *Agarista*, as figured by Lewin, but is more simple, having no hinder protuberance on the penultimate segment.

The *pupa* of *Ur. Fernandinæ* is not at all angular, like that of most diurnal *Lepidoptera*, but agrees with them in being rather gaily coloured. It is of a yellowish brown colour, the *thorax* being of a rather paler tint, and the wings of a darker hue than the rest of the body. The *antennæ*, *proboscis*, eyes, legs, and nervures of the wings, being of a dark brown hue, are particularly visible in this *chrysalis*. The head is rounded, and is marked with three or four black spots. The *mesothorax* has four or five very conspicuous black spots interspersed with points, and the abdominal segments are each marked transversely with from about twenty five to thirty five black linear dots.

The perfect butterfly is truly diurnal, and very swift in its flight. It is not found in the interior of the island, but it may be seen in plenty to haunt gardens as far as two or even three leagues from the coast, sporting in the sun and sucking the flowers of *Cestrum diurnum*, *Ehretia tinifolia*, and other odoriferous trees of small stature. In hot weather and about midday it flies particularly high, and may be even observed surmounting the tops of the highest members of the forest. In the afternoon I have often seen it sport about some capriciously chosen spot, such as a particular branch of Mango, where it would always return to alight on almost the same leaf, in a manner that has sometimes reminded me of a well known habit of the *Muscicapæ*[1]. Thus does our insect spend whole hours until sunset, when the bats[2] usually terminate its diversion and life. On the approach of winter it may be seen at times alighting on hedges, when specimens are more easily captured. The flight, however, of *Ur. Fernandinæ* is always strong, and in starts like that of *Fringillidæ*. When it alights on a leaf all the four wings are expanded horizontally, and rarely, if ever, take a vertical position like those of other species of the Linnæan genus *Papilio* when at rest[3].

[1] And also of *Apatura Iris* among the true diurnal *Lepidoptera* of Great Britain.

[2] Principally the *Phyllostoma Jamaicense*, Horsf. By the way, in the second edition of Cuvier's 'Règne Animal' this author says of the *Phyllostomes*, "Ce sont des animaux .... qui ont l'habitude de sucer le sang des animaux." I can only say that this is not only quite untrue as respects the Cuban species, but perfectly impossible. The *Phyll. Jamaicense*, for instance, lives on fruits and winged insects, in search of which last it will often be found in bed-rooms. The *Vampire Bat* of South America is also a *Phyllostoma* of Cuvier and Geoffroy; but until some person having pretension to the name of naturalist shall establish the fact on personal observation, I shall as readily believe that it sucks the blood of men as that the *Caprimulgus* sucks the milk of goats. I should not be surprised if the mischief now attributed to the *Vampire* shall be found to be the work of some *Annulose* animal, perhaps an *Annelide*, like that which infests Ceylon, Sumatra, &c. Time will show; but I have travelled enough to know that if natives are bad observers of nature, the great majority of travellers are still worse.

[3] There is in all probability, therefore, an error in the attitude given by M. Guérin to *Ur. Boisduvalii* in fig. 1. of his plate. The wings of *Urania*, in fact, are of that kind of complication which Messrs. Kirby and Spence, in their excellent Orismology, call *Alæ extensæ patentes*.

Ur. Fernandinæ is by far most plentiful on the sea-shore, because there grows its favourite *Omphalea*. However, it prefers to sport about the leaves of *Coccoloba uvifera* (unless when depositing its eggs[1]),—a circumstance which made me long search in vain for the *larva* on this last-mentioned tree. On the sea-coast of Surinam and Cayenne grows another species of *Omphalea*[2] (*Omph. diandra*), which in all probability affords pabulum to *Ur. Leilus*, for I have remarked that the minor natural groups of *Lepidoptera* often keep very constant to the same natural group of plants[3]. Therefore, also, the splendid Madagascar insect *Ur. Ripheus*, and the less gaudy *Ur. Orontes* of the East Indian islands, nay, *Patroclus*, and all the other species, may likewise feed on the leaves of sea-side *Euphorbiaceæ*. In his 'Narrative of a Survey of the Coasts of Australia'[4], Capt. P. P. King, R.N., describes his having found a variety of *Ur. Orontes*[5] sporting in immense numbers about a grove of *Pandanus* trees at the mouth of a stream which falls into the sea near the extremity of Cape Grafton on the north-east coast of New Holland. But I have little doubt that this species flitted about the *Pandani* as *Ur. Fernandinæ* does about the *Coccoloba*, while its eggs and *larvæ* might have been found on the neighbouring *Euphorbiaceæ*. *Ur. Orontes*, however, differs in many essential respects from *Ur. Fernandinæ*, and probably forms one of those genera into which, as I perceive from a note in the last edition of Cuvier's 'Règne Animal,' Dalman has distributed the Fabrician genus *Urania*. On this subject I can say no more at present, as I have not yet seen his characters of distinction; but I shall be disappointed if there be not found matter enough in the above observations to be turned to use by those who are investigating the natural affinities of Dalman's brilliant group[6].

[1] *Urania* agrees with the generality of Linnæan *Papiliones* in depositing its eggs singly, and in gluing each egg to its destined leaf, by alighting on it for a moment, or rather by touching it with its *abdomen*. I have rarely seen a leaf with more than two eggs of *Urania*.

[2] If the Jamaica *Omphalea* be a different species from the Cuba plant, *Ur. Sloanus* will more probably be a distinct species from *Ur. Fernandinæ*.

[3] Thus the *larvæ* of the *Heliconidæ*, so close to *Argynnis*, devour the leaves of the various species of *Passiflora*, and those of the *Euplæidæ* keep close to the genus *Asclepias* of Linnæus. Hence likewise we learn that *Heliconia Ricini*, a Linnæan species, has a false name, as the *larva* of no *Heliconia* will touch a *Ricinus*, or indeed any plant but one of the *Passifloreæ*. Hence also it is that the genus *Heliconia* is peculiar to the New World.

[4] Vol. ii. p. 14.

[5] This insect has also been described as *Castnia Orontes*: and that there is some close kind of relation between *Castnia* and *Urania*, I have not the least doubt.

[6] This is not the place for a detailed generalization of the Lepidopterous wing, else I might show, with Mr. Jones, that the nervures of the wings in the genus *Urania* differ most considerably from those of *Hesperia*, and indeed all other diurnal *Lepidoptera*. It is strange, as indeed Messrs. Kirby and Spence have already noticed, that Lepidopterists, complaining so much as they do of the deficiency of strong characters to guide them in the distribution of their favourite insects, should have paid so little attention to those nervures which, if traced from the simple form which the wing possesses in *Pterophorus* and *Orneodes* up to the complex form it presents in *Papilio*, will be found, while steadily varying, to present most valuable characters. Mr. Jones, in the 'Linnean Transactions', vol. ii. p. 63, first gave the hint of applying considerations founded on the nervures of the wing,

In a work which by the old Linnæan school was long reckoned of classical authority, but of which later and more accurate researches have demonstrated the dangerous worthlessness,—I mean Madame Merian's drawings of the insects of Surinam[1],—we find the following description of an insect which, to judge from the figure, has been since described as *Papilio* or *Ur. Leilus*.

"Insident arboribus, virentemque earum depascunt frondem erucæ virides, quibus caput cœruleum, corpus est pilis oblongis onustum, ferreo filo non mollioribus. Die 3 Augusti cœperunt agglutinari, in aurelias ex spadiceo maculatas dein permutatæ; undè ejusdem mensis die 19 tam venustæ exierunt papiliones, variis pictæ coloribus, nigro, viridi, cœruleo et albo, atque auri et argenti instar fulgentes; adeo veloces autem et altivolantes, ut vix nisi per erucarum metamorphosin capi possint illæsæ." This last sentence is without doubt a good description of the flight of *Urania*, and perhaps the whole paragraph may be true of *Ur. Leilus*; but I must observe that the *larva* of *Ur. Fernandinæ* has no resemblance to Madame Merian's figure of that of *Ur. Leilus*[2]. It is not green, has not a blue head: and so far from the hairs which cover its body being as hard as iron-wire, they are delicately soft and slender, and only moderately long. The *larva* of *Ur. Fernandinæ* does not glue itself to anything, but it spins an oval cocoon of dirty yellow silk, of which the threads are so lax, that the *chrysalis* remains visible through the meshes. Thus, so far as the metamorphosis is concerned, there is scarcely any resemblance between Madame Merian's description of *Ur. Leilus* and that which I have given of *Ur. Fernandinæ*. I do not say that the lady may not possibly in this particular instance have been faithful to Nature; but knowing how little she deserves to be believed on other points, and indeed having scarcely ever

to the distribution of *Lepidoptera*; but I am not aware that any subsequent person has acted upon it except my ingenious and active friend M. Poëy, who in his excellent 'Centurie de Lepidoptères de l'Ile de Cuba' has generally given a representation of the neuration of the wings *au trait* with each species figured. Still M. Poëy, like his predecessors, has not ventured to make any use of these important considerations in his descriptions,—a circumstance only to be attributed to his being duly sensible of our wanting that sufficiently valid generalization which can alone put the use of these organs of the wing within our power, either for analysis or synthesis. I shall be reminded, indeed, that Messrs. Kirby and Spence have attempted to remedy this deficiency in their valuable 'Introduction'; but it can scarcely excite surprise if these learned entomologists, among such a vast multitude of subjects for their attention, should be found to have still left much to be done with respect to the generalization of the Lepidopterous wing.

[1] The original drawings of this work are, I believe, in the British Museum, and in the late Dr. Shaw's time used to be considered among its choicest treasures. Cuvier, in the fourth volume of his 'Regne Animal,' calls the work itself a posthumous one, which, if true, might make us suspect that some portion of its faults ought to be assigned to the ignorance of its editor; but according to Messrs. Kirby and Spence, there is an Amsterdam edition of 1705, that is, twelve years prior to Madame Merian's death.

[2] This indeed seems to be a compound between a caterpillar and a *Cermatia*, and I have not the least doubt is quite an imaginary being. I judge from a traced outline which Dr. Horsfield, at my request, has had the goodness to send me from England.

found her to be correct, I confess that I can attach little credit to her description of the metamorphosis of *Ur. Leilus.*

Had Madame Merian, however, been only guilty of inaccuracy, it might have been pardoned; indeed it is a pardon which the most careful of us, as the poet says, "petimusque damusque vicissim;" but her wilful inventions are inexcusable. She it was, I believe, who first agitated the nerves of our unscientific great-grandmothers with the choice fable of *bird-catching Spiders.* The history of this fiction, although perhaps rather infringing on the unity of my Paper, is somewhat curious, as it will show how what may have originally been nothing more than a vague filmy misconception, can become gradually embodied into a pictorial lie.

The earliest account of American *Spiders* is by Oviedo in 1547, who says nothing of their catching birds, although those which he describes as "no muy pequeñas, què paresce que tienen figura de rostro humano en alguna manera," are doubtless the species which makes the strongest web in the West Indies, namely, *Nephila clavipes.*

The next mention I meet with of American *Spiders* is by Père Labat, in an account of 'Les Isles de Bermudez', which appears to have been taken from some early English work on those islands[1]. Labat says in 1640, "On n'y a trouvé jusques ici nuls animaux veneneux; mèsmes les arraignées n'y sont nuisibles, les quelles on y trouve fort belles, et elegamment begarrées de diverses couleurs, comme on escrit, et qui en l'esté filent de si fortes toiles que les petits oiseaux s'y empestrent." Now all this is very likely to be true, and probably relates to some species of the genus *Nephila* of Dr. Leach.

The next account of American *Spiders* I have is by Rochefort in 1658, in his 'Histoire Naturelle et Morale des Antilles', where he clearly alludes to the passage just quoted. He admirably describes that large brown *Spider* of tropical America which is now called *Mygale*[2], and ends his description with the following words: "Elles se nourissent de mouches et de semblables vermines, et on a remarqué qu'en quelques endroits, elles filent des toiles qui sont si fortes, que les petis oiseaus qui s'y embarrassent, ont bien de la péne de s'en developper. On dit le même des araignées, qui se trouvent communement dans les isles Vermudes, qui sont habitées par les Anglois; il est aussi fort probable qu'elles sont d'une même espèce." The mention of birds being introduced here, as it was by Père Labat, merely to show the strength of the web, this passage is so far correct; but it certainly refers not to the plain brown *Mygale* our

[1] A work on the natural productions of the Bermudas is much wanted to illustrate the geography of Natural History, as also a work on the Natural History of the Azores.

[2] This name was given by Walckenaer; but *Mygale* was the ancient Greek name for the *Shrew-mouse,* and has in consequence been with propriety assigned by Cuvier as a generic name to the *Sorex moschatus* of Linnæus. We entomologists ought therefore to abandon this name to so legitimate an owner, and adopt for our *Spider* the name *Theraphosa,* which M. Walckenaer has more lately given it.

author had just described, but to another large and beautifully coloured genus of *Spider*, now called *Nephila*.

Maria Sibylla Merian, thirty or forty years later, read that Rochefort's large brown *Spider* catches small birds in its web, and jumping at the conclusion that it would not catch them without an ulterior object, she accordingly, in her work 'De Generatione et Metamorphosibus Insectorum Surinamensium', has, if I recollect right, most obligingly figured from her imagination an enormous *Mygale* in the very act of ungraciously devouring a *Humming-bird*[1]! Hence Linnæus called it *Aranea avicularia*; hence, too, our ignorant bookmakers sometimes devote a popularly pathetic paragraph and explanatory wood-cut to the horrors of the *bird-catching Spider*.

Now the genus *Mygale*, of which several and enormous species exist in Cuba, cannot possibly catch birds, because it spins no net; because it lives during the day in holes under stones[2], or in tubes sometimes three feet deep in the earth, which generally open under stones, and where certainly no *Humming-bird* can get at it; and finally, because *Mygale* is itself too inactive in its motions, and humbly keeps too close to its mother earth to be able to get near a *Humming-bird*, which, as far as I have seen, never perches except on branches. The true food of this *Spider* I have found from the *debris* in its tubes to be *Iuli*, *Porcelliones*, subterranean *Achetæ*, and those large sluggish *Cockroaches* which swarm under almost every stone. So far from making a geometrical web like the crafty *Epëiridæ*, *Mygale* only spins at times a fine white silken tapestry to line its tube withal, and to keep itself dry. In rainy weather, indeed, I have noticed the orifice of this tube, if not opening under a stone, to be sometimes closed by an irregular cobweb.

[1] It is singular with what tenacity even the best naturalists will adhere to any story that has a touch of the marvellous. In the last edition of Cuvier's 'Règne Animal', the fable of a *Spider* catching birds retains its place, although Messrs. Kirby and Spence had long referred to a work of M. Langsdorff, in which it is denied. See 'Introduction to Entomology', vol. i. p. 424. By the way, in the same page of the 'Introduction', *Aranea venatoria* is said to construct in the ground a singular cavity. The *Ar. venatoria* of Linnæus is very common in Cuba, and does no such thing. Messrs. Kirby and Spence no doubt, therefore, allude to the *Ar. venatoria* of Fabricius, which is a *Mygale*. The work of M. Langsdorff mentioned by Messrs. Kirby and Spence, is doubtless the 'Bemerkungen auf einer Reise um die Welt', which, however, I only know by an extract given in Germar's 'Magazin der Entomologie', p. 183. Here M. Langsdorff unequivocally declares that the *Vogelspinne* of Brazil does not catch *Humming-birds*, and that this vulgar story is altogether false. He truly says, "Diese Spinne macht kein gewebe, sondern lebt beständig unter die erde in löchern."

[2] The holes of the *Mygale avicularia* are very common in my garden, and in external appearance exactly like what in the gardens of England are called toad-holes. The *Mygale* is of the greatest use to me, as it feeds on the *Achetæ*, *Gryllotalpæ*, *Blattæ*, and other subterranean *Orthoptera* that are the greatest plagues of the horticulturist in warm countries. If *Myg. avicularia* does not catch birds, birds, however, will sometimes catch it. I had once in my garden a tame *Cão* (*Corvus Jamaicensis*), which was skilfully expert in turning these *Spiders* up out of the soil, and still more scientifically tasty in his mode of sucking the entire juice out of their body. He did not, however, devour them.

Under stones these animals may always be detected, but never during the day in the open air[1]. At night, indeed, they sally forth to enjoy an interesting promenade, more particularly before rain, when the electrical state of the atmosphere seems to put *Scorpions* and all other *Arachnida* in motion. At such periods *Mygale*, or, as the Spaniards term it, the *Araña peluda*, crawls slowly into the houses,—an unwelcome guest,—although from its inactivity, and its unguiform *antennæ* being bent downwards, it is easily and without danger crushed. It is said, however, that the bite of the *Araña peluda* is worse than the sting of the *Alacran* or *Scorpion*: it may be so; but I can scarcely conceive how any one should have known the fact, unless he had been curious enough to resolve on being bitten. In that case, indeed, I can well imagine that the strong sharp *ungues*[2] which terminate the *antennæ* may have made a severe wound, even had the animal not the power, which it possesses, of inserting venom whenever it bites. Nevertheless, as to these immense *Spiders*,—the expansion of whose feet has been sometimes found to extend nearly a foot wide,—killing *Humming-birds*, it is not merely, I repeat, that they possess no net or other means for catching them, but they will not even devour them when caught; for I once placed a live *Humming-bird*[3] and a small *Anolis* in the tube of a *Mygale*, and it deserted it, leaving my vertebrated animals untouched.

So much for the fidelity of that pencil whose monstrous and misshapen figures have been reconciled often to form and grace, merely by our due distance from Surinam. As the above is one instance among a thousand, I repeat that until some Surinam naturalist shall prove where our good lady is true, I shall always most ungallantly believe her to be the contrary.

One word, however, as to *bird-catching Spiders*. The largest *Spiders* that make a geometrical net belong to the genus *Nephila*; and the largest *Nephila* that I have seen in the West Indies is the elegant *Neph. clavipes*, or *Epeira clavipes* of Latreille. This species is common in gardens, suspended to trees in the centre of a web, the mathe-

[1] Surely M. Langsdorff, notwithstanding his assertion of having accurately studied the economy of these animals, is quite wrong in describing them to leave their holes, "nur bei sehr warm scheinender sonne, und nicht weiter als höchstens auf einen schritt entfernung." So far from enjoying a warm sunny day, the *Mygale* is truly nocturnal, and wanders by night great distances. It is no doubt the aspect of this insect,—so little lovely,—which has fated it always to be incorrectly observed. When M. Langsdorff asked the people of Brazil if the *Caranguexeira*—for such it seems is the terrific name of our poor *Spider* in that country—fed on *Humming-birds*, they answered him with bursts of laughter, that it only gratified its maw with large *Flies*, *Ants*, *Bees*, *Wasps*, *Beetles*, &c., an answer which our traveller afterwards, as he says, found the truth of by personal experience. This ought, no doubt, to be quite conclusive evidence; but nevertheless I must beg leave still to doubt that any *Mygale* can catch winged *Hymenoptera*. M. Langsdorff, I have no doubt, ascertained that they devoured *Ants* and *Beetles*, and the rest, I suspect, must merely be attributed to a loose mode of expressing himself.

[2] So far back as the time of Rochefort these *ungues* were mounted in gold and used as tooth-picks, being supposed, as he says, to possess a peculiar virtue in preventing all diseases of the teeth.

[3] A young *Trochilus pectoralis*, Lath., and a young *Anolius rhodolæmus*, Bell.

matical regularity of which may compete with that of the ancient *Spiders* described by Ælian as Εὐκλείδου δέονται οὐδέν. Now it is certainly possible that the net of this *Nephila* should, in accord with Labat's account, accidentally arrest such small birds as are several species of *Trochilidæ*[1]; but I do not believe that the *Spider* would touch them. My garden, I repeat, is full of these *Nephilæ* in autumn, and I have tried to regale one of them with a small species of *Sphæriodactylus*[2], by putting it into her net. The *Spider*, on feeling the threads vibrate with the struggles of the *Lizard*, instantly approached and enveloped it in her web. As soon, however, as it was thus disabled, my *Nephila* seemed to become aware of her mistake, and losing no time in cutting the lines, allowed her prisoner to fall to the ground.

Thus, then, have I proved that the *Mygale avicularia* does not catch birds, any more than another *Spider*, celebrated in one of our philosophical journals a few years back, could ever have lived on arsenic or corrosive sublimate; I forget, indeed, what mineral was most easy of digestion: and although undoubtedly there be more things on earth than are dreamt of by our philosophy, I will even go so far as to add my utter disbelief in the existence of any *bird-catching Spider*. I am fully sensible that such a vermin, so interestingly disgusting, forms a treasure too valuable in the eyes of mere adepts in the free use of scissors and paste, for me to be able to dislodge it from their affections, when Langsdorff had already failed to break the charm; but however popularly pretty it may be thus occasionally to wander off into "fancy's maze," the dull, dry, and unromantic naturalist must positively stick to the stubborn truth.

[1] Particularly *Orthorhynchus minimus*, a species, by the way, that I have never seen in the Island of Cuba, although I believe it occurs in Jamaica. The only two species of *Humming-bird* I have seen in the vicinity of the Havana, are the *Trochilus pectoralis* and *Troch. Colubris* of Dr. Latham, now, I believe, assigned to distinct genera. The former remains all the year round, while the latter appears only in winter. Both are strong enough to burst three such nets as those of *Nephila clavipes*, and in fact *Trochilus pectoralis* may be seen at times to peck small flies out of them.

[2] This *Lizard* clearly belongs to the family *Geckotidæ* of Mr. Gray; and as it has the tail round, the toes 5—5, free, and dilated at their extremity, with the nail placed in a groove, I have little hesitation in referring it to the genus *Sphæriodactylus* of Cuvier. There are two or three species very common in Cuba in houses, where they occur among books, or wherever they can find shelter. They have bright eyes, are pretty, and very harmless, and come out of their corners in rainy weather, declaring war against everything in the shape of a *Fly* or *Musquitoe*. The following are the descriptions of the most common.

1. *Sphæriodactylus cinereus*. Sphær. caudâ corporis longitudine, totus cinereus, translucidus capite flaviori; apice roseo, squamis dorsalibus punctis minutissimis nigris aspersis.

Long. tot. $2\frac{3}{4}$ unc.

N.B. This may possibly be the *Small House-lizard* of Browne's Jamaica.

2. *Sphæriodactylus elegans*. Sphær. fasciis dorsalibus transversis nigris 14, capite cœruleo-cinereo subtùs nigro-fasciato, dorso subviridi, caudâ rubrâ corpore breviori, ventre cinereo.

Long. tot. $1\frac{1}{4}$ unc.

N.B. There are nine of the black bands between the eyes and the tail, which near the root has three, but towards the tip has none, and is of a subtranslucid red colour.

PLATE XXVI.

Fig. 1. Egg of *Urania Fernandinæ.*
- *a.* Natural size.
- *b.* Magnified, and seen from the summit.
- *c.* One which is rather more yellow, also magnified, seen laterally.

2. *Larva* of *Urania Fernandinæ.*
- *d.* Adult caterpillar, of the ordinary size that occurs.
- *e.* Caterpillar of the largest size.

3. Cocoon of the natural size, allowing the *pupa* within to be visible through the meshes.
4. *Chrysalis* of the natural size, seen dorsally.
5. The same seen laterally.

1
b
c
2
d
3

XXII. *Descriptions of some new Species of* Calyptræidæ. *By* W. J. Broderip, *Esq., Vice-Pres. of the Geological and Zoological Societies, F.R.S., L.S., &c.*

Communicated February 25 and May 13, 1834.

AFTER an inspection of perhaps the largest collection of *Calyptræidæ* ever brought together, I am inclined to think that the best specific characters are to be found in the markings or sculpture of the external shell, in the shape of the delicate internal chamber or cup (*cyathus*, as I have designated it in *Calyptræa* and *Calypeopsis*), and in the mode of its adhesion to the inside of the limpet-like shell which contains and protects it. External form, the character solely relied on by Lamarck, varies so much, according to the accidents of locality, that very little reliance is to be placed upon it; for the animal seems to accommodate the shell entirely to the circumstances under which it is placed. I have before me specimens taken from under the same stone, evidently of the same species, varying in shape from a regular high cone to an almost flat surface, with nearly every intervening irregularity of circumference that can be imagined. Thus much I have ventured as an apology for not laying great stress on that which satisfied Lamarck, who did so much for the science; but when it is remembered that he has only described four recent and two fossil species of *Calyptræa* and but six species of *Crepidula*, it will readily occur to the reader that he had not the opportunities of judging of the value of external shape which the rich collection brought home by Mr. Cuming has afforded me. That collection contains all the species that are described in the present communication.

M. Deshayes has given the anatomy of *Calyptræa Sinensis*, Lam., with his usual accuracy; and M. Lesson, in the 'Zoologie de la Coquille,' has divided the *Calyptrææ* and *Crepidulæ* into several subgenera, observing that it is immaterial by which of the abovementioned names the leading genus is known. M. Lesson chooses *Calyptræa*, and the following arrangement will be very nearly the same as his, though it may be necessary to make some slight alterations, and to extend the definition of his subgenus *Calyptræa*.

M. Lesson has founded his arrangement upon the following observations. "L'animal des calyptrées et des crépidules nous paraît ne différer en rien d'essentiel; et quant à la cloison du test, soit que cette cloison soit transversale, soit qu'elle ne consiste qu'en lamelles annexées au fond de la coquille, elle présente des passages de ces deux états et ne peut servir qu'à établir de simples sous-genres au grand genre *calyptræa* ou *crepidula* comme on voudra l'appeler. Voici ce que nous pensons qu'on pourrait admettre dans l'état actuel de nos connaissances."[1]

[1] Zoologie de la Coquille, tom. ii. p. 388. *et seq.*

The philosophical view which M. Lesson has taken of this subject is entirely confirmed, as far as regards the anatomical part of it, by Mr. Owen, who gives me the following result of his investigations founded on the dissection of Mr. Cuming's specimens. "The soft parts of *Crepidula*," says Mr. Owen, "are the same with those of *Calyptræa* in all essential points of structure, differing only in the proportionate extent of the anterior part of the foot, and dorsal groove of the mantle." The truth of the observation on the gradations of form of the inner chamber will strike every zoologist who views Mr. Cuming's extensive collection; and it should be recollected that M. Lesson came to this conclusion from the study of materials comparatively slender.

As the memoir of M. Lesson must deservedly become a leading authority on this family of *Gasteropods*, it becomes the more necessary to point out an error of the draftsman, which, as I do not find that M. Lesson has observed upon it, may probably have escaped that gentleman's notice. In the figure of *Calyptræa* (*Crepipatella*) *Adolphei*[1], the position of the head of the animal is wrong; its real situation is nearly opposite to the point which it occupies in M. Lesson's plate. I have, in company with Mr. Owen, examined many specimens, and there are some yet undisturbed in the Museum of the Royal College of Surgeons in London which leave no doubt on this subject; indeed, it would be contrary to all analogy and the general rules of animal mechanism were the fact otherwise. The position of the head in M. Deshayes's plate is correct.

CALYPTRÆIDÆ.

Subgenus Calyptræa.

Testa subconica, subacuminata, cyathi basi adhærente, lateribus liberis.

α. Cyatho integro.

1. Calyptræa rudis.

Tab. XXVII. Fig. 1.

Cal. testâ fuscâ, subdepressâ, suborbiculari, radiatim corrugatâ; limbo crenato; cyatho concentricè lineato, albido, irregulariter subcirculari; epidermide subfuscâ.

Diam. 2 poll., alt. $\frac{7}{12}$.

Hab. in Americâ Centrali. (Panama and Real Llejos.)

This species, whose white onyx-like cup, adhering only by its base, shows to great advantage against the ruddy brown which is the general colour of the inside of the protecting shell, was found under stones. The young shells are the flattest and most regular in form, but their inside is generally of a dirty white dimly spotted with brown. The measurement is taken from the largest specimens.

[1] Zoologie de la Coquille, Atlas, Mollusques, Pl. 15. fig. 2. A.

β. Cyatho hemiconico, longitudinaliter quasi diviso. (Calyptræa, *Less.*)

2. Calyptræa corrugata.

Tab. XXVII. Fig. 2.

Cal. testâ subalbidâ, suborbiculari, subdepressâ, corrugatâ, intùs nitente ; cyatho concentricè lineato, producto ; epidermide fuscâ.

Diam. $\frac{5}{8}$ poll., alt. $\frac{8}{10}$.

Hab. in Americâ Centrali. (Guacomayo.)

Found under stones at a depth of fourteen fathoms.

3. Calyptræa varia.

Tab. XXVII. Fig. 3.

Cal. testâ albidâ, suborbiculari, crassiusculâ, longitudinaliter creberrimè striatâ ; cyatho concentricè lineato, crassiusculo, producto.

Diam. $1\frac{3}{8}$ poll., alt. max. $\frac{7}{8}$, alt. min. $\frac{2}{8}$.

Hab. in Oceano Pacifico. (Lord Hood's Island, the Gallapagos, and the Island of Muerte in the Bay of Guayaquil.)

This is a very variable species allied to *Cal. equestris*, Lam., and taking almost every shape which a *Calyptræa* can assume. It differs in thickness according to locality and circumstances. The thickest individuals were found at the Gallapagos and Lord Hood's Island; at the former place on shells, at the latter on the reefs. Those from Muerte are the thinnest and the most depressed.

4. Calyptræa cepacea.

Tab. XXVII. Fig. 4.

Cal. testâ albâ, suborbiculari, subconcavâ, tenui, diaphanâ, striis numerosis subcorrugatâ, intùs nitente ; cyathi terminationibus lanceolatis.

Long. $1\frac{1}{12}$ poll., lat. $1\frac{1}{8}$, alt. $\frac{3}{8}$.

Hab. in sinu Guayaquil. (Island of Muerte.)

This was dredged up, adhering to dead shells, from sandy mud at a depth of eleven fathoms, by Mr. Cuming. Besides other differences, the terminating points of the divided *cyathus* are much more lanceolate than they are in *Cal. varia.*

5. Calyptræa cornea.

Tab. XXVII. Fig. 5.

Cal. testâ suborbiculari, complanatâ, albidâ, subdiaphanâ, concentricè lineatâ et radiatim striatâ, intùs nitente.

Diam. $\frac{6}{8}$ poll., alt. $\frac{1}{8}$.
Hab. ad Aricam Peruviæ.

Dredged up from sandy mud at a depth of nine fathoms.

Subgenus Calypeopsis, *Less.*

Cyatho interno integro, lateraliter adhærente.

Before I proceed to describe the species of this subgenus which appear to me to be new, I must refer to the finest specimens of *Cal. Extinctorium*, Lam., and of *Cal. spinosa*, Sow., and its varieties, that I have hitherto seen. The specimen of *Cal. Extinctorium* was taken by Mr. Cuming at Guaymas in the Gulf of California: its length is $2\frac{6}{8}$ inches, its breadth $2\frac{3}{8}$, and its height $1\frac{1}{8}$. The large-spined varieties of *Cal. spinosa* (Tab. XXVIII. fig. 8.) were found under stones at low water at St. Elena and at Lobos Island, and some small-spined varieties were dredged from sandy mud, adhering to stones and shells, at a depth of from six to eight fathoms, at St. Elena. In all the varieties the spines are tubular. The originals are in Mr. Cuming's collection. It will be observed that the specimen of *Cal. spinosa* is so flat that the edge of the cup is considerably below the margin of the external shell, whereas the species is generally more or less conical, the *apex* of the cone often rising to a fair height.

6. Calyptræa radiata.

Tab. XXVII. Fig. 6.

Cal. testâ conico-orbiculari, albidâ fusco radiatâ, striis longitudinalibus crebris; limbo crenulato; apice acuto, subrecurvo; cyatho depresso.
Diam. 1 poll., alt. $\frac{5}{12}$.
Hab. in Americâ Meridionali. (Bay of Caraccas.)

The cup of this pretty species is pressed in, as it were, on one side, and adheres to the shell, not only by its *apex*, but also by a lateral seam, which scarcely reaches to the rim of the cup. The *apex* of the younger specimens, both externally and internally, is generally of a rich brown, and there can be little doubt that when first produced they are entirely of that colour.

Found in sandy mud on dead shells, at a depth of from seven to eight fathoms.

7. Calyptræa imbricata.

Tab. XXVII. Fig. 7.

Cal. testâ albidâ, crassâ, subconicâ, ovatâ, costis longitudinalibus et squamis transversis imbricatâ; apice subincurvo, acuto; limbo crenato; cyatho depresso.

Diam. 1 poll., lat. $\frac{6}{8}$, alt. $\frac{6}{8}$.
Hab. ad Panamam.

Found on stones in sandy mud, at a depth of from six to ten fathoms.

8. Calyptræa lignaria.

Tab. XXVII. Fig. 8.

Cal. testâ crassâ, fuscâ, deformi, striis corrugatâ; apice prominente, subadunco, acuto, posteriore.

Diam. 1 $\frac{4}{10}$ poll., lat. $\frac{6}{8}$, alt. $\frac{7}{8}$.
Hab. in Americâ Centrali. (Real Llejos.)

The majority of individuals of this species have their shells so deformed that they set description at defiance; the comparatively well-formed shell occurs so rarely, that it may be almost considered as the exception to the rule. When in this last-mentioned state, the circumference of the shell is an irregular somewhat rounded oval, and it rises into a form somewhat resembling the back of *Ancylus*, with the *apex* very sharp and inclining downwards. The shell in this shape is generally less corrugated than it is in deformed individuals, though some of those are comparatively smooth; but, in both states, the shell is striated immediately under the *apex*, and is, for the most part, corrugated on the other side of it.

Found under stones.

Var. *α*. Enormiter conica, cyatho valdè profundo.

Tab. XXVII. Fig. 8*.

This variety is often one inch and six eighths in height, and its cup nearly one inch deep, while the diameter of the shell at the aperture does not exceed one inch.

Found on shells in sandy mud, at the depth of four fathoms, at the island of Chiloe.

9. Calyptræa tenuis.

Tab. XXVII. Fig. 9.

Cal. testâ irregulari, tenui, subdiaphanâ, creberrimè striatâ, albidâ, interdum fusco pallidè strigatâ.

Diam. 1 poll., alt. [illegible]/12.
Hab. ad Peruviæ oras. (Samanco Bay.)

Found on living shells in muddy sand, at a depth of nine fathoms.

10. Calyptræa hispida.

Tab. XXVII. Fig. 10.

Cal. testâ subovatâ, subconicâ, albâ strigis maculisque subpurpureo-fuscis variâ, striis frequentibus et spinis tubularibus erectis hispidâ; limbo crenulato; apice turbinato; cyatho subdepresso.

Diam. $\frac{10}{12}$ poll., lat. $\frac{8}{12}$, alt. $\frac{3}{10}$.

Hab. in sinu Guayaquil. (Island of Muerte.)

This elegant species, the circumference of whose somewhat depressed cup is free with the exception of one part, where it adheres laterally, was found on dead shells in sandy mud at a depth of twelve fathoms.

11. Calyptræa maculata.

Tab. XXVII. Fig. 11.

Cal. testâ ovatâ, albidâ purpureo-fusco maculatâ, longitudinaliter rugosâ; limbo serrato; apice subturbinato, subincurvo.

Diam. $\frac{11}{12}$ poll., lat. $\frac{7}{10}$, alt. $\frac{3}{8}$.

Hab. in sinu Guayaquil. (Island of Muerte.)

The external contour of this shell, more especially in the position of the subturbinated *apex*, much resembles that of *Ancylus*. The circumference of the cup is free, excepting at one point, where it adheres laterally throughout its length.

Found in sandy mud on dead shells, at a depth of eleven fathoms.

12. Calyptræa serrata.

Tab. XXVIII. Fig. 1.

Cal. testâ suborbiculari, albâ, subpurpureo vel fusco interdum fucatâ vel strigatâ, costis longitudinalibus prominentibus rugosis; limbo serrato; apice subturbinato; cyatho valdè depresso.

Diam. $\frac{1}{2}$ poll., lat. $\frac{5}{12}$, alt. $\frac{3}{12}$.

Hab. ad Real Llejos et Muerte.

Var. testâ albâ.

Found on dead shells in a muddy bottom, at the depth of from six to eleven fathoms. There is a variety entirely white.

Subgenus Syphopatella, *Less.*?

Cyatho seu potius laminâ internâ subtrigonâ, subcirculari, latere dextro replicato.

I think it very probable that the five following species belong to M. Lesson's subgenus *Syphopatella*; but no reference is given in the 'Zoologie', and in a family where the passages are so very gradual, it is difficult to come to a satisfactory conclusion from an unassisted description, however well written it may be.

13. Calyptræa sordida.

Tab. XXVIII. Fig. 2.

Cal. testâ subconicâ, sordidè luteâ, longitudinaliter subradiatâ; apice turbinato; cyatho depresso, subtrigono, haud profundo.

Diam. $\frac{1}{2}$ poll., lat. $\frac{5}{12}$, alt. $\frac{2}{10}$.

Hab. ad Panamam.

This species, the inside and outside of which are of a sordid yellow, is generally covered externally with coral or other marine adhesions. The plate is spoon-shaped.

Found on stones, on a sandy bottom, at a depth of twelve fathoms.

14. Calyptræa Unguis.

Tab. XXVIII. Fig. 3.

Cal. testâ tenui, conicâ, corrugatâ, fuscâ; apice subturbinato; cyatho depresso, subtrigono.

Diam. $\frac{4}{12}$ poll., alt. $\frac{3}{10}$.

Hab. ad Valparaiso.

The plate is spoon-shaped, but not so shallow as that of *Cal. sordida.*

Found on shells at a depth of from seven to forty-five fathoms.

15. Calyptræa Lichen.

Tab. XXVIII. Fig. 4.

Cal. testâ albidâ, interdum pallidè fusco sparsâ, subdiaphanâ, subturbinatâ, orbiculatâ, complanatâ.

Diam. $\frac{6}{8}$ poll., alt. $\frac{2}{8}$.

Hab. in sinu Guayaquil. (Island of Muerte.)

Found on dead shells in sandy mud, at a depth of eleven fathoms.

16. Calyptræa mamillaris.

Tab. XXVIII. Fig. 5.

Cal. testâ albidâ, subconicâ; apice subpurpureo, mamillari.

Diam. $\frac{5}{10}$ poll., alt. $\frac{4}{12}$.

Hab. in sinu Guayaquil. (Island of Muerte.)

This pretty species varies. It is sometimes milk-white, with the mamillary *apex* of a brownish purple, and with the inside sometimes of that colour, sometimes white, and sometimes yellowish. In other individuals the white is mottled with purplish brown stripes and spots.

Found on dead shells in sandy mud, at a depth of eleven fathoms.

17. Calyptræa striata.

Tab. XXVIII. Fig. 6.

Cal. testâ sordidè albâ, suborbiculatâ, subconicâ, subturbinatâ, striis longitudinalibus elevatis creberrimis corrugatâ, intùs fusco-flavescente.

Diam. $\frac{10}{12}$ poll., alt. $\frac{3}{10}$.

Hab. ad Valparaiso.

Found on shells in sandy mud, at a depth varying from forty-five to sixty fathoms.

18. Calyptræa conica.

Tab. XXVIII. Fig. 7.

Cal. testâ conicâ, fuscâ albido maculatâ, subturbinatâ.

Diam. 1 $\frac{4}{8}$ poll., alt. $\frac{7}{10}$.

Hab. ad Xipixapi et ad Salango.

Found attached to shells in deep water.

Subgenus Crepipatella, *Less.*

Laminâ rotundatâ, apice laterali et subterminali.

19. Calyptræa foliacea.

Tab. XXVIII. Fig. 9.

Cal. testâ suborbiculari, albidâ, foliaceâ, intùs castaneâ vel albâ castaneo variâ.

Diam. 1 poll., alt. $\frac{3}{8}$.

Hab. ad Aricam Peruviæ saxis adhærens.

This *Crepipatella*, which bears no remote resemblance to the upper valve of some of the *Chamæ* when viewed from above, was found on exposed rocks near the shore.

20. Calyptræa dorsata.

Tab. XXVIII. Fig. 10.

Cal. testâ subalbidâ, planiusculâ, costis longitudinalibus irregularibus rugosâ, intùs medio fusco-violaceâ.

Diam. $\frac{3}{8}$ poll., lat. $\frac{1}{2}$.

Hab. ad Sanctam Elenam.

The back of this shell is not unlike the upper valve of some of the *Terebratulæ*. Found on dead shells in sandy mud, at a depth of six fathoms.

21. Calyptræa dilatata, *Lam.*

Varietas intùs nigro-castanea.

Tab. XXVIII. Fig. 11.

Cal. testâ sordidè albâ castaneo strigatâ, intùs nitidè nigro-castaneâ, laminâ albâ.

Diam. $1\frac{3}{8}$ poll., lat. $1\frac{1}{8}$, alt. $\frac{1}{2}$.

Hab. ad Valparaiso.

This highly coloured variety was found on exposed rocks at low water. The pure white of the plate shows to great advantage, lying above the rich back ground of the interior of the shell. In some individuals this internal colour is all but black.

22. Calyptræa strigata.

Tab. XXVIII. Fig. 12.

Cal. testâ subcorrugatâ, sordidè rubrâ albo variâ, intùs subrufâ interdum albâ vel albâ rubro-castaneo variâ.

Diam. 1 poll.

Hab. ad Valparaiso.

This varies much both in colour and shape. Some of the specimens are quite flat, and the plate is almost convex. An obscure, subarcuate, longitudinal, whitish, broad streak may be traced on the backs of most of them. It is not impossible that it may be a variety of *Cal. dilatata.*

Found on *Mytili* at depths varying from three to six fathoms.

23. Calyptræa Echinus.

Tab. XXIX. Fig. 1.

Cal. testâ albidâ violaceo maculatâ, interdum fuscâ, striis longitudinalibus creberrimis, spinis fornicatis horridâ, intùs flavente vel albâ.

Diam. $1\frac{1}{2}$ poll., lat. $1\frac{1}{8}$, alt $\frac{5}{8}$.

Hab. ad Peruviam. (Lobos Island.)

In old specimens the spines are almost entirely worn down, and rough *striæ* only for the most part remain. In this state it bears a great resemblance to the figure given of *Crepidula fornicata* in Mr. Sowerby's 'Genera of Shells', No. 23. f. 1.

Found under stones at low water.

24. Calyptræa Hystrix.

Tab. XXIX. Fig. 2.

Cal. sordidè albâ vel fuscâ, complanatâ, longitudinaliter striatâ, spinis magnis fornicatis apertis seriatim dispositis, intùs albidâ interdum castaneo maculatâ.

Diam. $1\frac{3}{8}$ poll., lat. $\frac{7}{8}$, alt. $\frac{3}{8}$.

Hab. ad Peruviam. (Lobos Island.)

Approaching the last, but differing in being always more flattened, in the comparatively great size of the vaulted spines, and in the comparatively wide interval between them. Still I would not be positive that both are not varieties of *Crepidula aculeata*, Lam.

25. CALYPTRÆA PALLIDA.

Tab. XXIX. Fig. 3.

Cal. testâ sordidè albâ, ovatâ; apice prominente.

Diam. $\frac{7}{8}$ poll., lat. $\frac{5}{8}$, alt. $\frac{2}{8}$.

Hab. ad Insulas Falkland dictas.

Found under stones.

Subgenus CREPIDULA, *Less.*

Laminâ subrectâ, apice postico et submedio.

26. CREPIDULA UNGUIFORMIS, *Lam.*

Varietas complanato-recurva.

Tab. XXIX. Fig. 4.

Long. $1\frac{2}{8}$ poll., lat. $\frac{6}{8}$.

Hab. ad Insulam Chilöen et ad Panamam.

This variety affords a good example of the powers of adaptation of the animal. The shell is either flattened or concave on the back, and recurved, in consequence of its adhesion to the inside of dead shells of *Ranellæ Vexillum, cœlata*, &c.

It was dredged from sandy mud, at a depth ranging from four to ten fathoms.

27. CALYPTRÆA LESSONII.

Tab. XXIX. Fig. 5.

Cal. testâ complanatâ, subconcentricè foliaceâ, foliis tenuibus, albâ fusco longitudinaliter strigatâ, intùs albidâ, limbo interno interdum fusco ciliato-strigato.

Long. $1\frac{4}{10}$ poll., lat. $\frac{11}{12}$, alt. $\frac{2}{8}$.

Hab. in sinu Guayaquil. (Island of Muerte.)

This beautiful species, which I have named in honour of M. Lesson, was found under stones at low water. It will remind the observer of the upper valves of some of the *Chamæ*.

28. CALYPTRÆA INCURVA.

Tab. XXIX. Fig. 6.

Cal. testâ fusco-nigricante, tortuosâ, corrugatâ, intùs nigricante, septo albo; apice adunco.

Long. $\frac{6}{8}$ poll., lat. $\frac{1}{2}$, alt. $\frac{3}{8}$.

Hab. ad Sanctam Elenam et ad Xipixapi.

Found on dead shells dredged from sandy mud, at a depth ranging from six to ten fathoms.

29. Calyptræa excavata.

Tab. XXIX. Fig. 7.

Cal. testâ crassiusculâ, subtortuosâ, lævi, albidâ vel subflavâ fusco punctatâ et strigatâ, intùs albâ, limbo interdum fusco ciliato-strigato.

Long. $1\frac{7}{8}$ poll., lat. $1\frac{1}{8}$, alt. $\frac{5}{8}$.

Hab. ad Real Llejos.

This species is remarkable for the depth of the internal margin before it reaches the *septum* formed by the plate. In *Crepidula adunca*, Sow., this depth is even greater than it is in *Crep. excavata.* The *apex* is close to the margin, obliquely turned towards the right side.

The dimensions are taken from the largest specimen.

30. Calyptræa arenata.

Tab. XXIX. Fig. 8.

Cal. testâ subovatâ, albidâ rubro-fusco creberrimè punctatâ, intùs subrubrâ vel albidâ subrubro maculatâ, septo albo.

Long. $1\frac{1}{8}$ poll., lat. $\frac{7}{8}$, alt. $\frac{4}{12}$.

Hab. ad Sanctam Elenam.

This approaches *Crepidula Porcellana,* Lam. The *septum* is somewhat distant from the margin; and the *apex,* which is also somewhat distant from it, is obtuse, and obliquely turned towards the right side.

From sandy mud on shells, at a depth ranging from six to eight fathoms.

31. Calyptræa marginalis.

Tab. XXIX. Fig. 9.

Cal. testâ subovatâ, sublævi vel vix corrugatâ, subflavâ vel albidâ fusco strigatâ, intùs nigricante vel flavâ fusco strigatâ, septo albo.

Long. $1\frac{1}{8}$ poll., lat. $\frac{10}{12}$, alt. $\frac{4}{12}$.

Hab. ad Panamam et ad Insulam Muerte.

This species was found on stones and shells in sandy mud, at a depth ranging from six to ten fathoms. The white *septum* shows beautifully against the black brown of the interior. The *apex* is almost lost in the margin, and is directed towards the right side.

32. Calyptræa Squama.

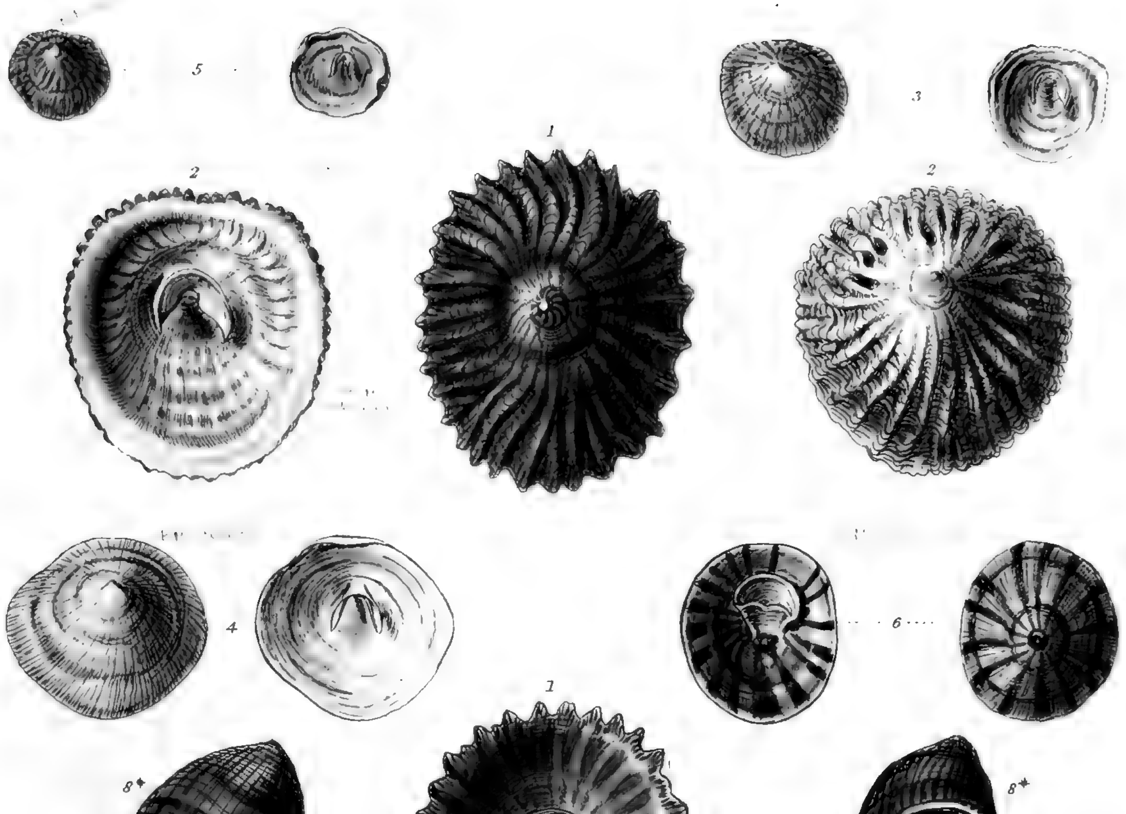
Tab. XXIX. Fig. 10.

Cal. testâ suborbiculari, complanatâ, sublævi, subtenui, pallidè flavâ vel albidâ fusco substrigatâ, intùs subflavâ vel subflavâ fusco strigatâ.

Long. 1 poll., lat. $\frac{11}{12}$, alt. $\frac{2}{10}$.
Hab. ad Panamam.

The *apex* of this very flat species is lost in the margin.
Found under stones.

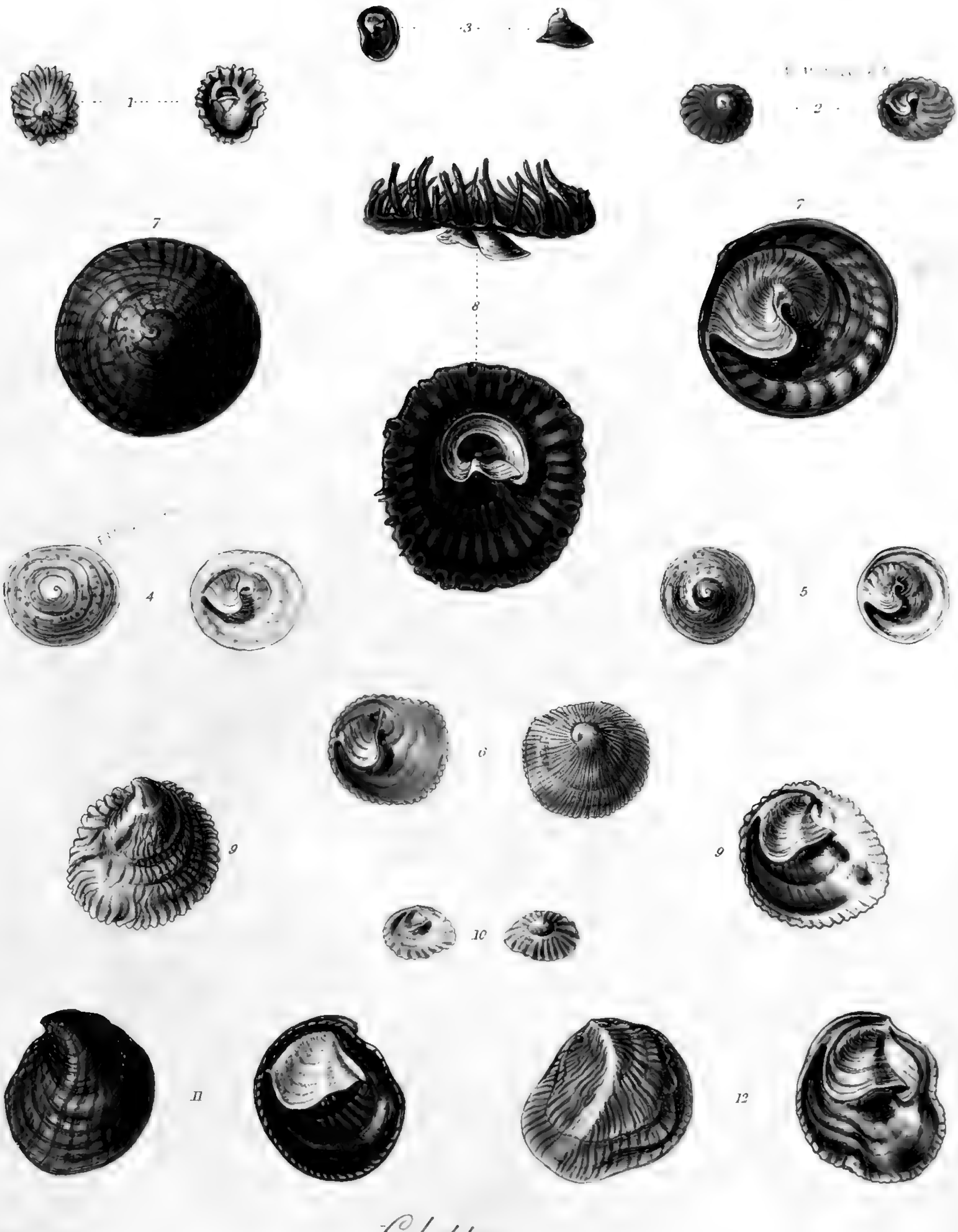
I have before me several more of this family, some of which may be new; but I hesitate to describe them till I have more satisfactory evidence that they are not varieties or species already recorded. Many shells of *Calyptræidæ* are figured by Martini, Lister, and other authors; and it is not improbable that some of the species above described may have afforded the subjects from which the engravings were made: but the figures are for the most part so doubtful that no dependence can be placed upon the majority of them, and they rather embarrass than assist the inquirer.



G.B.Sowerby, Jun. del. & sculp.

Calyptræa.

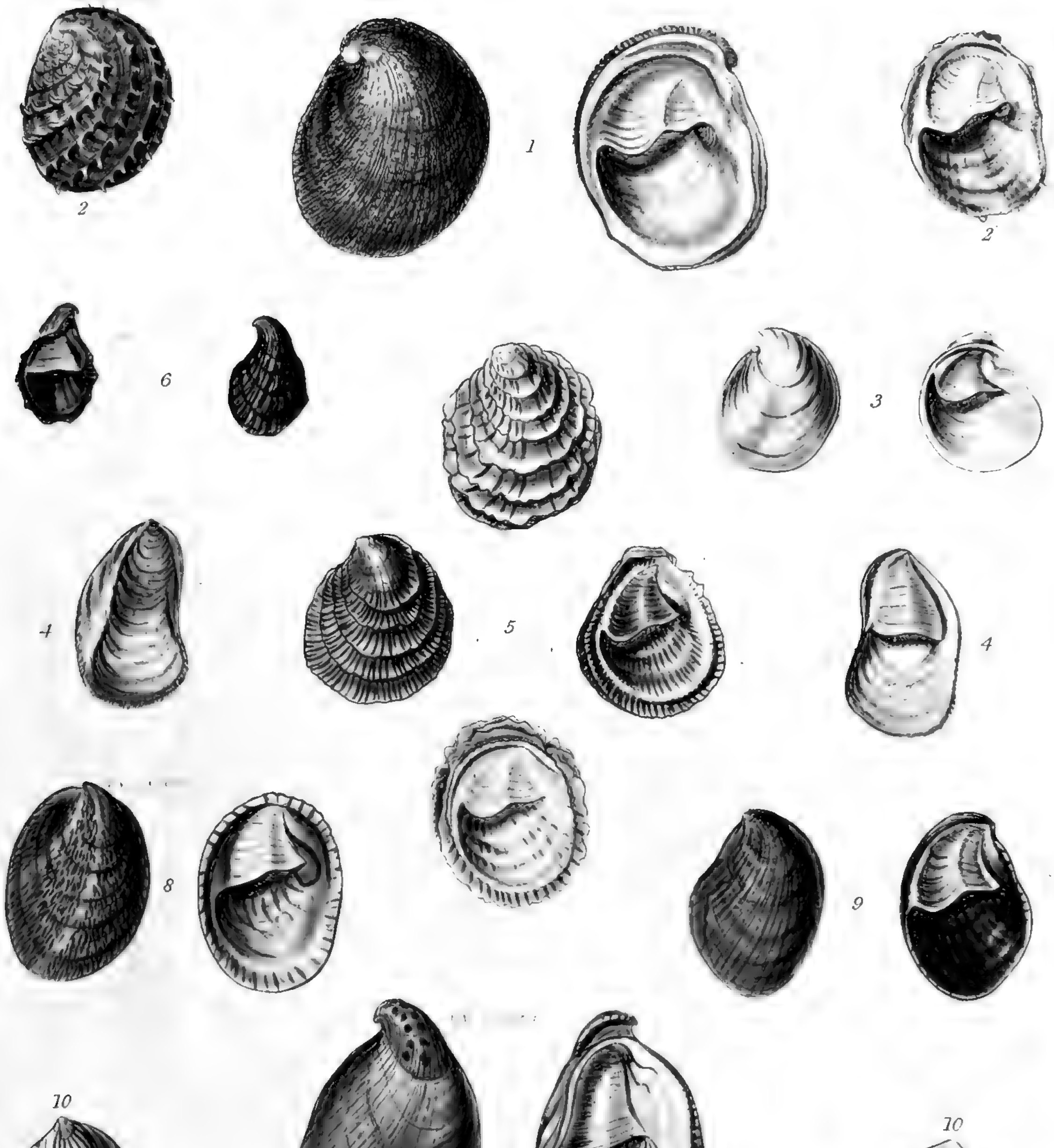
(Calyptræa.) 1. Cal. rudis. 2. Cal. corrugata. 3. Cal. varia. 4. Cal. cepacea?
5. Cal. cornea. (Calypeopsis.) 6. Cal. radiata. 7. Cal. imbricata. 8. Cal. lignaria & var.
9. Cal. tenuis. 10. Cal. hispida. 11. Cal. maculata.



G.B. Sowerby. Jun. del. & sculp.

Calyptraea.

(Calypeopsis.) 1. Cal. serrata. (Syphopatella?) 2. Cal. sordida. 3. Cal. Uvgui.
4. Cal. Lichen. 5. Cal. mamillaris. 6. Cal. striata. 7. Cal. conica?
8. Cal. spinosa, var. (Crepipatella.) 9. Cal. foliacea. 10. Cal. dorsata?
11. Cal. dilatata, var. 12. Cal. strigata.



G. B. Sowerby, Jun. del. & sculp.

Calyptraea ?

(Crepipatella,) 1. Cal. Echinus. 2. Cal. Hystrix. 3. Cal. pallida ?
(Crepidula.) 4. Cal. unguiformis, var. 5. Cal. Lessonii. 6. Cal. incurva ?
7. Cal. excavata. 8. Cal. arenata. 9. Cal. marginalis. 10. Cal. Squama ?

XXIII. *On the Anatomy of the* Calyptræidæ. *By* Richard Owen, *Esq., F.Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated February 25, 1834.

My friend Mr. Broderip having, in the course of his examination of the shells of the family *Calyptræidæ* in the collection of Mr. Cuming, detected a series of gradations in the form and extent of the internal shelly plate, intermediate to those characterizing the species which have been proposed as types of subgenera, he requested me to examine the soft parts, and see whether a corresponding gradation prevailed in any of the organic systems, or whether these presented differences sufficiently marked or constant to sanction the adoption of the proposed subgeneric divisions.

Mr. Cuming's collection and that of Captain King have afforded the necessary materials for this investigation; and although the difference between *Crepipatella*, Less., and *Calypeopsis*, Less., in the extent of the locomotive and respiratory systems is considerable, yet the intermediate or connecting species present gradations in the structure of these parts corresponding to those in the form of the shelly plate, the latter peculiar feature of this family of *Gasteropods* acquiring magnitude, for the purpose of protecting the visceral mass and of isolating it from the foot, in proportion as this part is better organized for extension and contraction.

The labours of Cuvier[1], of M. Deshayes[2], and of M. Lesson[3] have sufficiently elucidated the general plan of formation which pervades this family of *Gasteropods*. Their dissections illustrate the structure of the subgenera *Crepidula*, *Calyptræa*, and *Crepipatella* respectively; but the soft parts of *Calypeopsis*, Less., or *Dispotæa* of Say, have never been figured or described; and two large specimens of a species of this subgenus[4], kindly presented to me by Capt. P. P. King, have afforded me the means of adding a few particulars to the amount of anatomical knowledge already possessed with respect to the *Calyptræidæ*.

The internal shelly *lamina* in that form of *Calyptræa* which M. Lesson has distinguished by the name of *Calypeopsis*, is free in the whole of its circumference, forming a delicate cup-shaped shell, adhering by the base and nearly the whole of one of the sides to the outer large limpet-shaped shell.

[1] Anat. de la Crépidule, Mém. des Mollusques. [2] Ann. des Sci. Nat., tom. iii p. 338. pl. xvii.

[3] Anat. de la *Crepipatella Adolphei*, Zoologie de Duperrey, tom. ii. pt. 1. p. 392.

[4] *Calyptræa (Dispotæa) Byronensis*, Gray, Mus. Brit.

This internal cup is received in a deep fissure of a corresponding form on the dorsal aspect of the body of the animal. Its cavity is filled by what may be termed the *apex* of the foot, which here loses its muscular character and assumes a gelatinous texture: the ovary, liver, heart, and loop of intestine are lodged in the recess between the cup and the outer shell. The margin of the mantle is free in the whole of its circumference, and is generally in the contracted state folded upon itself, as in Plate XXX. Fig. 4.

The entrance to the branchial chamber is above the head, as in the *Pectinibranchiata*, and opens towards the right side, but is not prolonged into a *siphon*. In *Calyptræa Sinensis*, Lam., (the species dissected by M. Deshayes,) this chamber is continued along the left side only of the body; but in *Calypeopsis*, where the internal plate is cup-shaped, the *branchia* and its pallial receptacle are prolonged round to the right side, describing a complete circle. The foot, which in *Cal. Sinensis* is of a simple circular form, is here provided with two thin aliform expansions continued from its anterior margin: the rest of the foot is of considerable thickness, and is separated from the mantle by a fissure. The head, the mouth, the unretractile tentacles,—a single pair, with the eyes at the outer side of their base,—the neck, and its lateral expansions, present no deviations from the structure of the same parts as they exist in *Crepidula*[1] and in *Cal. Sinensis*. In the males (for the *Calyptræidæ* are incontestably diœcious, like the higher *Pectinibranchiata*,) the *penis*, a long filiform organ, extends from the right side of the neck, just below the tentacle. In some female specimens a small production of the cervical *ala* extends from the corresponding part, simulating, as it were, the intromittent organ of the male.

The tongue is a semiorbicular body, with a free anterior margin, and supports a long, narrow, horny, laminated plate, or rasp, similar to that of *Cal. Sinensis*, and capable, doubtless, of being protruded externally, as in other *Mollusks*. The *œsophagus* is long and narrow; it begins to dilate into the stomach at the lower part of the neck, and it is just anterior to this dilatation where it is surrounded by the nervous collar. Anterior to this collar, the neck on either side of the *œsophagus* is occupied by two elongated unbranched salivary follicles, with glandular *parietes*, which open into the *œsophagus* on each side the base of the lingual plate. I have found the same salivary apparatus in the subgenus *Crepipatella*, which, in the form of the internal plate, resembles *Cal. Sinensis*. The genus *Clio* among the *Pteropods* presents a similar simple form of the salivary apparatus, but in the *Whelk* (*Buccinum*), and other dibranchiate *Pectinibranchiata*, the glands assume the conglomerate structure. The globular stomach is surrounded by the granulated liver, and receives the biliary secretion by many orifices. The intestine is continued a little way down the left side, and after penetrating the ovary in

[1] Cuvier, loc. cit.

the female, and the *testis* in the male, suddenly turns upon itself, passes dorsad of the stomach, adhering to the roof of the branchial chamber, and terminates by a small projecting *anus* on the right side of the orifice of the branchial chamber, anterior to the renal, or mucous, gland.

In the male[1] the *testis* occupies the *apex* of the triangular visceral mass which is lodged between the internal and external shelly plates; it surrounds the fold of the intestine, and gives off the *vas deferens* near the *pylorus*. The excretory duct passes dorsad of the *rectum* and stomach, inclines dextrad, and runs along a groove to the outer side of the base of the *penis*, which it there penetrates: its disposition within the intromittent organ I have not been able to determine satisfactorily.

The *ovarium* in the female occupies a corresponding situation to the *testis* in the male, and, like it, is in close contact with the concave side of the branchial chamber. It is of considerable size in the large specimens, forming the principal mass of the *viscera*. The oviduct in these specimens projects a little from the mantle: it terminates posterior to the *anus*, as above described. A mucous gland, probably analogous to a renal organ, is lodged in a membranous chamber, about 3 lines in length and 2 in breadth, close to the termination of the *rectum*, at the entrance of the branchial chamber. It consists of a glandular part, of a light brown colour, and fibrous texture when seen under the lens; though from analogy the apparent fibres are no doubt secreting tubes. By the side of this gland there is a bag appropriated to receive the secretion, which bag or dilated duct communicates with the termination of the oviduct in the female, in which sex this gland is larger than in the male.

The heart is readily distinguishable, by the colour of the ventricle, through the transparent *pericardium*, which is situated on the left side of the stomach. The branchial vein receives the blood from the branchial filaments by a vessel which runs along the dorsal aspect of the base of the filaments, a little above their inserted extremities: three or four veins from this marginal vessel anastomose upon the roof of the branchial chamber, and communicate by a common trunk with the auricle. The veins of the body run over the floor of the branchial chamber, and terminate in a marginal vessel which runs parallel with the inserted extremities of the branchial filaments. From this vessel, a small branch is given off to each filament, which, under the microscope, may be seen to turn over the free extremity of the central horny support, and passing down the opposite side, to enter the branchial vein. This is analogous to the structure of the tem-

[1] My first dissections were of female specimens of *Calyptræa*, as all that I then possessed were of that sex; but since the reading of this Paper I have met with a male *Calypeopsis* in the collection made by Capt. P. P. King, and have been favoured with a second male specimen of *Calyptræa* by the kindness of J. E. Gray, Esq., from which specimens the above account of the male organs is derived.

porary *branchiæ* of the fœtal *Plagiostomous Fishes*, each filament of which also contains a single artery and vein.

The nervous system consists of five *ganglia*: four disposed round the *œsophagus* at the lower part of the neck, and one small one at the internal angle of the branchial aperture. The two superior œsophageal *ganglia* are the smallest: they give off the nerves of the tentacles without the interposition of another *ganglion*; they also give off lateral filaments to the cervical aliform expansions. The two larger subœsophageal *ganglia* give off the nerves of the foot and *viscera*, and from the left of them a nerve extends to the entrance of the branchial chamber, where a small *ganglion* sends a nervous twig along the floor of that cavity.

In the cabinets of the Naturalist, the shells of the *Crepidulæ* and *Calyptrææ* attract by the singularity rather than the beauty of their forms; but they are still more interesting as manifesting some of the successive stages of complexity in the passage from the simple *Patella* to the spiral univalve.

The superaddition of the internal plate or cup is obviously immediately caused by the dorsal fold or duplicature of the mantle, the margins of which, being endowed with the same power of secreting shell as the exterior margin itself, form the internal plate or cup according to the extent of the duplicature. The necessity for such a superaddition is probably to be sought for in the more active locomotive powers of *Calyptræa* as compared with *Patella*; the foot in the former, being from its organization adapted to more extensive and frequent contractions, would be liable to affect the superimposed *viscera* if they were in immediate contact with it. A calcareous plate, the first stage of a *columella*, is therefore interposed, which supports the *viscera*, and separates them from the locomotive organ.

As respiration has a direct relation to locomotion, so we find the *Calyptræidæ* approaching the higher marine univalves in the structure and position of the part dedicated to this function. The branchial filaments are, however, arranged in a single series; and the entry to the branchial chamber is not prolonged into a *siphon*, as in *Buccinum* and the higher *Pectinibranchiata*, which in their double *branchiæ* and respiratory *siphon* approximate more closely to the *Cephalopods*. But throughout the family of *Calyptræidæ* I have found the extent of the respiratory *lamina* to be in direct relation with the extent of the internal shell, and the superior extent and organization of the foot.

PLATE XXX.

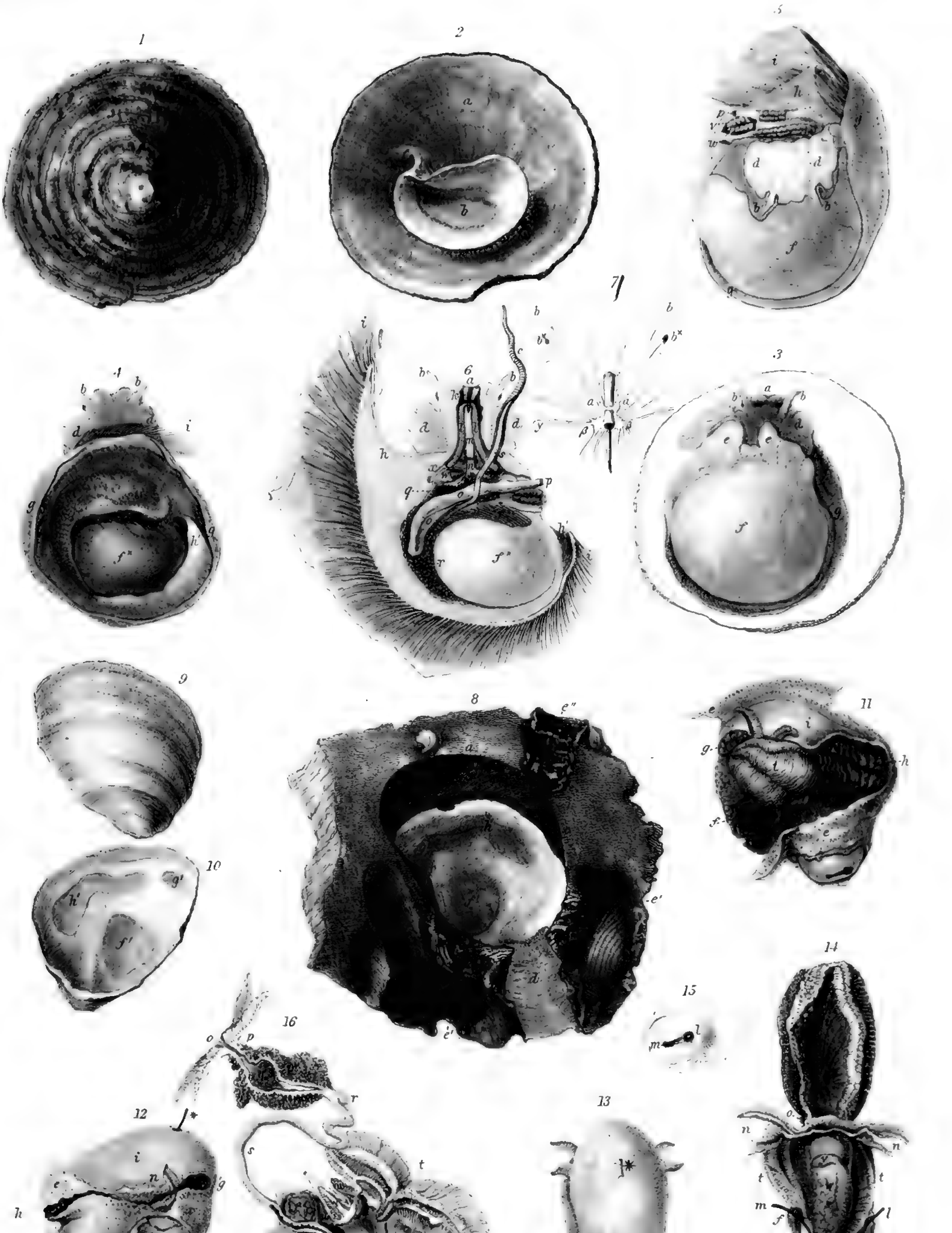
Fig. 1. Outside view of the shell of *Calyptræa Byronensis*, Gray.

2. Inside view of the same shell.
    - *a.* The front part of the shell, corresponding to the head of the animal.
    - *b.* The internal cup.
3. The soft parts of the same species from the ventral aspect.
4. The soft parts of the same species from the dorsal aspect.
5. The soft parts of a female specimen of the same species from the ventral aspect, with the head turned down to show the orifice of the branchial chamber and the terminations of the *rectum* and oviduct.
6. The soft parts of a male specimen of the same species dissected from the dorsal aspect.
7. The principal *ganglia* of the nervous system. (A bristle is passed through the *œsophagus.*)

The same letters are used for the same parts in each figure.

a. The mouth.
b. The tentacles.
*b**. The eyes.
c. (Fig. 6.) The *penis.*
d. The aliform expansions of the neck.
e. The anterior expansions of the foot.
f. The foot.
*f**. The *apex* of the foot lodged in the cavity of the cup.
*f***. The point of attachment to the shell.
g. The mantle.
h. The entry, or beginning, *h'.* the end, of the branchial chamber.
i. The branchial filaments.
k. The tongue supporting the horny rasp.
l, l. The salivary glands.
m. The *œsophagus.*
n. The stomach.
o. The intestine.
p. The *anus.*
q. The liver.
r. The *testis.*

s. The *vas deferens*.
t. (Fig. 4.) The ovary.
u. (Fig. 5.) The oviduct.
v. The mucous gland.
w. The auricle, *x*. The ventricle, of the heart.
α. The supra-œsophageal *ganglia* giving off the nerves to the tentacles and eyes.
β. The sub-œsophageal *ganglia*.
γ. The branchial *ganglion*.



1-7. Calyptræa (Calypeopsis) Byronensis.
8-16. Clavagella lata.

R. Owen. del.

Zeitter, sc.

XXIV. *On the Structure of the Heart in the* Perennibranchiate Batrachia. *By* Richard Owen, *Esq., F.Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated April 22, 1834.

As the *Reptilia* form the transition between those classes of *Vertebrata* that possess the highest and lowest degrees of the respiratory function, they differ considerably among themselves both in the extent and mode of respiration, and present corresponding variations in the external form and internal structure of the heart. This part of their anatomy has therefore been a subject of peculiar interest, not only from its physiological relations, but, as Mr. Hunter first observed[1], from its varieties of structure exhibiting as permanent conditions some of the transitional states which the heart of the warm-blooded *Vertebrata* successively assumes in its progress towards perfection.

The knowledge of these different structures has, however, been slowly, and much of it recently, acquired. Linnæus attributed to the whole of his class *Amphibia* a simple bipartite heart, as in *Fishes*, "Cor uniloculare uniauritum." But prior to the publication of the 12th edition of the 'Systema Naturæ', the more complex structure of the *Tortoise's* heart had been described by Duverney and Méry in the 'Mémoires de l'Académie des Sciences'[2], as well as by Bussières in the 27th volume of the 'Philosophical Transactions'[3]. Hasselquist had also pointed out the superior organization of the heart of the *Crocodile*[4]. Daudin[5], therefore, in his systematic work on *Reptiles*, admits the double auricle in the heart of the *Chelonia* and *Sauria*, but characterizes the *Ophidia*, as well as *Batrachia*, as having the simpler bipartite form of the organ; and this is sanctioned by Blumenbach as far as regards the *Serpents* of Germany. Cuvier and Meckel, however, more correctly attribute to the *Ophidia* a heart with two separate auricles; but in their latest writings[6] they state the single auricle to be common to, and characteristic of, the *Batrachian* order of *Reptiles*.

Meckel, indeed, after premising that the *Batrachia* have the simplest form of heart, "which consists uniformly of but one auricle and ventricle, of which the first receives the blood by many trunks from the body and lungs at the same time,"[7] afterwards

[1] On the Blood, p. 135.

[2] For the years 1676, 1703.

[3] For the year 1712. p. 172. The figures given by this author appear to me to be more faithful, and from the mode of dissection employed more intelligible, than those of Méry.

[4] Itin. Ægypt. et Palest., p. 293.

[5] Hist. Nat. des Reptiles, tom. i. p. 335.

[6] Cuvier, Règne Anim., nouv. ed., tom. ii. p. 101.—Meckel, Vergl. Anat., band v. p. 215.

[7] "Die Batrachier haben die einfachste Herzform. Das Herz besteht sehr allgemein nur aus *einer* Vorkammer und *einer* Kammer, von denen die erste das Blut durch mehrere Stämme aus den Körper und den Lungen zugleich aufnimmt."—Loc. cit., p. 215.

observes with respect to its external form, that in *Salamandra, Triton, Siren pisciformis*, and *Sir. lacertina* "the auricle is divided by a strong contraction into an anterior larger, and a posterior lesser moiety;"[1] and then proceeds to state that in the genus *Pipa* he finds "a very interesting transition-structure in a membranous *velum*, which extends from the floor of the ventricle to the upper and posterior wall of the auricle, where a manifest opening is left."[2]

My own dissections have, however, satisfied me of the correctness of Dr. Davy's ascription of a distinct auricle for the pulmonic blood to the *common Frog* and *Toad*[3]; and the more recent researches of Dr. Martin St. Ange[4] have shown, that not only do the *Anourous Caducibranchiata* recede from the character assigned by Cuvier to the *Batrachian* order, but that in the *Salamanders* also there exists a small but distinct pulmonic auricle.

In justice to Mr. Hunter it must be observed that he had accurately ascertained the true structure of the heart of the higher *Batrachia*, and included the *Frogs*, *Toads*, and *Salamanders*, with *Serpents* and the higher *Reptiles*, in the class which he denominates *Tricoilia*[5], from the heart being composed of three cavities. The *Siren*, the *Amphiuma*, the *Kattewagoe* or *Menopoma* of Harlan, in short, all the *Reptiles douteux* of Cuvier that Mr. Hunter was acquainted with, he considered as a distinct class, which he denominates *Pneumobranchia* in the manuscript which is quoted by Rusconi in the work entitled 'Amours des Salamandres Aquatiques'[6], and which is now published in the 'Physiological Catalogue of the Hunterian Collection'[7]. Neither Rusconi, Cuvier, Meckel, nor Hunter, who have severally made one or more of the *doubtful Reptiles* the subjects of particular investigation, has suspected that these remarkable animals resemble the higher *Reptiles* in the number of cavities of which the heart is composed; but they appear to have been uniformly regarded as approximating *Fishes*, as well in the simplicity of the circulating organ as in the permanence of a greater or less proportion of the branchial apparatus.

In the progress of the arrangement and description of the preparations of the circulating organs which are preserved in the Gallery of the Museum of the Royal College of Surgeons, I have had occasion to dissect an *Amphiuma means*, a *Proteus anguinus*, and a *Siren lacertina*, in order to reconcile the appearances presented by the Hunterian preparations with published descriptions, and more especially with that of the *Siren lacertina*, given by Mr. Hunter himself in the 56th volume of the 'Philosophical Transactions'[8]. In all these animals I find the pulmonary veins terminating in a small but

[1] "Der Vorhof—durch eine starke einschnürung in eine vordere, grossere und eine hintere, kleinere Hälfte getheilt ist."—Loc. cit., p. 216.

[2] "So eben finde ich indessen bei einem frischern Exemplar eine interessante Uebergangsbildung in einem häutigen, senkrechten Segel, das sich von der Grundfläche der Herzkammern bis zum obern und hintern Rande der Vorhöfe erstreckt, hier aber eine deutliche Lücke lässt."—Loc. cit., p. 217.

[3] See the Zool. Journal, vol. ii. p. 586.

[4] Table of the Circulating System.

[5] On the Blood, p. 135.

[6] p. 12.

[7] vol. ii. p. 145.

[8] 1766. p. 308.

distinct auricular chamber, which communicates with the ventricle by an oblong orifice, situated close to, but separated from, the corresponding orifice of the great auricle of the veins of the body.

In the present communication the heart of the *Sir. lacertina* is selected for more immediate consideration, as this species, in presenting a combination of but one pair of extremities with persistent external *branchiæ*, recedes furthest from the *Batrachian* type of structure, and might be supposed to approximate *Fishes* most closely in the construction of the central organ of circulation.

The heart of the *Sir. lacertina* is of an oblong figure, situated immediately behind the *branchiæ* in the middle line of the body between the two fore legs and surrounded by a strong fibrous *pericardium*, which is smooth and glistening on the inner surface, as in *Fishes*, adheres by the whole of its exterior surface to the surrounding parts, and is defended on the ventral aspect by the expanded cartilaginous coracoid bones. The length of the *pericardium* in a specimen two feet in length was two inches, its breadth three fourths of an inch.

The heart when viewed externally seems composed of a membranous sinus, a large muscular fimbriated auricle, a ventricle, and an elongated *bulbus arteriosus*.

The venous sinus is situated at the posterior part of the *pericardium*. The great inferior *cava* terminates in this sinus by two orifices, separated from each other by a membranous *septum*[1], which extends a little way into the sinus, and terminates in a concave edge anteriorly; on either side of this free margin of the *septum* there is an orifice, one of the right, the other of the left, superior *cava*[2], between which the common trunk of the pulmonary veins[3] is seen adhering by a small part of its posterior surface to the *parietes* of the sinus, but not terminating there.

If the lower part of the auricle be carefully laid open in the transverse direction, a small cavity will be exposed distinct from the rest of the auricle, and above the sinus, into which the trunk of the pulmonary veins opens. This distinct compartment[4], which is analogous to the left auricle, and is here situated to the left side of the ventricle, communicates with the ventricle by an oblong aperture close to that by which the right auricle opens into the ventricle, the two apertures being separated by a transverse band which forms the point of attachment to the simple membranous auriculo-ventricular valves. This division of the auricle into two cavities, one for the systemic the other for the pulmonic blood, would scarcely be suspected to exist upon an external view of the heart, on account of the remarkable fimbriated structure of the auricles, arising from numerous indentations of varying extent: the deepest of these clefts is, however, that which separates the appendix of the left from that of the right auricle. The internal surface of both auricles presents numerous delicate muscular ridges, which decussate in various directions: the subdivided elongated cylindrical pouches continued from the margin of the auricle present a manifest analogy with the remarkable structure of

[1] *c'*. Fig. 2. Pl. xxxi. [2] *b, b*. Fig. 3. [3] *m*. Figg. 2. & 3. [4] *e*. Fig. 2.

the branchial divisions of the *vena cava* in the *Cephalopods*, which also in that class are contained within a large *pericardium*, and serve, besides other uses, as reservoirs of blood to the branchial ventricles.

The auricles are placed on the dorsal aspect of the ventricle, and more to the left than to the right side: they are not, however, so absolutely to the left side as Meckel describes[1], but, when fully distended, advance forwards, as in *Pipa*, on both sides the ventricle and *bulbus arteriosus*, so as almost to encompass and conceal those parts. The size of the combined auricles is thus very considerable in proportion to that of the ventricle. In *Amphiuma* and *Menopoma* the auricles are proportionately smaller, and situated more completely to the left of the ventricle. The margin of the auricle in *Amphiuma* is but slightly notched as compared with that of the *Siren*; in *Menopoma* it is almost entire.

The ventricle in *Sir. lacertina* is of an oblong-oval and slightly flattened form, similar to that of *Ophidia*: a slight notch or tendency to a division is observable at the *apex*, which lodges a branch of the coronary vein[2], which is continued from this end of the ventricle into the inferior *cava*. The opposite end of the ventricle projects a little beyond the origin of the artery. The serous investment of the ventricle, besides being continued along the *bulbus arteriosus* to the anterior end of the *pericardium*, is reflected also from the lower third of the dorsal margin of the ventricle upon the venous sinus; and between these two layers the coronary vein is continued to the inferior *cava*, as in the *Crocodile* and some *Chelonia*.

The *parietes* of the ventricle (which measured $\frac{8}{10}$ths of an inch in length and $\frac{5}{10}$ths of an inch in breadth,) are about $\frac{1}{10}$th of an inch in thickness, and of a loose fasciculate structure. The most interesting appearance within the cavity is a rudimentary *septum*[3] extending from the *apex* half way towards the base of the ventricle, and terminating in a concave edge directed towards the orifice of the artery. The whole inner surface is reticulated by the decussating *carneæ columnæ*.

The valvular structure at the orifices of the auricles was not very conspicuous in the specimen examined. A slight membranous production extended from either side the bar or *septum* which separated the orifices, and this *septum* was attached by a fleshy column to the *parietes* of the ventricle.

The artery comes off about a line above the auriculo-ventricular apertures. It makes a half spiral curve, and then dilates into an elongated muscular bulb, which extends straight forwards to the anterior end of the *pericardium*, and there emerging, divides at once into the six branchial arteries, three on each side. There are two valves, one large and one small, at the origin of the artery; but the latter is a mere ridge. At the commencement of the bulb there are two similar but smaller valves. The bulb itself is almost wholly occupied by a cylindrical fleshy valvular body, attached posteriorly, and marked anteriorly with grooves which lead to the several arteries given off above: the form of the canal, as seen on a transverse section, is, at this part, crescentic.

[1] Loc. cit., p. 216. [2] *n*. Fig. 2. [3] *f'*. Fig. 3.

In *Amphiuma* and *Menopoma* the contracted membranous part of the *aorta* intervening between the ventricle and bulb, is proportionately longer than in the *Siren*, but has the same spiral twist. The bulb itself, on the other hand, is much shorter, and broader: the ventricle in both these genera is also shorter in proportion to its breadth, and in *Menopoma* approximates to the triangular form which characterizes the ventricle in *Osseous Fishes*. This genus also presents an affinity to *Cartilaginous Fishes*, in having two rows of semilunar valves in the *bulbus arteriosus*, three in each row; but neither in *Menopoma* nor *Amphiuma* is there any fleshy cylindrical body in the bulb,—this additional valve being unnecessary from the free passage which the undivided branchial arteries afford to the blood in these genera. In *Amphiuma* the pulmonary arteries are given off from the end of the bulb of the branchial *aorta*: in *Menopoma* they are formed by the union of two twigs given off respectively by the first and second branchial arteries near their origin. In the *Siren* the pulmonary arteries are branches of the lower branchial vein. It is worthy of observation, that in both *Amphiuma* and *Menopoma* the pulmonary artery supplies other parts besides the lungs, branches being sent off from it to the *œsophagus*: but I have not been able to trace any ramifications to the skin, as has been observed by Dr. Davy to be the case in the *Toad*.

The presence of two auricles in the heart of the *Reptiles douteux* now renders applicable to the whole class of *Reptiles* the phrase "Cor uniloculare biauritum"; and forms an additional argument for retaining as an Order of that Class the *Amphibia* of Latreille.

But besides the zoological application of the preceding anatomical facts, they are interesting also in a physiological point of view.

From the impediments which frequently occur to a free and regular circulation of blood in these cold-blooded and slow-breathing animals, the venous side of the heart is subject to great distension; hence the large size of the auricles, and of the sinus which receives the systemic veins, and the perfect development of the intervening pair of valves, of which the Eustachian valve in the *Mammiferous* heart still presents a rudiment. Had the pulmonary veins terminated along with the systemic in the same cavity, their orifices would have been subjected to the pressure of the accumulated contents of that cavity, and there would have been a disproportionate obstacle to the passage of the aerated blood into the ventricle. This is obviated by providing the pulmonary veins with a distinct receptacle, which is equally ready with the right auricle to render its contents into the ventricle during the diastole of that cavity.

In considering the heart with reference to the breathing organ in other classes, we find that at its first appearance as a distinct mechanical and muscular organ its energies are expended on the systemic circulation, and that the respiratory apparatus is placed at the termination of the circle; the venous blood, prior to re-entering the heart, being either diffused in extensive and irregular sinuses, over whose *parietes* air is distributed by minutely ramified *tracheæ*, as in *Insects*; or passing from venous trunks to branches indefinitely ramified upon a more concentrated respiratory organ, as in *Crustaceans* and

Mollusks. But at the point, or trunk, where the two venous trees are united we find no heart interposed, the respiratory circulation in these *Invertebrata* being in this respect analogous to the portal circulation in the *Vertebrate* classes. Even in the *Dibranchiate Cephalopods*, where the respiratory apparatus is perfected by the development of a muscular ventricle appropriated to the lesser circulation, it is interesting to observe that this organ is not placed at the point of divergence of the branchial vessels from the great central vein, but is, as it were, divided, and a branchial heart is placed at the base of each gill. I have on a previous occasion[1] pointed out the dependence of this superadded complexity upon the superior locomotive energies, and the related perfections of the nervous system which the *Dibranchiate Cephalopods* enjoy.

The still higher developed muscular powers of *Fishes* necessarily demand that the circulation through the respiratory organs in them should, in like manner, be aided by the propelling power of a ventricle. If the branchial and pericardiac cavities of a *Heptatrema*, Dum., be laid open and compared with the corresponding parts of a *Sepia*, it would seem as if the two branchial hearts of the *Cephalopod* had been approximated and united at the median plane in the *Fish*, while the arteries remained separate, each diverging from the other, and supplying the gills of its respective side. In *Petromyzon* the lower or posterior half of the branchial artery continues single, or conjoined. In other *Fishes* the mesial conjugation extends throughout the branchial trunk. The heart, however, which in the *Mollusks* is appropriated to the immediate reception and distribution of the aerated blood, has disappeared in *Fishes*. The gills in this class being so subdivided as to be subjected to effectual and constantly repeated pressure of the surrounding parts, the blood is driven more forcibly out of them than in the *Cephalopods*, where they float loosely in a large cavity. Again, the proportion which the muscular parts of the *Fish* bear to the visceral cavity is much greater than in the *Mollusk*, and therefore the systemic circulation derives more effectual assistance from the general contractions of the body; and it is this circumstance principally, though doubtless aided by the structure and allocation of the gills, which renders a ventricle for the greater circulation unnecessary in *Fishes*.

It is well known that the more complex heart of the higher *Vertebrata* is developed from, or at an early stage has a structure analogous to, the simple heart in *Fishes*, and that, at first, its force is in like manner immediately exerted to propel the blood through branchial vessels, but is afterwards gradually concentrated upon the *aorta* by a series of obliterations of these vessels. In *Siren*, *Proteus*, *Menobranchus*, and *Axolotes* the stream issuing from the ventricle is still considerably subdivided in the external *branchiæ*; and in consequence of this resistance to its passage additional means are provided to prevent regurgitation into the ventricle. In *Menopoma* the stream is diverted into eight undivided channels before passing into the *aorta*; in *Amphiuma* it is carried from the heart to the descending *aorta* along four equally simple channels; in

[1] Memoir on the Nautilus, p. 50.

the higher *Reptilia* the retarding channels are reduced to two, while in the more energetic warm-blooded classes the blood is distributed over all the frame by branches of a single continuous vessel. A corresponding gradation may be traced in the place of origin of the pulmonary arteries, and the consequent impulse received by them from the contractions of the heart. In the *Siren* the pulmonary arteries come off at the end of the branchial circulation. In *Menopoma* they come off from a corresponding situation, but receive more of the heart's impulse, from its not being previously expended on subdivisions of the branchial vessels. In *Amphiuma* the pulmonary and branchial arteries rise together from the end of the aortic bulb. In the higher orders of *Reptiles* the pulmonary arteries proceed by a common trunk from the ventricle itself: and lastly, in the warm-blooded classes they have a ventricle expressly appropriated to accelerate the circulation through them.

In the *Vertebrate*, as in the *Molluscous* division of the Animal Kingdom, the Muscular and Perceptive energies rise in proportion to the perfection of the Respiratory and Sanguiferous systems.

PLATE XXXI.

Fig. 1. The heart *in situ* of *Siren lacertina.*

a. The termination of the inferior *vena cava.*

b, b. The two superior *venæ cavæ.*

c, c. The venous sinus.

d, d. The right or systemic auricle.

e, e. The left or pulmonic auricle.

f. The ventricle.

g. The elongated *bulbus arteriosus.*

h. The branchial arteries. These are divided on the right side, and the branchial arches turned outwards, to show

i. The descending *aorta,* formed by the union of the trunks of the branchial veins.

k, k. The pulmonary arteries.

l, l. The commencement of the lungs, laid open to show their cellular structure, and

m, m. The pulmonary veins.

n. The *œsophagus.*

o, o. The external *branchiæ.*

Fig. 2. The heart and *pericardium* of the *Siren,* showing the structure of the auricles. The same letters denote the same parts as in the preceding figure. The whole extent of the *pericardium* is here shown. The bristles marked $e'' e''$ are passed through the pulmonary veins along the common trunk m' into

the left auricle, and by the orifice e' into the ventricle. Bristles are also passed through the inferior *cava* on either side of the valvular *septum* c', and one of them by the orifice of the right auricle d' into the ventricle. n is the coronary vein.

Fig. 3. The heart of the *Siren*, showing the structure of the ventricle, and *bulbus arteriosus*.

d', e'. The auricular orifices.

f'. The incomplete ventricular *septum*.

g'. The membranous commencement of the *aorta*.

g''. The valvular projection into the bulb.

q. Branches sent off from the anterior branchial vessel to the head.

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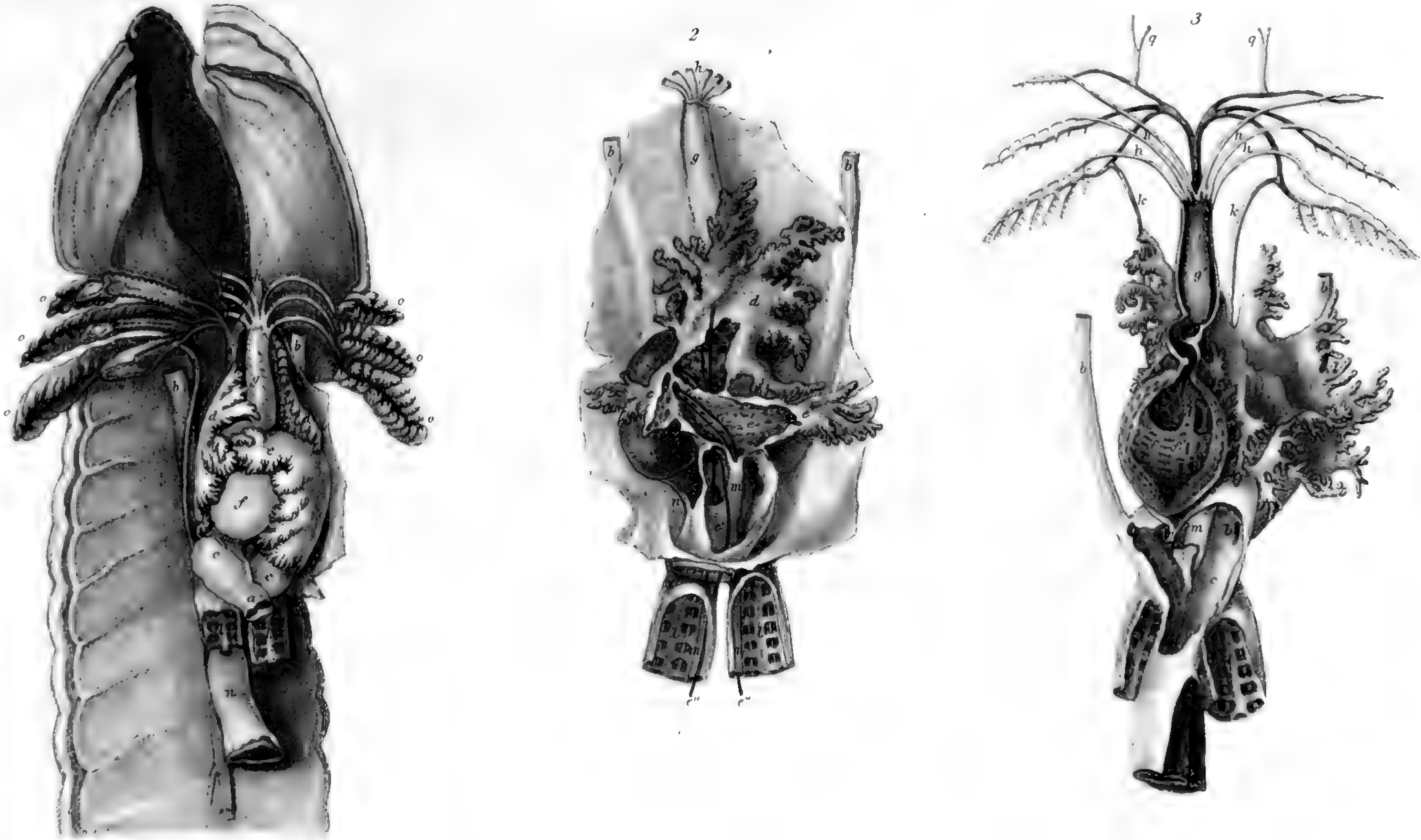


Siren lacertina?

R. Owen, del.

XXV. *On the Young of the* Ornithorhynchus paradoxus, *Blum.* *By* RICHARD OWEN, *Esq., F.Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated May 27, 1834.

IT must be gratifying to every friend of Natural History to perceive how rapidly, by the exertions of enlightened travellers, the different facts and materials are accumulating which tend towards the complete elucidation of the economy and natural affinities of the *Monotrematous Quadrupeds.*

On a retrospect of the history of these anomalous animals, we find in the year 1829 the sum of what was then certainly known as to their generative function thus expressed by Cuvier: "Comme enfin on n'est pas encore unanime sur l'existence de leurs mamelles, on en est à savoir si ces animaux sont vivipares[1] ou ovipares."[2] Such was the condition in which this question was left, notwithstanding the valuable labours of Meckel and M. Geoffroy, and such the received opinion as to the essential nature of the connexion between lactation and placental generation.

It appears to have been under this impression that the revival of Meckel's doctrine in 1832 was, on the one hand, regarded, though erroneously, as proof of the viviparous generation of the *Ornithorhynchus*[2], and on the other hand, as strenuously opposed by those Naturalists who had adopted the oviparous theory, and who regarded the *Monotremata* as a distinct class of *Vertebrata.* The true theory will in all probability be found somewhere between these extremes. Of all known *Mammalia*, the *Edentulous Marsupiata* undoubtedly approximate most closely the oviparous type. But if we except the partial atrophy of the right moiety of the female organs, and the form of the mouth of the *Ornithorhynchus*, all the principal deviations from the mammiferous type, as exhibited in the skeleton and in the composition of the entire generative apparatus, indicate the affinity of the *Monotremata* to the *Reptilia* rather than to the *Aves*; and all the well ascertained facts respecting their generation support the inference, that, as in many *Reptiles*, the germ is developed within the body of the parent unaided by the formation of a *placenta.*

[1] That there might be no mistake as to the sense in which this word is used, Cuvier previously defines it. "Dans tous les Mammifères la génération est essentiellement vivipare; c'est à dire que le fœtus, immédiatement après la conception, descend dans la matrice, enfermé dans ses enveloppes, dont la plus extérieure est nommée *chorion*, et l'intérieure *amnios*; il se fixe aux parois de cette cavité par un où plusieurs plexus de vaisseaux, appelés *placenta*, qui établissent entre lui et sa mère une communication, d'où il tire sa nourriture, et probablement aussi son oxygénation."—Règne Animal, tom. i. p. 64.

[2] Ibid., p. 234.

At the time when I was engaged in examining the structure and relations of the mammary glands of the *Ornithorhynchus* in 1832, my friend Mr. George Bennett was frequently with me: he became deeply interested in the question, and left England for Australia, determined on devoting his utmost endeavours while in that country towards its solution. His efforts have been attended with unexampled success, especially when it is considered how short a space of time was allowed him for these investigations. The results of his observations on the habits and economy of the *Ornithorhynchus*, he will himself lay before the Society; and I shall only here allude to a few of the facts which relate more immediately to the subject of the present communication.

The season of copulation is at the latter end of September or the beginning of the month of October. The precise period of gestation, and the condition of the excluded product, still remain to be determined; but in the first week in December Mr. G. Bennett found in one of the nests of the *Ornithorhynchus*, three[1] small naked embryos, not quite two inches in length, and which he therefore supposes, with much probability, to have been recently born. These specimens he was unable to preserve, from the want of the necessary means in a situation remote from any settlement.

Fortunately, young specimens of *Ornithorhynchus* a little further advanced have been transmitted through other channels to this country. The Society is indebted for them to the prompt liberality of Dr. Hume Weatherhead, and they form the subject of the present communication. These specimens are of different sizes: the smaller one rather exceeds 2 inches in length, measured from the end of the bill to the end of the tail in a straight line; the larger one is double that size, and is one of those two young animals which, with the mother, were taken from a nest on the banks of the Fish River, and kept alive for about a fortnight by Lieut. the Hon. Lauderdale Maule[2].

The following are admeasurements of these two specimens.

	Smaller Ornithorhynchus. Inches.	Lines.	*Larger Ornithorhynchus.* Inches.	Lines.
Length from the end of the upper jaw over the curve of the back to the end of the tail	3	9	6	6
Length from the same points in a straight line along the *abdomen*	2	1	4	0
Greatest circumference of the body	2	9	4	8
Length of the head		$8\frac{1}{2}$	1	0
Length of the upper mandible		3		5
Breadth of the upper mandible at the base		4		6
Thickness of the upper mandible at the anterior margin		$\frac{2}{3}$		1
Length of the lower mandible		2		$2\frac{1}{2}$

[1] The left ovary of one of the impregnated *uteri* exhibited three *corpora lutea*; and Mr. G. Bennett believes that the *Ornithorhynchus* occasionally brings forth four young ones.

[2] Proceedings of the Committee of Science, Zool. Soc., vol. ii. p. 45.

	Smaller Ornithorhynchus. Lines.	*Larger Ornithorhynchus.* Lines.
Breadth of the lower mandible at the base	3	5
Length of the tail from the vent	$4\frac{1}{2}$	10
Breadth of the tail at the root	4	8
Length of the fore foot	3	5
Breadth of the fore foot	$3\frac{1}{2}$	5
Length of the hind foot	4	$8\frac{1}{2}$
Breadth of the hind foot	3	5
Distance between the eyes	$3\frac{2}{3}$	6
Distance between the nostrils	$1\frac{1}{2}$	$1\frac{1}{4}$
From the exterior nostrils to the end of the mandible	$1\frac{1}{2}$	2
From the tip of the tongue to the end of the lower mandible	$\frac{1}{4}$	$\frac{1}{4}$

The circumstances which first attract attention in these singular objects are, the total absence of hair[1], the soft flexible condition of the mandibles, and the shortness of these parts in proportion to their breadth as compared with those of the adult.

The integument with which the mandibles are covered is thinner than that which covers the rest of the body, and smoother, presenting under the lens a minutely granulated surface when the cuticle is removed, which however is extremely thin, and has none of the horny character which the claws at this period present. The margins of the upper beak are rounded, smooth, thick, and fleshy: the whole of the under mandible is flexible, and bends down upon the neck when the mouth is attempted to be opened. The tongue, which in the adult is lodged far back in the mouth, advances in the young animal close to the end of the lower mandible; all the increase of the jaws beyond the tip of the tongue, which in the adult gives rise to a form of the mouth so ill calculated for suction or application to a flattened surface, is peculiar to that period, and consequently forms no argument against the fitness of the animal to receive the mammary secretion at an earlier stage of existence. The breadth of the tongue in the larger of the young specimens was $3\frac{1}{2}$ lines; in the adult it is only one line broader; and this disproportionate development is plainly indicative of the importance of the organ to the young animal, both in receiving and swallowing its food. The mandibles are surrounded at their base by a thin fold of integument, which extends the angle of the mouth from the base of the lower jaw to equal the breadth of the base of the upper one, and must increase the facility for receiving the milk ejected from the mammary *areola* of the mother. The oblique lines which characterize the sides of the lower mandible in the adult, running from within outwards and forwards, were faintly visible on the corresponding parts of the same jaw of the young animal: a minute ridge at the inner sides of these lines indicates the situations of the anterior horny teeth of the adult.

[1] This is not accidental, as in many of the adult specimens sent over in spirit, for the cuticle is entire. In the specimens which Mr. G. Bennett discovered, the skin had a slight downy appearance.

The situation of the exterior nostrils has already been given; they communicate with the mouth by the *foramina incisiva*, which are situated at nearly 3 lines' distance from the end of the upper mandible, and are each guarded by a membranous fold extending from their anterior margin: the nasal cavity then extends backwards, and terminates immediately above the *larynx*, the tip of the *epiglottis*[1] extending into it, and resting upon the soft palate.

On the middle line of the upper mandible, and a little anterior to the nostrils, there is a minute fleshy eminence lodged in a slight depression. In the smaller specimen this is surrounded by a discontinuous margin of the *epidermis*, with which substance, therefore, and probably (from the circumstance of its being shed) thickened or horny, the caruncle had been covered. It is a structure of which the upper mandible of the adult presents no trace, and is obviously analogous to the horny knob which is observed on the upper mandible in the fœtus of some *Birds*. I do not, however, conceive that this structure is necessarily indicative of the mandible's having been applied, under the same circumstances, to overcome a resistance of precisely the same kind as that for which it is designed in the young *Birds* which possess it. The shell-breaking knob is found in only a part of the class; and although the similar caruncle in the *Ornithorhynchus* affords a curious additional affinity to the *Aves*, yet as all the known history of the *ovum* points strongly to its ovoviviparous development, the balance of evidence is still in favour of this theory.

The situation of the eyes was indicated by the convergence of a few wrinkles to one point; but when, even in the larger of the two specimens, these were put upon the stretch, the integument was found entire, and completely shrouding or covering the eyeball anteriorly. This fact is one of great importance to the question of the mammiferous character of the *Ornithorhynchus*. For on the supposition of the young animal possessing locomotive faculties, which would enable it, like the young *Gosling*, immediately after birth or exclusion, to follow the parent into the water, and there to receive its nutriment (whether mucous or otherwise), the sense of vision ought certainly to be granted to it in order to direct its movements. The privation of this sense, on the contrary, implies a confinement to the nest, and a reception on land of the mammary secretion of the parent.

The general form of the body, and the cartilaginous condition of the bones of the extremities, equally militate against the young *Ornithorhynchus* possessing at this period of its existence active powers of swimming or creeping. The head and tail are closely approximated on the ventral aspect, requiring force to pull the body out into a straight line; and the relative quantity of integument on the back and belly shows that the position necessary for the due progressive motions is unnatural at this stage of growth. The form of the young *Kangaroo* soon after birth is very similar to this, which is common to the fœtus both of the viviparous and oviparous classes.

[1] The *epiglottis* is essentially associated with lactation, not with viviparous generation.

The toes on each of the four feet were completely formed, and terminated by curved conical horny claws; but the natatory fold of membrane of the fore foot had not the same proportional extent as in the adult, and the spur of the hind foot did not project beyond its socket in either specimen. In the smaller one, which was a male, it presented the form of an obtuse *papilla*; while in the larger specimen, although a female, it was more plainly developed and more pointed. This circumstance is in exact accordance with the known laws of the development of sexual distinctions, especially of those of secondary importance, such as beards, manes, plumes, horns, tusks, spurs, &c., which do not avail in distinguishing the sexes till towards the period of puberty. As the spur is the only obvious distinction of the sexes in the full-grown *Ornithorhynchus*, I was compelled to refer to the internal essential organs, in order to determine the sex of the specimens here described.

The ventral surface of the smaller specimen was carefully examined with a lens; but no trace of an *umbilicus* could be satisfactorily determined. In the very young or newly born *Kangaroo*, a longitudinal linear trace of the attachment of the umbilical vesicle is at that time apparent, but it is rapidly obliterated; as is probably also the case in the *Ornithorhynchus*.

In the smaller specimen the intromittent organ projected a little way beyond the excrementory orifice, as in the young *Marsupiata*; but it was not continuous, as in them, with the anterior margin of that outlet. In the larger female specimen the corresponding organ was visible just within the verge of the opening; but this *clitoris*, remaining stationary in its development, is afterwards, as I have shown in my Paper on the Mammary Glands*, removed to a distance from the preputial aperture by the elongation of the sheath, just as the minute spur of the female lies concealed at the bottom of the progressively elongated tegumentary socket, and as the tongue is left at the back of the oral cavity by the growth of the jaws.

The following were the anatomical appearances observable in these young individuals, so far as the rarity of the specimens would warrant dissection to be carried.

On laying open the *abdomen* in the larger specimen, the most prominent *viscus* was the stomach, which was almost as large as in the adult animal, deriving at this period no assistance from the preparatory digestive cavities, the cheek-pouches, which were not yet developed. The stomach extended in a curved direction across the epigastric, and down the left hypochondriac region to the left iliac region. It was full of coagulated milk. On carefully inspecting the whole contents with a lens, no portions of worms or bread could be detected; which solves the doubt entertained by Lieut. Maule as to whether the mother nourished this young one with the food which was given to her for her own support, or with secretion afterwards discovered to escape from the mammary pores.

I took a portion of the coagulated substance from the stomach, and diluted it with

[1] Phil. Trans. for 1832, p. 525.

water; and having at the same time prepared a little *Cow's* milk by first coagulating it with spirit, and then diluting the *coagulum*, I compared the two substances under a high magnifying power. The ultimate globules of the *Ornithorhynchus's* milk were most distinctly perceptible, detaching themselves from the small coherent masses to form new groups: the corresponding globules of the *Cow's* milk were of larger size. Minute transparent globules of oil were intermixed with the milk globules of the *Ornithorhynchus*. A drop of water being added to a little mucus, it instantly became opake; and was resolvable by minute division into transparent angular flakes, entirely different from the regularly formed granules of the milk of the *Ornithorhynchus*.

In the smaller specimen the stomach was empty; when distended with air it exhibited a less disproportionate development. It was situated in the left hypochondriac and lumbar regions. The intestines contained air, with granular masses of a mucous chyme adhering to their internal surface. This condition of the digestive canal would seem to show that no long period had elapsed since the birth of the specimen, and that lactation had either not been in full action, or that the young one had been deserted by the parent for some time before it was taken.

In both specimens the spleen bore a proportionate size with the stomach; and as the difference in the development of the stomach was considerable, the correspondence of the condition of the spleen with that of the digestive cavity was made very obvious. The difference in the development of the liver was not greater than corresponded with the different size and age of the two specimens. But the *pancreas* in both bore the same ratio to the stomach as the spleen. This would seem, therefore, to afford some indication of the organs with which the function of the spleen is more immediately related.

The intestinal canal in the larger specimen was situated almost entirely on the right side of the *abdomen*. The *cæcum*, in both, was very minute and filamentary. I examimed the *ileum*, and more especially in the usual situation above the *cæcum*, but could not perceive any trace of the pedicle of the umbilical or vitelline vesicle. The other vestiges of fœtal organization were more obvious than in the ordinary *Marsupial* or ovoviviparous *Mammalia*.

In both specimens, but more distinctly in the smaller one, the umbilical vein was seen extending from a linear *cicatrix* of the *peritoneum*, opposite the middle of the *abdomen*, along the anterior margin of the suspensory ligament, to the liver. It was reduced to a mere filamentary tube, filled with *coagulum*. From the same *cicatrix* the remains of the umbilical arteries extended downwards, and near the urinary bladder were contained within a duplicature of *peritoneum*, having between them a small flattened oval vesicle, the remains of an *allantois*, which was attached by a contracted pedicle to the fundus of the bladder.

As both the embryo of the *Bird* and that of the ovoviviparous *Reptile* have an *allantois* and umbilical vessels developed, no certain inference can be drawn from the above appearances as to the oviparous or viviparous nature of the generation of the *Ornitho-*

rhynchus. But the structure of the ovary, and that of the *ovum* both before and after it has quitted the ovisac, afford the strongest analogical proof of the intra-uterine development of the embryo, and at the same time accord with the ascertained fact of the mammary nourishment of the young animal; there being no store of yelk appended to the *ovum* when it quits the ovisac, as in the *Bird*, where it supplies the place of a mammary secretion to the newly hatched chick, and where also the voluminous yelk and its *chalazæ* serve as an essential *nidus* to the embryo at the early stages of incubation.

The kidneys were situated far away from the *pelvis* and high up in the lumbar region. This marked deviation from the oviparous type is well worthy of being taken into account in the consideration of the nature and affinities of the *Monotremata*. It is characteristic of the *Mammiferous* type of structure, and would seem to be intended to give free space for the enlargement of the *uterus*, and to prevent the kidneys being affected by the continued pressure of this *viscus* and its contents during the latter periods of gestation.

The situation of the kidneys with respect to each other varied in the two specimens: in the larger one, the left was a little higher than the right; in the smaller one, it was a little lower: the latter is the ordinary position in the adult. The supra-renal glands did not correspond with this arrangement; but in both instances the right was higher than the left, agreeing with the relative position of the *testes* in the male, and the ovaries in the female. In *Man*, the large size of the supra-renal glands is noted as a fœtal peculiarity; but in the *Ornithorhynchus* they are of minute size, their greatest diameter not exceeding $\frac{1}{8}$th of a line in the smaller specimen here described; and they increase in size progressively with the growth of the animal, and in a greater proportion than the kidneys; which increase would appear, therefore, to have relation to the development of the generative organs. There were no traces of the *corpora Wolffiana*.

The *testes* in the small male specimen were situated a little below the kidneys: they were of an elongated form, pointed at both ends, with the *epididymis* folded down, as it were, upon their anterior surface. In the female, the ovaries were freely suspended to the loins in a similar position, the right being at this period as large as the left: it is the persistence of the latter at an early stage of development which occasions the disproportionate size of the two glands in the adult. The still greater inequality of size in the oviducts of the *Bird* arises from a similar arrest of the development of the one on the right side; but both are equal at an early stage of existence. The *uteri* were straight linear tubes, scarcely exceeding the size of the ovarian ligaments.

The lungs were found amply developed in both specimens; the air-cells remarkably obvious, so as to give a reticulate appearance to the surface, and a resemblance to the lungs of a *Turtle*. They had evidently been permeated by air in the smaller specimen.

The heart in both specimens was of the adult form, with the *apex* entire; but the left auricle was proportionately larger than in the adult heart, which is correctly figured by

Meckel[1]. The *ductus arteriosus* was here very evident, and formed a filamentary chord in the usual situation between the *aorta* and pulmonary artery, but proportionately longer than in the true viviparous *Mammalia*. Here also we have the indication of a more prolonged fœtal existence than in the *Marsupial* animals, there being no trace of a *ductus arteriosus* either in the uterine or mammary fœtus of the *Kangaroo*.

The *Ornithorhynchus* also deviates from the ordinary *Marsupiata* in having the *thymus* gland. This is situated in front of the great vessels of the heart, and consists of two lobes, of which the right is the largest.

PLATE XXXII.

Fig. 1. The smaller specimen of *Ornithorhynchus paradoxus*.
2. The larger specimen.
3. The same in another view.
4. Front view of the mandibles of the same, a little open to show the tongue. In each of these figures, *a*, is the nostrils; *b*, the prominence on the upper beak; *c*, the eyes; *d*, the ears; *e*, the vent; *f*, the orifice and rudimentary spur of the hind foot; *g*, the membrane at the base of the mandibles; *h*, the tongue.
5. A magnified figure of the hind foot of the female, showing the rudimentary spur projecting from the socket.

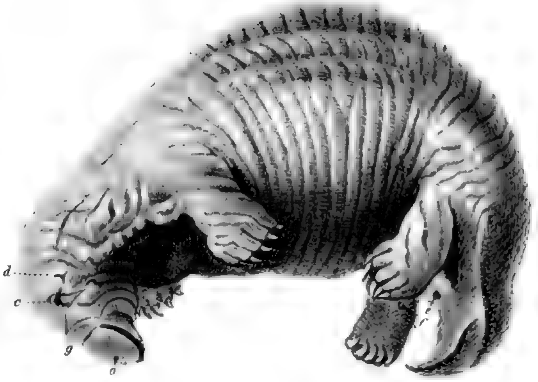
PLATE XXXIII.

Fig. 1. Abdominal *viscera* of the smaller specimen, principally to show the remains of *g*, the umbilical vein, and *h*, the *allantois*; *i*, is the liver; *k*, the stomach.
2. The stomach; and *l*, the spleen of the same specimen.
3. The stomach and spleen of the larger specimen.
4. The heart, showing the single *ductus arteriosus*.
5. *m*, The kidneys; *n*, the supra-renal glands; *o*, the *testes*; and *p*, the urinary bladder of the younger specimen.
6. The corresponding parts *in situ* of the female specimen: *q*, the ovaries; *r*, the *uteri* and oviducts.
7. The urinary bladder, umbilical arteries, and *allantois* (*h*) of the smaller specimen, magnified.
8. The upper mandible of the smaller specimen, magnified, to show the caruncle (*b*) between the nostrils. The figure marked thus * is of the natural size.

[All the figures, except where otherwise indicated, are of the natural size. Those in Plate XXXII. were drawn by my friend T. Rymer Jones, Esq., whose valuable assistance I am happy in acknowledging.]

[1] Ornithorhynchi paradoxi Anatomia, tab. vii. fig. 1.

2



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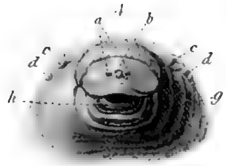

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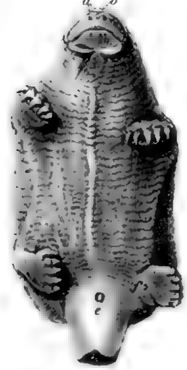


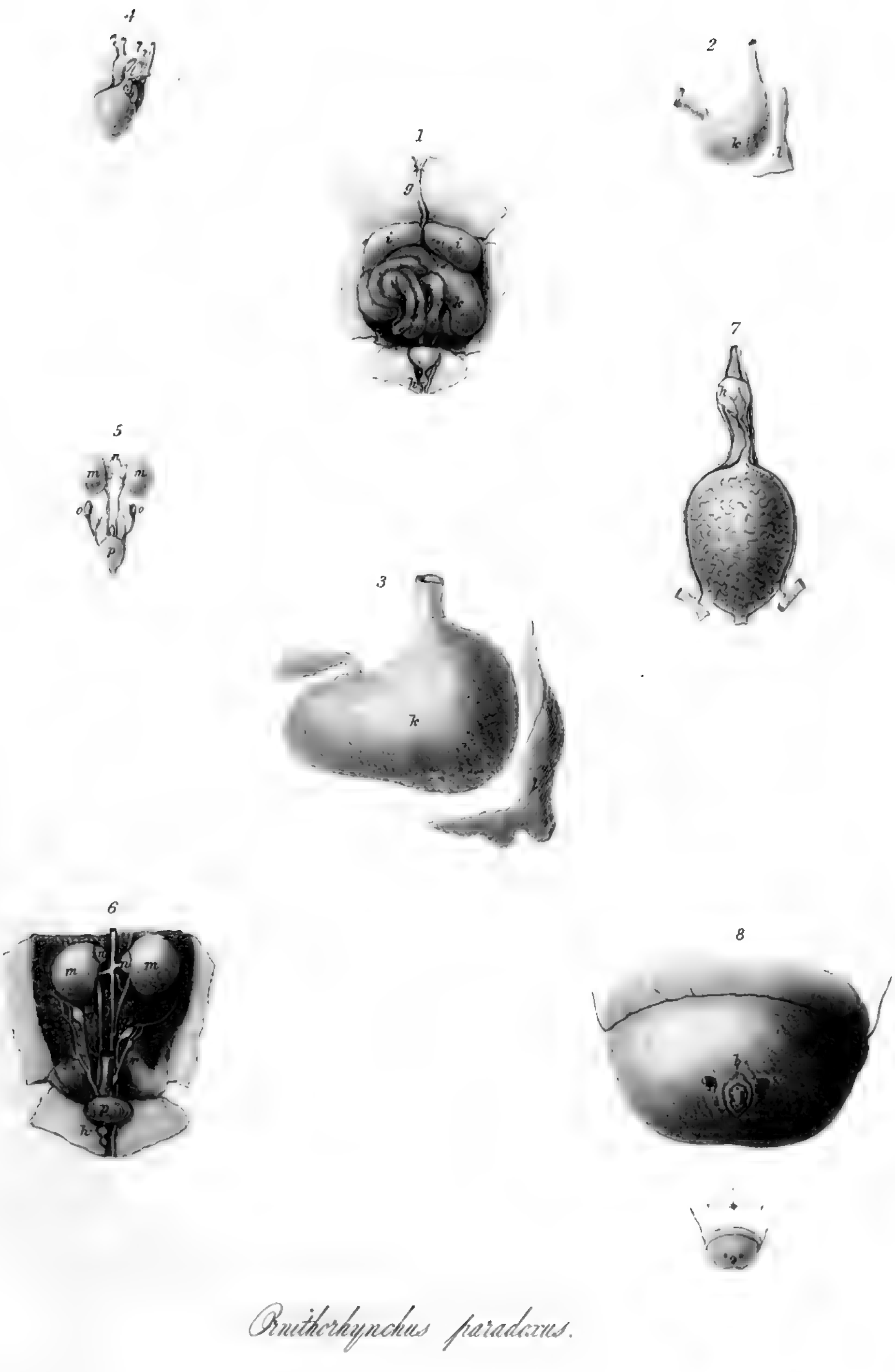
5

3

Ornithorhynchus paradoxus.

Rymer Jones Esq. del.

Zatter, sc.



Ornithorhynchus paradoxus.

R. Owen del.

Zeitter sc.

XXVI. *Notes on the Natural History and Habits of the* Ornithorhynchus paradoxus, *Blum.* *By* George Bennett, *Esq., F.L.S., Corr. Memb. Z.S.*

Communicated May 27, 1834.

In the commencement of the year 1829, when I first arrived in the Colony of New South Wales, my attention was directed towards two points of Natural Science which were at that time desiderata—one the mode of generation of the *Kangaroo*, to explain in what manner the young are brought into connexion with the nipple—and the other the mode of generation and habits of the animal which forms the subject of the present communication.

To all the inquiries I made of persons long resident in the Colony, I could only procure very unsatisfactory replies. I found then, as I also found on my subsequent and second visit to the Colony, that the majority preferred forming theories of their own and arguing on their plausibility, to devoting a few leisure days to the collection of facts by which the questions might be set at rest for ever. At this time a voyage of great interest to me, among the Islands of the Polynesian Archipelago and to New Zealand, prevented my devoting the time which I had at first intended to employ in attempting the discovery and elucidation of those doubtful points; and I left New South Wales in March 1829, expecting that before my return to England some intelligent person resident in the Colony would devote himself to the task and determine them by actual observation. On my return to England, however, in April 1831, I found that all the questions relative to those animals still remained in the same undecided state, excepting that my friend Mr. Owen had succeeded in injecting with mercury the ducts of the supposed mammary glands of the *Ornithorhynchus*; a communication on which subject, as I have seen since leaving England in 1832, he has laid before the Royal Society.

I again left England for the Colony of New South Wales in May 1832, and soon after my arrival there in August I visited the interior of the country, and devoted much time to the investigation of the habits and œconomy of these animals in their native haunts.

The *Ornithorhynchus* is known to the colonists by the name of *Water-Mole*, from some resemblance which it is supposed to bear to the common *European Mole, Talpa Europæa*, Linn.: by the native tribes at Bathurst and Goulburn Plains, and in the Yas, Murrumbidgee, and Tumat countries, I universally found it designated by the name of *Mallangong* or *Tambreet*; but the latter is more in use among them than the former.

The body of this singular animal is depressed in form, and in some degree partakes of the characters of the *Otter*, the *Mole*, and the *Beaver*. It is covered by a fine long and thick hair, underneath which is a finer short very soft fur, resembling the two distinct kinds of fur found in the *Seal* and *Otter*. On the *abdomen*, breast, and throat, the fur and hair are of a much finer quality, and of a more silky nature, than on the other parts of the body of the animal. In young specimens the under surface of the tail, as well as the hind and fore legs near the feet, is covered by a fine hair of a beautiful silvery white appearance: this is lost, however, in the adult, in which the under surface of the tail is almost entirely destitute of hair[1]. Whether this proceeds from its trailing along the ground (which the close approximation of the *abdomen* and under surface of the tail to the ground in all the movements of the animal on land makes very probable,) I know not; but the most prevailing opinion among the colonists, for which, however, in the observation of their habits, I could not discover any foundation in fact, was that it was occasioned by the animals using the tail, in a manner similar to that which was formerly believed of the *Beaver*, as a trowel in the construction of its dwelling. The tail is flat, broad, and inclining on each side abruptly off at the termination, beyond which the long hairs project: on its upper surface the hair is longer and coarser than on any other part of the body; it is destitute of that peculiar glossy appearance which adds so much to the beauty of the fur generally, and is also of a darker colour. The colour of the fur of the animal in all the specimens I have seen, of whatever age, is a light black, varying in shades according as it is seen in a stronger or weaker light: the under short fur is greyish. The whole of the under surface of the body is of a ferruginous colour, varying in its intensity according to the age of the specimen[2]. I do not regard this difference as any distinguishing mark of sex, as was at first supposed. Immediately below the inner angle of the eye is a small spot of a light or pale yellow colour. This I have remarked in all the specimens of either sex that I have seen, excepting in one which was captured on the banks of the Wollondilly River near Goulburn Plains, in which these marks were deficient, although it did not differ in other external appearances from the specimens I had before examined.

The only external difference of sex to be accurately distinguished, and indeed the only one on which any dependence can be placed, is the spur or claw on the hind leg of the males; the females being destitute of that appendage.

The legs of these animals are very short; the feet are pentadactyle and webbed. In the fore feet (which seem to have the greatest muscular power, and are in principal use both for burrowing and swimming,) the web extends a short distance beyond the claws, is loose, and falls back when the animal burrows: the fore feet are thus capable of

[1] The under surface of the tail, both in males and females, is sometimes bare; and sometimes has only a few coarse hairs scattered over it.

[2] I have heard that an *Albino* specimen of this animal was once seen; it was stated to have been close to the water's edge at the time it was noticed, and to have been perfectly white. On the approach of the person who observed it, it dived, and although watched did not reappear.

great expansion. The claws on the fore feet are strong, blunt, and well calculated for burrowing; and the two lateral are shorter than the three middle ones. The hind feet are short, narrow, turned backwards, and when the animal is at rest have, like those of the *Seal*, some resemblance to a fin; their action is backwards and outwards. The first toe is very short, and the nails of all are curved backwards, and are longer and sharper than those of the fore feet; the web does not extend further than the roots of the claws. The spur of the male is moveable, and is turned backwards and inwards: it is situated some distance above the claws, and rather towards the internal part of the leg.

The head is rather flat; and from the mouth project two flat lips or mandibles, resembling the beak of a *Shoveller Duck*, the lower of which is shorter and narrower than the upper, and has its internal edges channelled with numerous *striæ*, resembling in some degree those seen in the bill of a *Duck*. The central portion of the mandibles is a bony continuation from the skull, and anteriorly and laterally a cartilaginous substance, perfectly moveable, extends from the bony portion to the distance of $\frac{3}{8}$ths of an inch. The colour of the superior mandible above, when seen in an animal recently taken out of the water, is of a dull dirty greyish black, covered with innumerable minute dots; while the cartilaginous expansion around the mandible is uniformly smooth and soft. The under part of the upper mandible is of a pale pink or flesh colour, as well as the internal or upper surface of the lower mandible, the under surface of which is either perfectly white or mottled: in younger specimens it is usually white, while in the older it assumes a mottled appearance.

At the base of both the lower and upper mandibles is a transverse loose fold or flap of the integument, always similar in colour to the skin covering the mandibles, that is to say, of a dull dirty greyish black in the upper, and white or mottled in the lower. In the upper mandible this is continued very nearly to the eyes, and may perhaps afford some protection to those organs when the animal is engaged in burrowing or seeking its food in the mud. The upper fold or flap is continuous with another portion arising from the lower mandible also at its base. Sir Everard Home[1] considers the apparent use of these folds to be to prevent the beak from being pushed into the soft mud beyond this part, which is so broad as completely to stop its further progress. From careful observation of the actions of living specimens I can, however, assign no other use to this part than that which I have just mentioned. In dried specimens the colour and form of the beak are almost entirely lost.

The eyes are very small, but brilliant, and of a light brown colour: they are situated rather high up the head. The external orifice of the ears is situated near the upper part of the external angle of the eye. When a living specimen is examined the orifice[2] is easily discoverable, as the animal has the faculty of closing or opening it at

[1] Observations on the Head of the *Ornithorhynchus paradoxus*, in the 'Philosophical Transactions' for 1800.

[2] I could not perceive any valve corresponding to that which is usually possessed by animals that frequent the water, but believe that the muscular contraction of the orifice answers the same purpose.

will: in dead specimens, being closed, it would not be readily perceived by a person unacquainted with its exact situation. From this orifice a semicircular cartilaginous canal is continued, terminating at the base of the skull.

The *Ornithorhynchus* has a peculiar fishy smell, more especially when wet, which probably proceeds from an oily secretion. The aborigines use these animals as food: but it is no particular recommendation of them to say that they are eaten by the Native Australian, as nothing in the shape of provender comes amiss to him, whether it be snakes, rats, frogs, grubs, or the more delicate Opossum, Bandicoot and Flying Squirrel.

There are two species usually described in our works on Natural History, the *Ornithorhynchus rufus* and the *Orn. fuscus*; but the differences between them appear to me to be so unimportant that I hesitate in considering them as otherwise than specifically identical. Not having referred the *Water-Moles* which fell under my observation to either of these presumed species, I retain for them the name originally proposed by Professor Blumenbach, that of *Orn. paradoxus*: though subsequent in date to the denomination assigned by Shaw to the same animal, it has been so extensively adopted as to render it inexpedient in this instance to adhere to the strict rule of nomenclature.

The size of the *Ornithorhynchus* varies, but the males are usually found to be in a small degree larger than the females: the average length I consider to be from 1 foot 6 inches to 1 foot 8 inches. From the following dimensions of specimens shot in the Yas and Murrumbidgee rivers[1] an idea may be formed of the relative proportions of the different parts to the body: the measurements were taken immediately after the animals had been shot and removed from the water, the specimens, still in their flaccid state, being placed in their natural position. On the dimensions thus taken more dependence can be placed for accuracy than on those derived from stuffed specimens, which, from the contracted state of most of the parts, and the artificial elongation given to the body, cannot be relied on. As the integuments, moreover, hang very loose about the animal, they are usually distended by the stuffer to a much greater degree than is natural.

Male specimen shot in the Yas River.

	Ft.	In.
Length from the extremity of the mandible to the extremity of the tail	1	$7\frac{7}{8}$
Length of the upper mandible		$2\frac{7}{8}$
Breadth of the upper mandible		$2\frac{1}{8}$
Length of the lower mandible		$1\frac{6}{8}$
Breadth of the lower mandible		$1\frac{3}{8}$
Length of the fore leg		$3\frac{6}{8}$

[1] Mr. George MacLeay informs me that the specimens procured from the Nepean River are seldom longer than 1 foot 2 inches.

	Ft.	In.
Length of the web projecting beyond the claws of the fore feet		$\frac{5}{8}$
Breadth of the fore foot expanded		$4\frac{2}{8}$
Length of the tail		$4\frac{5}{8}$
Breadth of the tail at the broadest part		$3\frac{2}{8}$
Length of the hind leg to the extremity of the longest claw		4
Breadth of the hind foot expanded		$2\frac{4}{8}$

Female specimen shot in the Yas River.

	Ft.	In.
Length from the extremity of the mandibles to the extremity of the tail	1	7
Length of the upper mandible		$2\frac{6}{8}$
Breadth of the upper mandible		$2\frac{2}{8}$
Length of the lower mandible		$1\frac{5}{8}$
Breadth of the lower mandible		$1\frac{3}{8}$
Length of the fore leg and foot		$4\frac{2}{8}$
Length of the fore foot		$2\frac{3}{8}$
Breadth of the fore foot when expanded		$2\frac{5}{8}$
Length of the web projecting beyond the claws		$\frac{6}{8}$
Length of the tail		$5\frac{4}{8}$
Breadth of the tail at the broadest part		$2\frac{7}{8}$
Length of the hind leg and foot		$3\frac{5}{8}$
Length of the hind foot to the extremity of the longest claw		$2\frac{4}{8}$

Of fifteen specimens shot and captured alive, the length of the males averaged from 1 foot 7 to 1 foot 8 inches (measuring from the extremity of the mandibles to that of the tail); and that of the females from 1 foot 6 to 1 foot 7 inches.

During my stay at Gudarigby, the farm of Mr. W. H. Dutton, near the Murrumbidgee River, a male was shot which measured 1 foot $11\frac{2}{8}$ inches in length; but the relative proportions of the other parts were not so great as might have been expected.

Male specimen shot in the Murrumbidgee River.

	Ft.	In.
Length from the extremity of the mandibles to the extremity of the tail	1	$11\frac{2}{8}$
Length of the upper mandible		$2\frac{5}{8}$
Breadth of the upper mandible		$2\frac{1}{8}$
Length of the tail		$6\frac{2}{8}$
Breadth of the tail at the broadest part		$2\frac{1}{2}$
Expansion of the fore foot		4
Length of the spur on the hind leg		$\frac{1}{2}$

The narrower tail and small proportion of the beak to the length of the body made this specimen appear different from all the others that I had seen ; but in other respects it was similar to them. A female shot in the evening of the same day, and in the same part of the river, measured only 1 foot 4 inches, as follows :

Female specimen shot in the Murrumbidgee River.

	Ft.	In.
Length from the extremity of the mandible to that of the tail . . .	1	4
Length of the upper mandible		2
Breadth of the upper mandible		$1\frac{6}{8}$
Breadth across the back		4
Length of the tail		$4\frac{3}{8}$
Breadth of the tail		$2\frac{2}{8}$
Expansion of the web of the fore feet		$3\frac{1}{8}$

On the 17th of September 1832 I took my departure from Raby Farm in company with Mr. Henry O'Brien, who was proceeding to his farm in the Yas country. Having made a very interesting journey through the Bathurst country, we arrived, on the 4th of October, at Mundoona, the estate of Mr. James Rose, near Yas Plains in the Murray County. It was at this place that I had determined to commence my investigations of the *Ornithorhynchus*, as a portion of the Yas River ran through the estate, in which these animals were to be found in great numbers.

We arrived at the Farm at 5 P.M. ; and as the river was but a very short distance from the dwelling-house and I was eager to have even a distant view of the animal in a living state, I readily acceded to an offer to walk on the banks whilst refreshment was preparing for us after our long journey, and ascertain if one could be procured that evening. We soon came to a tranquil part of the river, such as the colonists call a "pond," on the surface of which numerous aquatic plants grew. It is in places of this description that the *Water-Moles* are most commonly seen, seeking their food among the aquatic plants, whilst the steep and shaded banks afford them excellent situations for excavating their burrows. We remained stationary on the banks, with gun in rest, waiting their appearance with some degree of patience ; and it was not long before my companion quietly directed my attention to one of these animals paddling on the surface of the water, not far distant from the bank on which we were then standing. In such circumstances they may be readily recognised by their dark bodies just seen level with the surface, above which the head is slightly raised, and by the circles made in the water around them by their paddling action. On seeing them the spectator must remain perfectly stationary, as the slightest noise or movement of his body would cause their instant disappearance, so acute are they in sight or hearing, or perhaps in both ; and they seldom reappear when they have been frightened. By remaining perfectly quiet when the animal is "up," the spectator is enabled to obtain an excellent view of its movements on the water ; it seldom, however, remains longer than one or two minutes playing and paddling on the surface, soon diving again and reappearing a short distance above or below, generally according to the direction in which it dives. It dives head foremost with an audible splash.

Although the animal may "come up" close to the place where the sportsman is standing, it would be useless to attempt to level the gun, for that action alone would cause its instantaneous disappearance; but after waiting patiently until the animal dives, and watching the direction in which it sinks [1], preparation must be made to receive it with the discharge of the piece instantly on its reappearance on the surface, which (when it descends unfrightened) is almost certain to take place in a short time. A near shot is requisite, a distant one being almost hopeless; and the aim should be invariably directed at the head, in which spot the shots are more likely to take speedy effect than in the loose dense integuments of the body, which, as they afford little resistance, the shot are unable to penetrate. I have seen the skull shattered by the force of the shot when the integuments covering it have scarcely suffered injury.

Although the following day was very showery, this did not deter us from ranging the banks of the river in quest of *Ornithorhynchi*. The heavy rain in the course of the night and morning had swollen the stream considerably, and we saw only one specimen during the morning, which proved too vigilant for us, and consequently escaped. In our return home, however, along the banks, about 2 P.M., at a narrow part of the river, one of these animals was seen paddling about on the surface. We waited until it dived, which it did soon afterwards; and having made our preparation, on its returning to the surface of the water, a short distance further down, it received the contents of the gun, which took effect; for although it immediately sank, it soon came up again, evidently severely wounded. It evaded capture by frequently diving, although in its wounded condition it was soon obliged to regain the surface of the water, and was evidently striving to reach the opposite bank [2]: it moved tardily, with the greatest part of the body above the surface of the water, as is usually observed in these animals when they are severely hurt. It received, however, two effective discharges from the fowling-piece before it remained tranquil on the water and allowed the dog to bring it out. It proved to be a fine male specimen, and was not yet dead, but moved occasionally, making no noise except frequent deep expirations from the nostrils.

When the fur of the animal is wet, it has a sordid and far from attractive appearance, resembling rather a lump of dirty weeds than any production of the animal kingdom. Indeed, were it not for their paddling motion on the water, these animals would

[1] If the water is very clear, the course of the animal beneath its surface after diving can be distinctly seen; but as the places frequented by it usually abound in river-weeds, it seldom occurs that it is noticed in a clear part of the river. On diving, they never rise again at the same place; but it is not difficult, with a little experience in sporting for these animals, to judge with tolerable accuracy where they may again rise, so as to obtain a mark at them.

[2] When wounded, they make for the land, either to escape into their burrows, or from being unable to support themselves in their weakened condition on the water.

often escape observation; for their suppleness and colour when wet, would cause them to be regarded only as masses of weeds, such as are so often seen floating about the rivers. Such at least was their appearance when lying dead on the surface of the water, or when drifted by the current against the stump of a tree, or among the reeds and bullrushes which grow so profusely near and upon the banks.

A few minutes after the animal had been taken out of the water it revived and ran along the ground, instinctively endeavouring to regain the water, but with an unsteady motion. In about twenty-five minutes from the time of its capture, it gave a few convulsive sighs and expired.

This specimen being a male, and having heard so much related about the injurious effects resulting from a puncture by the spur, I determined to avail myself of the opportunity to ascertain the correctness of the assertion. The wounded state of the animal presented no objection to the experiment, as in one published account in which the poison is reported to have produced such terrible effects, the animal was also mortally wounded. As soon, therefore, as it became lively, I put its "poisonous spurs" to the test. I commenced by placing my hands in such a manner, when seizing the animal, as to enable it, from the direction of the spurs, to use them with effect: the result was that the animal made strenuous efforts to escape, and in these efforts scratched my hands a little with the hind claws, and even, in consequence of the position in which I held it, with the spur also. But although seized so roughly, it neither darted the spur into my hand, nor did it even make an attempt so to do. As, however, it had been stated that the creature throws itself on the back when it uses this weapon[1], (a circumstance not very probable to those who have any knowledge of the animal,) I tried it also in that position; but though it struggled to regain its former posture, no use was made of the hind claw. I tried several other methods of effecting the object I had in view, but as all proved futile, I am convinced that some other use must be found for the spur than as an offensive weapon. I have had several subsequent opportunities of repeating the experiments with animals not in a wounded state, and the results have been the same.

These animals are seen in the Australian rivers at all seasons of the year, but a question may arise whether they do not in some degree hybernate, for they are more abundant during the summer than in the winter months. During floods or freshes it is, however, not an uncommon occurrence to see them travelling up and down the rivers. When going down, they allow themselves to be carried along by the force of the stream, without making any exertion of their own; but when swimming against the stream, all their muscular power is exerted to the utmost to stem the force

[1] Some of the settlers consider the spur of the *Ornithorhynchus* as poisonous, not from any experience of their own, but in consequence of the aborigines saying, alluding to the spur, "It is very saucy;" such being their English expression when they wish to imply that anything is hurtful or poisonous: they apply, however, the same expression to the scratching of the hind feet of the animal. It is also certain that they never seem afraid of handling in any way the male *Ornithorhynchus* alive.

of the current, and it is generally done effectively. I recollect, however, seeing two making repeated and ineffectual attempts to pass a small waterfall during a rapid current of the river, and after many persevering efforts they were unable to attain their object.

The opinion that I had heard advanced at Sidney, of its being requisite to shoot the *Water-Moles* dead instantly, otherwise they would sink and not reappear, I did not find to be correct in practice. If missed, indeed, this is likely to occur; but if the animal is wounded, it immediately sinks, but soon reappears on the surface of the water some distance beyond the place at which it was seen to dive. Some require two or three shots before they are killed or so severely wounded as to enable them to be brought out of the water; and they frequently evade being captured, even when wounded, by frequent and rapid diving. Sometimes too, unless the sportsman is very vigilant, they may come up among the reeds and rushes, which are plentiful in some parts, extending out from the banks of the river, and thus escape observation altogether. I have no doubt, also, that some which sink after being wounded, escape into their burrows; as even when they cannot reach the bank, they may get access to the hole by the subaqueous entrance.

On the evening of the day on which the first specimen was shot, we were fortunate in procuring a female. It was twice seen paddling about on the water, diving and then rising again, but not sufficiently near to allow of its being fired at; the third time it dived, rising within good aim, it was shot. On being taken out of the water it bled from the mouth, and it was found that the shot had struck it about the base and on other parts of the mandibles; it died almost immediately. The only indications of vitality which it gave consisted of a gasping motion of the mandibles and a convulsive action of the hind feet, as when the animal combs the sides of the *abdomen* with the claws of the hind feet. This specimen differed from the last in the *abdomen* being of a much darker ferruginous colour; but from subsequent observations of numerous specimens, I find these differences to depend merely on the age of the animal. In this individual the web of the fore feet was entirely black, but in many it is found mottled; the under mandible was nearly white, the upper of the usual colour. There was no spur on the hind foot, but on the situation of it in the male, the female had a small impervious depression, which it is not improbable may serve for the reception of the spur of the male.

I felt great delight at having procured a female specimen, as I had some expectation of being able thereby to ascertain the mode of procreation in this most extraordinary quadruped. At all events I expected to determine whether this was or was not the commencement of the breeding-season among them. My attention was immediately directed to the abdominal or mammary gland, and on laying aside the abdominal integuments and examining its situation, I was at first rather surprised to observe scarcely any appearance of it. On reflection, however, it occurred to me (a supposition which was afterwards confirmed by facts,) that as the gestation advances, the gland becomes enlarged; and that when the lacteal secretion is no longer required for the support of the young, it again decreases, becoming scarcely perceptible.

Omitting the rest of the anatomy, I shall at once proceed to the result of the investigation of the uterine organs. These I found to consist of two *uteri* extending some distance above the *pelvis*. On the upper, rather posterior and lateral part of the *uteri* (but more particularly and more clearly marked in the left than in the right *uterus*,) were well developed clusters of *ova*, giving an indication of an impregnated female. Both *uteri*, gradually diminishing in size as they proceeded, had their termination in the *cloaca*; the bladder was situated between and rather anterior to the *uteri*, and the *rectum* posterior to the bladder; and both these organs also had their termination in the *cloaca*.

The ovaries were white[1], and covered by a semitransparent membrane, through which the *ova* could be readily distinguished. The left *uterus* had the largest development: its coats were thickened, and on laying the internal part open gradually from the *os uteri* to the *apex*, three loose *ova* of the size of swan-shot were successively exposed to view, one a short distance above the other, but all in the uterine cavity. They were perfectly white and quite round; their external coat consisted of a dense opake membrane; and they could be taken into the hand and examined without fear of their sustaining any injury[2].

The *os uteri* was contracted so closely at this period as scarcely to permit a very thin

[1] After having been preserved in spirits, they became rather of a yellowish colour: indeed the whole of the preparation of the uterine organs had, as may be supposed, a far more beautiful appearance when viewed in the recent state than after it had been for some time preserved in spirit. For such purposes I should prefer brine to spirit, as the natural appearance of animal preparations is not so liable to be lost.

[2] I took the earliest opportunity of transmitting to my friend Mr. Owen the impregnated *uterus* of this *Ornithorhynchus*, and of two others which I subsequently obtained, and the following is the result of his examination of these specimens as detailed in a paper just published by him in the 'Philosophical Transactions.'

"In each of the specimens, the left ovary only had taken on the sexual actions, but did not exceed in size the same parts in the unimpregnated specimens above described. The right ovary had, however, become enlarged; it measured half an inch in length, a third of an inch in breadth, and was about half a line in thickness: a few ovisacs, about the size of a small pin's head, projected from the surface.

"The left ovary in each of the specimens was concealed by the thin membrane forming the expanded orifice of the oviduct. In one of these it was with some difficulty it could be withdrawn from the Fallopian aperture, owing to the adhesion which was occasioned by what appeared to be a coagulated secretion; a circumstance which must have effectually ensured the passage of the *ovum* into the oviduct. In two of the specimens, the left ovary presented two empty ovisacs, or *corpora lutea*, corresponding with the number of *ova* found in the *uterus*. In the third specimen, the left ovary presented two ovisacs still uncicatrized, but only one *ovum* was contained in the *uterus*. * * * *

"The discharged ovisacs were of an elongated flask-shaped form, about three lines in length and two in diameter, with the margins of the orifice through which the *ovum* and granular substance had passed everted, with a slight contraction, resembling the neck of a flask, below the aperture. On compressing these ovisacs, small portions of coagulated substance escaped. When longitudinally divided, they were found to consist of the same parts as the ovisac before impregnation, with the exception of the granular contents and granular stem of grass, not much larger in diameter than a hog's bristle, to pass through it; just within the orifice were two small raised reddish bodies, the use of which I do not know. The interior coats of the *uterus* were corrugated and of a fine pinkish colour.

On laying open the right *uterus*, although it was also enlarged and had some degree of vascularity, with ovaries on its upper part, no eggs were found within: internally it had the same corrugated appearance as was observed in the left, but the vascular tinge existed in a less degree.

The cheek-pouches, or, as I am inclined to consider them, the first stomachs, of both

stratum: but the *theca*, or innermost *parietes* of the sac, was much thickened, and encroached irregularly upon the empty space, so as to leave only a cylindrical passage to the external opening. * * * *

"The two smallest sized *ova* * * * were situated at the upper part of the left *uterus*, and at the distance of about a line from each other. Each *ovum* was spherical in form, and measured two lines and a half in diameter: they were of a deep yellow colour, with a smooth and polished surface, and had not the slightest adherence to the uterine *parietes*.

"The two *ova* next in size * * * measured each three lines in diameter, and were situated a little below the middle of the left *uterus*: they were of a spherical form, but had evidently been slightly compressed in the uterine cavity. They were of a lighter colour than the preceding, a circumstance which was specially evident at the upper part, from the subsidence of the contained vitelline mass. Externally they were smooth, and rolled freely out of the position where they were lodged like those of the preceding specimen.

"The largest *ovum* * * * had the same spherical form, smooth exterior surface, and freedom from connexion with the *uterus*, as the preceding, but was of a much lighter colour, owing to the increased quantity of its fluid contents, to which its greater size was chiefly attributable. It measured three lines and a half in diameter, and had been situated in a depression or cell a little below the middle of the left *uterus*. The lining membrane of the *uterus* was highly vascular in the recent state in each of the above specimens.

"In all these *ova* the contents could be seen, through the cortical or outer membrane, to be of two kinds, viz., a greyish subtransparent fluid and a yellowish denser mass, which varied in their relative proportions as above mentioned, the denser substance always subsiding to the lowest part of the *ovum*, whichever way it was turned. In the largest *ovum*, the yellow mass or yolk occupied about one third of its cavity, while in the smallest it constituted four fifths of the whole mass.

"The *chorion* or cortical membrane of these *ova* offered a moderate degree of resistance when torn open with the forceps, and yielded equally in every direction when separated from the yolk, the rent margins curling inwards like the coats of a hydatid. This membrane was of a dull greyish colour inclining to brown, slightly transparent, and more polished upon its inner than upon its outer surface: it resembles the cortical membrane of the *ovum* of the Salamander, but is of a more delicate texture. The fluid contents occupied the space between the cortical and vitelline membranes, a situation analogous to that of the albumen in the egg of the Fowl, but had not become coagulated by the action of the spirit in which the *ova* had been so long immersed.

"The yellow matter, or yolk, was seen to be invested by its proper capsule, which, when reflected under the microscope, was found to consist of an extremely thin, smooth, and transparent outer layer, which I regard as the *membrana vitelli*, with a thicker granular membrane immediately lining it, analogous to the *blastoderma* or germinative membrane. The contents of the above investments, or substance of the yolk, consisted of innumerable minute opake granules, similar in size and regularity of form to those contained in the ovarian follicles, and with these granules were mingled larger transparent globules of oil. There was not the slightest trace of *chalazæ* attached to the vitelline membrane, as, from analogy, we should expect to be the case had the *ovum* been destined to have been perfected by incubation. I was unable to detect any rudiments of the embryo."—Philosophical Transactions for 1834, p. 555.

the animals were filled with mud and gravel, among which comminuted fragments of insects and minute shell-fish could be plainly discovered.

The various contradictory accounts that have been given on the authority of the aborigines (who may be supposed, from their so often seeking these animals for food, to be able to state their habits correctly,) as to the animal laying eggs and hatching them, induced me to take some pains to find out the cause of error; and being now perfectly satisfied that *ova* were produced in the *uteri*, I could the more readily determine the accuracy or inaccuracy of the accounts which I might receive from the natives. I determined, however, not to question any who had been repeatedly questioned before on the same subject; but some time after, when I visited the out-stations in the Tumat country, where such questions had never been previously asked, I made inquiries among the most intelligent.

The Yas natives in the first instance asserted that the animals lay eggs, but very shortly afterwards contradicted themselves. To ascertain what dependence could be placed on them, I made a drawing of an oval egg, which was recognised to be like that of the *Mallangong*. I then made a drawing of a round egg, and that also was declared to be *cabango* (egg) of the *Mallangong*. It was also declared that "old woman have egg there in so many days" (the number of which they did not know); that the young ones "tumble down"; and that two eggs are laid in one day. An account subsequently obtained from a native, who appeared anxious to explain the fact, would lead to the belief that the animal is ovoviviparous; but yet, from the difficulty they find in expressing themselves correctly in our language, we often misunderstand them. He asserted the animal to be oviparous, but when desired to procure the eggs he replied, "Bel cabango (no egg) tumble down; bye bye, pickaninny tumble down." In the Tumat country the answers were readily and satisfactorily given; and afterwards more minute questions being put to them through my interpreter, the result was the same. "*Tambreet* make egg tumble down?" was the first query I made. "Bel" (no) was the reply. "No egg (*corbuccor*) tumble down; pickaninny make tumble down." This accorded with my observations, for it was at the season that this inquiry was made that the young *Duckbills* hereafter noticed were found, as if just brought forth, in the burrow. The natives are of course accurate in their observation of the breeding-season of animals, upon which their principal means of sustenance in this country depend.

On showing one of the natives at Yas the preparation of the *uteri*, he recognised them as the place "where pickaninny is made." When he saw the small eggs in the *uterus* on the opposite side, (for the empty one was first shown him,) he first stared, and then said, "Cabango, cabango" (egg, egg); but even with this before him no satisfactory reply could be procured from him whether the animal laid and hatched them. On the whole we may infer that no dependence can be placed on native accounts, but that naturalists must seek for information in their own investigations.

On the following day (6th of October) the Yas River was much swollen by the continued rains; but although exposed to heavy drenching showers, we again visited the river. A few of the *Duckbills* were to be seen occasionally, but none at this time within shot, until about 2 P. M., when a male specimen was shot; the under mandible and flap, and the web of the fore feet, were mottled as in the last specimen. On the lower part of the spur two small leeches were attached, one of which was red and swollen with the blood it had sucked from the animal; the other appeared to have just attached itself. The undistended one was $\frac{5}{8}$ths of an inch in length, and of a dull black colour. I may here remark that I could not discover any parasites among the short thick fur of any of these animals.

When shot, this specimen was borne down by the rapidity of the stream of the river, the current having been much increased by its swollen state. The animal, however, was readily brought out by the expertness of a small spaniel dog (which seemed to enter into the delight of the sport as much as ourselves), and after a few convulsive sighs expired.

The *testes* in the first male specimen I examined were large, being nearly the size of a pigeon's egg, and were situated near the kidneys. The *penis* is concealed in a sheath near the verge of the *anus*, so that unless pressure is made near the sheath, which occasions the *penis* to be thrust out, that organ is not visible; and there is consequently no external distinguishing mark of the difference of sex in these animals, excepting the spur on the hind feet of the males. In the last male specimen shot the *testes* were not larger than a very small pea. Does the difference of size depend on the breeding-season? or rather, How is the difference at the same season of the year to be explained? In a male specimen shot at the Murrumbidgee the *testes* were also not larger than very small peas. Thus out of three males the *testes* were only found large in the specimen shot on the 5th of October.

At 5 P. M. of the evening of the same day (6th of October) another female specimen was shot; on being brought out of the water it merely gave a few convulsive motions of the hind feet before it expired.

Another specimen was soon afterwards seen, a short distance lower down the river, dabbling on the surface of the stream in apparent enjoyment of the cool evening. One discharge laid it motionless on the surface of the water, and the dog immediately brought it out. This proved, much to my satisfaction, to be another female. At first it lay quite motionless as if dead; but soon after, on the way home, it showed symptoms of vitality, and on placing it on the ground, it walked with tolerable rapidity instinctively towards the river. This specimen died, however, soon after it was taken home.

On examining the first specimen that had been shot this evening, I found the *uteri* enlarged, more particularly that of the left side, above which a distinct cluster of *ova* were seen as in the former specimen; they were covered by a delicate membrane[1].

[1] This is the expanded end of the Fallopian tube.

On laying open the left *uterus* it was found to contain two unattached *ova*, of a white colour, and of transparent appearance while left in the moisture of the *uterus*, but which became opake when dry: being covered by a dense membrane they could be handled and examined without any fear of injury. The *parietes* of the right *uterus* were also much distended and thickened, but on an examination of its interior it was found not to contain any eggs.

In the second female shot this evening the left *uterus* was more distended than in the former specimens, and in the usual situation a fine cluster of *ova*, covered by a thin pellicle, was seen. The right *uterus* was much smaller, hardly appearing to be at all distended, and was destitute of *ova*. On laying open the left *uterus* it was found to contain a single *ovum* of the size of a buck-shot.

The next morning (October 7), at Mr. Manton's farm, I accompanied one of the aborigines called Daraga to the banks of the Yas River, to see the burrow of an *Ornithorhynchus*, from which he told me the young had been taken last summer. I asked him, "What for he dig up *Mallangong*?" "Murry budgeree patta" (very good to eat), was his reply. On arriving at the spot, which was situated on a steep bank about which long grass and various other herbaceous plants abounded, and close to the river, my guide, putting aside the long grass, displayed the entrance of the burrow, distant rather more than a foot from the water's edge. In digging up this retreat the natives had not laid it entirely open, but had delved holes at certain distances, always introducing a stick for the purpose of ascertaining the direction in which the burrow ran, previously to again digging down upon it. By this method they were enabled to explore the whole extent of it with less labour than if it had been laid entirely open. The termination of the burrow was broader than any other part, nearly oval in form, and the bottom was strewed with dry river weeds, &c., a quantity of which still remained. From this place our sable friend said he had taken last season (December) three young ones, which were about 6 or 8 inches long, and covered with hair. The whole of the burrow was smooth, extending about 20 feet in a serpentine direction up the bank.

I may here mention, that when a half-civilized young savage accompanied me one day in a search after *Water-Moles*' burrows, he expressly cautioned me against putting my hand into the burrow: "No put hand in, for he make smell hand." The burrows have one entrance, usually about the distance of a foot from the water's edge, and another under the water, communicating with the interior by an opening just within the upper entrance. It is no doubt by this entrance under the water that the animal seeks refuge within its burrow when it is seen to dive and not to rise again to the surface; and when the poor hunted quadruped is unable to enter or escape from the burrow by the upper aperture, it makes a second effort by its river entrance.

The search for a second burrow near the first afforded me an opportunity of witnessing the means the aborigines adopt to track these animals. Our black zoological collector pointed out to me in the course of his peripatetic lecture, or rather demonstration of the whole art of capturing them, the distinct marks of the hind and fore feet of one of these animals on the moist clay near the river; and afterwards inserting his hand up the burrow, brought from thence some lumps of clay taken from the under surface. These he regarded closely, and placing them in my hands pointed out recent impressions of the fore feet of one of the *Mallangong* tribe, which were certainly distinctly visible. He then removed some other pieces from the interior of the burrow, on which there were further proof impressions of the animal's recent presence, and it was therefore declared to be an inhabited one. I was anxious to explore it, but as Daraga said that no "pickaninnies" (eggs were not mentioned by him) would be found therein, nor "old women" either, I was overruled: indeed as respected the first, I was aware by the recent dissection of specimens that no young would be found at this early period of the season, and I depended on native accuracy for the living one not being in the burrow. This I afterwards regretted, for I subsequently procured a living female specimen by not relying on similar information given by the same native; and some time after, on exploring this burrow, I found it forsaken, the old one either having been killed or having deserted her habitation.

Returning early in the evening from Mr. Manton's, there was time to visit the banks of the Yas River at Mundoona; and at 6 P.M. a female was seen and fired at, which laid it tranquil as if dead on the surface of the water. When brought out, however, it was found not to be quite dead; and in a few minutes afterwards it revived, although severely wounded. By the time we had reached the house, the animal had become more recovered, ran rapidly (with a sidelong motion, on account of its wounded side,) about the room, and dashing in its passage through the burning wood fire, got much singed, but was not otherwise injured. It was extremely restless, and ran round and round the room, seeking some crevice from which it might escape: from the power which the animal possesses, by means of strong cutaneous muscles, to contract its loose integuments as well as its body, it can pass out of an aperture which, to a person ignorant of these circumstances, it would appear impossible for it to force itself through. When I took it into my hand, it made strenuous efforts to escape from my grasp; and from the flaccid nature of its skin, I found some difficulty in retaining it; but it made no attempt to bite or otherwise inflict injury: indeed, its weak mandibles would be useless for such a purpose. As the animal was so very restless, I tied it up by a string attached to the hind-leg; but it still renewed the efforts to escape from its place of confinement, scratching very violently until it became exhausted, expelling air from the nostrils, and uttering also a faint moaning noise, which excited our pity. When I placed it in a bucket of water, it sank, but immediately afterwards came to the surface, expelling air from the nostrils: it appeared evident, that in its wounded condition it was unable to support itself in the water; and in about two minutes, on taking it out, it was quite exhausted, and did not again move for several minutes. It died in the course of the night.

On examining the uterine organs of this specimen on the following morning, I found the right *uterus* distended, and measuring $2\frac{3}{8}$ inches in length; but on laying open its interior it was found not to contain any *ova*. The left *uterus* was vascular; and on laying open the interior, the inner surface was found thickened, corrugated, and vascular: at the loose part I found two white semi-transparent *ova*, about the size of, or rather smaller than, buck-shot. They lay perfectly unattached to the *uterus*, and readily came out. On placing them on my hand, and then holding them up to the light, I could distinctly perceive a yelk of a very pale yellow colour, which, in whatever direction I turned the *ovum*, fell to the under surface. After the *ova* had been taken out of the *uterus*, and the moisture which covered them at that time had become dried up, they lost their semi-transparent appearance, and became opake; but being replaced in the moist *uterus* they soon regained their former appearance. Like all those which I had previously seen they had a firm tough external membrane, which enabled them to be handled and examined without injury to their structure. A cluster of *ova* was situated in the usual place over each *uterus* in this specimen.

In all the females that I had now dissected, I had experienced much difficulty in finding the abdominal or mammary glands: indeed, had I not been previously acquainted with their situation, I should, in their present stage, have passed them over altogether. On one occasion a native was overlooking me when busily engaged in seeking for the gland. Perfectly aware, although I had not informed him, for what I sought, he pointed out its situation, saying at the same time, "Milliken (milk) come all same as from cow." When I told him that I could hardly see it, he replied, "Bye and bye, when pickaninny come, cobbong (large), milliken come."

On the afternoon of this day (October 8th) the usual ramble was taken on the banks, to observe and procure specimens of these animals. As the native Daraga came from Mr. Manton's to Mundoona this afternoon, he accompanied us, and we availed ourselves of the opportunity to obtain his assistance in seeking for burrows. On a steep bank at one part of the river, the keen-sighted native pointed out to our uninitiated eyes the tracks of these animals on the moist earth close to the water; which tracks being followed up the bank at a distance varying from two to five feet, the entrance of the burrow, concealed by the long grass and shrubs, was soon discovered, and the tracks had evidently a very recent appearance. Following the same method as he had adopted when the last burrow was discovered, the native placed his hand within it, and took from its lower surface pieces of clay on which impressions of the animal's feet were distinctly marked; but from the situation of these burrows I regarded it as next to impossible to explore them. We had often during this excursion mistaken the holes of water-rats and other animals for those of the *Ornithorhynchus*; but our tawny companion always told us to what animal they belonged, at the same time readily pointing out the differences.

Very late in the evening we watched two *Water-Moles* paddling about in a small pond of the river; but they eluded all the endeavours made to get a sufficiently near shot. I repeatedly heard a splash in the water at one particular part of the bank whenever I approached it, as if the animals had retreated to the land, but, unable to gain their burrow in time, had, on my approach, taken again to the water. As this occurred often about the same place, and as darkness was setting in rapidly, I marked the situation of the spot, and determined to examine it on the following day, and ascertain whether I was correct in my supposition.

Our tawny friend Daraga remarked to me that it was of no use digging up burrows [1] of *Water-Moles* now for "pickaninny", for "none yet tumble down from mother"; but that further in the summer season, in rather "more than one moon, plenty pickaninny tumble down from old woman." It puzzled him, however, to form a conjecture why, with such abundance of cattle, sheep, &c., we wanted *Mallangongs*.

On examining the cheek-pouches or the stomachs of these animals, I always observed the food to consist of river insects, very small shell-fish, &c., which were constantly found comminuted and mingled with mud or gravel: this latter might be required to aid digestion, as I never observed the food unmingled with it. The natives say that they also feed on river-weeds; but as I have never seen any of that description of food in their pouches, I cannot confirm the correctness of the statement[2]. The young are fed at first by milk, and afterwards, when sufficiently old, by insects, &c., mingled with mud. "All same you white feller," said one of the blacks to me one day, when I asked him on what the young moles were fed by the "old women"; "first have milliken, then make patta (eat) bread, yam," &c.

On the following morning, whilst the horses were saddling for a ride to Mount Lavinia, the farm and residence of Mr. O'Brien, on Yas Plains, we went down, accompanied by the native Daraga, to that part of the river at which I had supposed the *Water-Mole* to have been attempting to escape into its burrow. I was right in my conjecture, for near the spot tracks of one of these animals were very distinctly visible, and we traced them up the bank, where, amongst some long grass, the entrance was discovered; and further tracks having been discovered on the under surface of the interior, there was sufficient to determine its being an inhabited burrow; an opinion to which our black companion Daraga assented. The situation was one admirably calculated for digging, as the bank gradually sloped, and was neither very high nor steep; so I came to the determination to explore it. This was done, not with the expectation of meeting with any young, for my dissected specimens induced a contrary opinion, but from a desire of examining the internal construction of the burrows formed by these

[1] The name by which the natives express the burrow or habitation of any animal is *guniar*; and the same word is applied to our houses, being our habitations.

[2] Mr. George MacLeay informed me that he had shot some, in a part of the Wollondilly River, having river-weeds in their pouches; but he further observed that in that part of the river aquatic insects were very scarce.

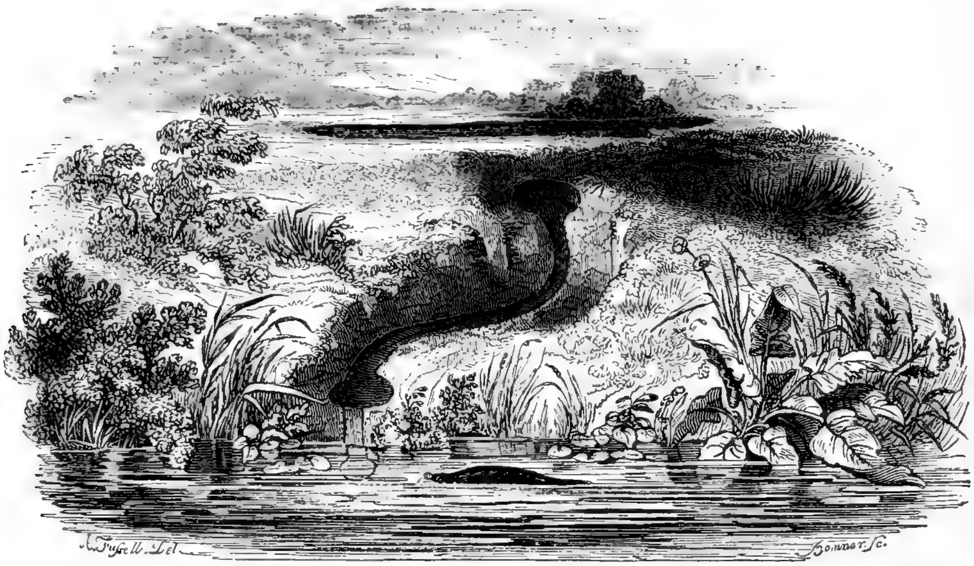
animals. Spades were consequently sent for; but when our sable friend Daraga heard the word "digging" pronounced, his countenance exhibited anything but a gleam of satisfaction, for he had evidently a strong aversion to work of that kind; and thinking that in the natural course of events, being black, a greater share of the labour would fall upon him than upon us who were "white fellers," he endeavoured to creep out of the scrape by declaring the burrow an old one and not worth examining. Being now, however, perfectly satisfied that it was an inhabited burrow, in a place to be dug up with more facility than any I had yet seen, I was not to be deterred from my purpose. Seeing that my resolution was not to be set aside by the force of his eloquence, Daraga sat down at a short distance from the scene of operation, consoling himself with a pipe of tobacco. When, however, he found that the operation of digging was not to be confined to himself, he came and assisted in the exploration by passing a stick up the burrow, in order to ascertain its direction. The entrance of the burrow was large, particularly when compared with the width of the passage continued from it, measuring one foot three inches in depth, and one foot one inch in breadth. Instead of laying the burrow entirely open from the entrance to the termination, which would have been a laborious undertaking, holes were opened at certain distances in the direction of the burrow, according to the method adopted by the aborigines. The native Daraga assisted us by digging also with a sharp-pointed stick, and he was able to effect his object with much greater rapidity by it than we with our spades.

The burrow became narrower as it receded from the entrance, being about the usual breadth of the animal when uncontracted. After having traced it for the distance of ten feet four inches, and having just delved down upon it so as to perceive it still continuing its course up the bank, the beak and head of a *Water-Mole* were seen protruding for an instant from the upper part, as if it had been disturbed from its repose, and had come down to see what we were about with its habitation. It only remained for an instant; for as soon as it beheld us, imagining no doubt that we could be there making such a noise for no very benevolent purpose, it immediately turned up to take refuge in that part of the burrow which yet remained unexplored. In turning round, however, it was seized by the hind leg and dragged out. The animal appeared very much alarmed when it was hauled out of its subterraneous dwelling: it discharged its urine (which had rather a strong odour) and its *fæces* when first caught, which I attribute to fear, for this is not usual with other living specimens that I have since seen. It uttered no sound, nor did it attempt to bite; and proved to be a full-grown female. When I held the unfortunate *Platypus* in my hands, its bright little eyes glistened, and the orifices of the ears were expanded and contracted alternately, as if eager to catch the slightest sound, while its heart palpitated violently with fear and anxiety. After it had been retained in the hands for some time and had lost its first fear, although it occasionally struggled to escape, it seemed to become more reconciled to its situation.

The *Ornithorhynchus* which I had thus succeeded in obtaining alive and uninjured, was placed in a cask, with grass, mud (taken from the river), and water, and everything that could make it comfortable under existing circumstances. It ran round its place of confinement, scratching and making great efforts to get out; but finding them useless, it became quite tranquil, contracted itself into a small compass, and soon became buried in sleep. At night, however, it was very restless, and made great efforts to escape, going round the cask with its fore paws raised against the sides, and the webs thrown back, and scratching violently with the claws of the fore feet, as if to burrow its way out. In the morning I found the animal fast asleep, the tail being turned inwards, the head and beak under the breast, and the body contracted into a very small compass: sometimes, however, its position when asleep is with the tail as usual turned inwards, the body contracted, and the beak protruding. The animal uttered, when disturbed from its sleep, a noise something like the growl of a puppy, but perhaps in a softer and more harmonious key. Although quiet for the greater part of the day, it made efforts to escape and uttered a growling noise during the night.

I found, by measurement, that the distance of the entrance of this burrow from the water's edge was five feet: it was on a moderately steep bank, abounding with long wiry grass and shrubs, among which, and concealed by them, was the opening of the subterranean dwelling. From the judgment which I have been enabled to form from the examination of this, as well as of several other burrows of these animals, I do not imagine that the natives have ever seen, or that any one could see, (except in a state of confinement,) the young ones in the act of sucking the mother; for in the tedious process of digging their habitations, the old animal is disturbed, and either endeavours to escape, or actually succeeds in escaping, long before the termination of the burrow is attained. I could not observe any heaps of earth near the burrow, nor can I form any opinion how in the process of excavation the animal disposes of the loose mould. May we be permitted to suppose that the animal carries away the earth collected during the excavation, in order that the heap which would otherwise be formed may not point out the situation of the burrow? A similar instinct is found among several insects, as in the Mason Wasp and Carpenter Bee; and why not in this animal?

This burrow ran up the bank in a serpentine course, approaching nearer to the surface of the earth towards its termination, at which part the nest is situated. This is sufficiently large to accommodate the old animal and its young. No nest had yet been made in the termination of this burrow, for that appears to be formed about the time of bringing forth the young, and consists merely of dried grass, weeds, &c., strewed over the floor of this part of the habitation. The termination was of the form shown in the following sketch, and measured one foot in length by six inches in breadth. The whole extent of the burrow, from the entrance to the termination, I found by actual measurement to be twenty feet. The burrows are situated above the usual river height, but do not appear to be above the extensive floods of the river which frequently take place during the winter season. The accompanying sketch of the burrow and locality conveys some idea of their appearance as well as situation.



On my return, after an absence of two days at the Murrumbidgee, I found my living specimen well, it having been kept confined during that time in the cask, which formed a very safe prison. I had now determined to leave this part of the country for Sidney, to forward to England the preparations of the animal which I had already made; and believing that this specimen, if it survived the journey, and proved to have been impregnated, would determine whether the animal was or was not ovoviviparous, on the 13th of October I took my departure, carrying it with me in a small box, with grass, &c., which was covered by battens, having very narrow spaces left between. On disturbing it, it being at the time asleep, to place it in the travelling-box, it uttered several savage growls. It arrived safely on the 14th at Lansdown Park, the estate of Mr. Bradley. Here I availed myself of the vicinity of some ponds, (also inhabited by these animals,) to give it a little recreation. On opening the box it was lying in a corner, contracted into a very small compass, and fast asleep. I tied a very long cord to its hind leg, and roused it, in return for which I received numerous growls. When placed on the bank it soon found the way into the water, and travelled up the stream, apparently delighting in those places which most abounded in aquatic weeds. Although it would dive in the deep water, it appeared to prefer keeping close to the bank, occasionally thrusting its beak (with a motion similar to that of the *Duck* when it feeds) among the mud and at the roots of the various weeds lining the margin of the ponds, and which we may readily suppose to be the resort of insects. After it had wandered some distance up the chain of ponds, feeding about the shallow water and mud near the banks, it crawled up the bank, and lying down on the grass, enjoyed the luxury of scratching itself and rolling about.

In this process of cleaning itself, the hind claws were alone brought into use for the operation, first the claws of one hind leg, then those of the other; but finding that it could not use the one to which the string was attached so well as the other which was disengaged, after repeated trials it gave up the attempt. The body being so capable of contraction was readily brought within reach of the hind feet, and the head also was brought so close as to have its share in the universal cleaning process. The animal remained for more than an hour cleaning itself, after which it had a more sleek and glossy appearance than before. On placing my hand on a part which it was scratching at the time, the claws passed over my hand instead of the animal's body, and I found that it performed the combing in a remarkably gentle manner. On my attempting to scratch the place gently, it started away, but not far, and soon resumed the method of cleaning itself in which I had interrupted it. It permitted me at last to smooth it gently over the back, but disliked being handled. After I had given it a range for three hours, it was replaced in its temporary habitation, the box.

The animal was brought in safety to the township of Bong Bong, at which place we arrived on the 16th, and while the horses were feeding, I took the advantage of the river passing through the place to indulge it with a bathe, and with an opportunity of feeding on the banks of the stream. It was fast asleep when I opened its box, but it was soon roused, and instinctively made for the water, plunging in, and taking a good range of the cord, which as before was attached to the hind leg. It was exceedingly lively, swam in the centre of the stream, dived, and appeared in excellent health and spirits. The water at one part of the river being very clear, I saw its motions distinctly under the water. On diving it sank speedily to the bottom, swam there for a short distance, and then rose again to the surface; it ranged the banks, guiding itself in its progress according to the impressions received by the mandibles, which appeared to me to be used by it as very delicate organs of touch. It seemed to feed well, for whenever it inserted its beak into the mud, it evidently procured some food from thence, as on raising the head after withdrawing the beak, the mandibles were seen in lateral motion as is usual when the animal masticates. Although several insects were basking and fluttering about the surface of the water, close to it, no attempt was made to capture them, either from its not seeing them or from its preferring the food which the mud afforded. The motions of the mandibles in this animal when seeking its food in the mud or water, are the same as those of a *Duck* when feeding in similar situations. After feeding it would lie sometimes on the grassy bank, and at others partly in and partly out of the water, combing and cleaning its coat as usual with the claws of the hind feet. After permitting it to swim, feed, and clean itself for an hour, it was replaced, although with great reluctance on its own part, in its box: it did not, however, as before, betake itself to repose, but commenced and continued a scratching on the sides of the box.

I did not again open the box to look at the *Ornithorhynchus* until the following morning, the 17th, at Mittagong, where we had arrived the previous night. The box had been placed as usual in my bed-room, but not hearing the usual scratching of the animal, I had some apprehensions with regard to its safety, and on the morning following I found them correct, for the box was empty. There was every reason to suppose that its struggles had raised one of the battens which had not been fastened with sufficient firmness, and that it had escaped between Bong Bong and Mittagong. Had the animal died I should have had some consolation in dissecting it, but as it was, all my hopes were frustrated by its escape.

Having thus failed in bringing the living female specimen to Sidney, I determined again to devote a portion of time, before the season became too far advanced, to the investigation of the habits and economy of this interesting animal. The success of my first journey excited me to fresh attempts with increased energy, to gain as much information as possible respecting it.

Knowing that I could ensure the kindness of the gentlemen who had before interested themselves in my investigation of this subject, I left Sidney on the 2nd, and Raby on the 8th of November, for the Yas, Murrumbidgee, and Tumat countries, with the intention of continuing my observations on the same subject, as well as on other points of natural history or of professional interest that might occur in my way. After an agreeable journey by way of Goulburn Plains, I arrived at Mundoona on the 15th of November.

The summer season had now advanced considerably in this part of the country. The river at Yas had fallen greatly, and the banks were covered by an increased luxuriance of high grass, towering reeds, and bull-rushes. The "ponds" of the river where I had sought for and procured these animals were still, however, of sufficient depth for them. They were covered with floating aquatic plants, some of which had displayed their snow-white flowers, which floated on the surface of the water: the golden blossoms of the *Acacia* had faded and fallen, and had given place to the less gay but still pretty flowers of smaller and less conspicuous shrubs and plants. Yet about those spots where these animals had before been seen in such numbers, I paced the bank without seeing one. I felt anxious to ascertain in what state the females were, and how far advanced in the production of their young, or whether they had already brought them forth; but although evening after evening I sought their usual haunts, I was unable to procure, or even to be gratified with the sight of, a solitary specimen. I remarked that the situations where burrows of these animals were known to exist, had been selected by their instinct where the ponds of the river contained water even during the dry summer season, and when other parts of the river were nearly dry or formed at best a mere small trickling rivulet. Of course where the water remained the river-weeds flourished, and the flowers now produced by them probably attracted insects, which would furnish these animals with food, in addition to the minute shell-fish which might also be found about the plants, and on which they also feed.

Can the animals, I thought, confine themselves in their burrows during the period of gestation? To ascertain this, two burrows were dug up, about the entrance of which tracks of the animal had been seen: one was only half completed, the animal having very probably been killed before the habitation had been finished; the second was empty, the owner having probably met with a similar fate. The long grass and shrubs were very luxuriant and dense at this season (the summer) of the year, rendering the exploration or discovery of the burrows of the animals more difficult than we had before experienced; and the thick grass afforded shelter for venomous reptiles, among which black and brown snakes were numerous, which rendered the process not a little dangerous.

Failing in procuring specimens at Yas, I left for Gudarigby, near the Murrumbidgee River, where I arrived on the 21st. There I remained for several days; but although I procured specimens of the animal, the results of the dissection were very unsatisfactory, the only female shot being young and unimpregnated. From the high reeds extending some distance out into the river, some difficulty was experienced in getting sufficiently near the animals; and the specimens, when shot, were often carried by the stream among the reeds, and lost.

On the 27th of November I left Gudarigby to return to Yas Plains. A female *Ornithorhynchus* had been shot at Mundoona the day before my arrival. In this specimen the fears I had entertained, that not having been able before to shoot or otherwise procure an impregnated female, the season would be too far advanced, as the young would probably have been produced, were realized. This female had evidently just produced her young, and the uterine organs exhibited no appearance of any more being likely to be brought forth: this I mention because some have thought that they may breed twice a-year, which I have reason to doubt. The left *uterus* in this specimen measured $2\frac{3}{8}$ inches in length and $\frac{1}{8}$ of an inch in diameter. The mammary glands on each side were very large; but it is a curious and rather an interesting circumstance in the œconomy of this animal, that after having been shot, no milk could be expressed from the glands. This was the more surprising to me, as the glands were very vascular on the surface, the mammary artery ramifying over them in a most beautiful and distinct manner. The fur still covered that portion of the integument on which the ducts terminated, and there was no appearance of a projecting nipple. In the animals which I have subsequently seen with a lacteal secretion, there has been no projecting nipple, and the fur is not even invariably found quite rubbed off at the situation where the ducts of the gland have their termination. The lacteal glands were conglomerate, situated one on each side of the *abdomen*, a short distance above and anterior to the hind legs, between the abdominal muscles and the integuments, and were covered with a quantity of cellular membrane, which enveloped and bound together the numerous lobes of which the whole mass of the mammary or lacteal glands was composed, and at the same time connected the aggregate mass to the surrounding muscles and integuments. The glands were not prominent, nor easily to be distinguished from without, on account of the very flaccid integuments with which the animal is covered. The smaller glands were usually of a long narrow form, running in a longitudinal direction towards one centre, and ending internally in the lacteal ducts, (beautifully displayed by this specimen in its recent state,) which converged and terminated on the surface of a very small portion of the integuments. One of the glands measured $3\frac{1}{2}$ inches in length, and, when expanded, $5\frac{3}{8}$ inches in breadth; but when seen lying undissected upon the *abdomen*, with the lobes united together closely by the cellular membrane, the breadth was from $2\frac{3}{8}$ to 3 inches, and the length the same as that given above.

How different was the appearance in the recent state of this mammary gland from that which I had previously seen at the Royal College of Surgeons in London, in a specimen long preserved in spirits, in which I had had the opportunity of witnessing the injection of the ducts with mercury by my friend Mr. Owen, the mercury exuding, as I have since seen the milk from the similar ducts, upon the integuments. In the recent specimen, the pale whitish glands clustered together, seen through the fine delicate cellular membrane which attaches them to the muscles and integuments, and the ramification of the blood-vessels and of the delicate ducts, form a picture of natural beauty most gratifying to the eye of an admirer of the works of nature, and far surpassing any of the productions of art.

I sought for the burrow of this animal about the banks of the pond in which it had been shot,—the same pond on the bank of which the burrow was discovered in which I caught the first living specimen,—but was unsuccessful.

In the same pond at Mundoona, from which many female specimens had been procured, two more females were shot; but both proved unimpregnated, with the *uteri* merely long thread-like tubes, destitute of *ova*, and with the abdominal glands hardly to be perceived on the most minute dissection of the parts.

On the 8th of December I again left Yas for the Murrumbidgee and Tumat countries: and near Jugiong an opportunity was afforded me of seeing a burrow on the banks of the Murrumbidgee River, containing some very young *Ornithorhynchi*, which appeared to have not long previously been brought forth, being only thinly covered with hair; a circumstance which corroborated the accounts of the natives in the Murrumbidgee and Tumat countries, who invariably told me, "Pickaninny tumble down now from old woman; very small now." In this burrow were three young ones, in length about $1\frac{7}{8}$ inch: there was not the slightest appearance of anything like shells about the burrow, or that would lead to the supposition of the eggs being excluded previously to the appearance of the young; and I am inclined to consider all the facts that I have been able to ascertain as militating against an assertion or theory of that kind. From the burrow above mentioned the "old woman" had made her escape; at all events she was not to be found. I regret that from a want of spirits of wine, in which these animals could be preserved, (for they died before I had proceeded far on my journey,) they were spoiled.

Having no new observations on these extraordinary animals to record during the remainder of my stay in the Tumat, Murrumbidgee, and Yas countries, I will now continue my observations in another field. I left Yas on the 23rd of December, and arrived at Lansdown Park, the estate of Mr. Bradley, at Goulburn Plains, on the 24th. On the 28th of December, with a small party of aborigines, we visited a very beautiful part of the Wollondilly River, which passes near this estate, and which has the native name of Koroa. It was a noble sheet of water, extending to some distance, and abounded in *Musk*, *black*, and other kinds of *Ducks*, as well as in various descriptions of *Water-Fowl*. We proceeded to explore the burrow of an *Ornithorhynchus* which had been discovered. The aborigines used their hard pointed sticks [1], and although the ground was firm, they succeeded as quickly as we could have done with our spades. The method of laying open the burrow was by holes dug above at certain distances, as I have before described. The holes were opened at about four or five feet apart, a stick being passed up to ascertain the direction of the excavation.

As we proceeded in exploring, there were abundant good omens to encourage us; for besides fresh tracks of the feet of the animal, pieces of grass, weeds, &c., such as they strew at the bottom of the termination of the burrow to form a warm nest for their young, were seen. On every indication of the presence of the animal, the older blacks quietly passed either the earth from the under surface of the burrow having recent impressions of its feet or tail, or the pieces of grass, reeds, &c., to one another, for the opinion of each; and if in favour of the presence of the animal, the digging up of the burrow was continued, the indications so well known to them giving fresh hopes and renewed vigour to the diggers. The extent to which this burrow was continued up the bank in a serpentine form was very great; and after a very laborious task in exploring it, in consequence of the great hardness of the ground, the termination was attained at a distance of thirty-five feet from the entrance to the inhabited part. Extensive as this may appear, burrows have been found of even fifty feet in length.

On arriving at the termination of this very large burrow, a growling was distinctly heard: this I at first thought proceeded from the old one, which I now believed that I should have an opportunity of viewing with her young; but thinking it on reconsideration more probable that the old one had forsaken them, as I had observed during the course of laying open the burrow that we had not seen her come down, in the usual manner, to ascertain why we destroyed her habitation, I could not account for it, more especially when the burrow at its termination being laid a little more open, the fur of the animal or animals was seen. What then surprised me was, that although there was abundance of growling there was no movement of the animals to escape. On being taken out they were found to be full-furred young ones, coiled up asleep, and they growled exceedingly at being exposed to the light of day. There were two, a male

[1] The stick used for this purpose is called *Kiar* by the aborigines: the same name is also given in their language to our spade.

and female, of the dimensions of ten inches from the extremity of the beak to that of the tail. They had a most beautifully sleek and delicate appearance, and seemed never to have left the burrow. The nest, if it may be so termed, consisted of dry river-weeds, the *epidermis* of reeds, and small dry fibrous roots, all strewed over the floor of the cavity, which was of sufficient size to contain the mother and her young. The animal, it may here be observed, has from one to four young ones at a time, but the most usual number is two.

When awakened and placed on the ground they moved about, but did not make such wild attempts to escape as we had observed in the old ones when caught. It was rather a subject of surprise to us that we had not captured the old one, or at all events noticed its escape; but not long after the blacks captured a female on the bank not far distant from the burrow, which was no doubt the mother of the young which we had just before taken. The old specimen was in a ragged and wretchedly poor condition; her fur was rubbed in several places; the hind claws were also rubbed and wounded; and she seemed to be in a very weak state. The milk that could be expressed from the glands was but trifling in quantity; and in the mother of these young animals such would have been expected to be the case, for they appeared fully capable of feeding upon a more substantial diet. This old specimen died at Mittagong, on my way to Sidney, on the 1st of January 1833. On dissection, the mammary glands were found diminished in size; and on cutting into them, but a very trifling secretion of milk was perceived. The *uteri* were very small, having merely the small slender tube-like appearance which I have had occasion to mention in the dissection of other female specimens.

In the young animals the beak above was of a similar colour to the same organ in the old specimens; but on its under surface the colour was a beautiful delicate pink, in consequence of the minute blood-vessels being distinctly visible through the delicate *epidermis*. The legs close to the feet were fringed with fine silvery hairs, and the whole of the fur on the back, although of a more delicate nature, was similar in colour to that of older specimens; but the ferruginous hue of the whole extent of the under part of the chest and *abdomen* had a lighter tinge, dependent probably on the age of the animal.

The eyes of the aborigines, both young and old, glistened, and their mouths watered, when they saw the fine condition of the young *Mallangongs*. The exclamations of "Cobbong fat" (large, or very fat), and "Murry budgeree patta" (very good to eat), became so frequent and so earnest, that I began to tremble for the safety of my destined favourites; and having given them in charge to the natives to convey to Mr. Bradley's dwelling, I turned and rode back more than once, from a fear lest they should be all devoured. But I was wrong in my calculation on the natives' power of resisting temptation, for they brought them all home safe, and were delighted with the reward of tobacco which was given them for their trouble[1].

[1] The natives said that these animals were more than eight moons old; if this can be depended on as correct, they must have been the young of the previous season.

The young animals sleep in various postures; sometimes in an extended position, and often rolled up like a hedgehog in the form of a ball. They formed an interesting group, lying in varied attitudes in the box in which I had placed them, and seeming happy and content. Thus, for instance, one lies curled up like a dog, keeping its beak warm with the flattened tail, which is brought over it; while the other lies stretched on its back, the head resting by way of a pillow upon the body of the old one, which lies on its side, with the back resting against the box; the delicate beak and smooth clean fur of the young contrasting with the rougher and dirtier appearance of the older one, all fast asleep. At another time they might be seen, a curious-looking group, one lying on its back with outstretched paws, another on its side, and the third coiled or rolled up in the form of a ball. They shift themselves from one position to another, as they may feel fatigued by lying long in the first; but the favourite posture of the young animals appears to be lying rolled up like a ball. This is effected by the fore paws being placed under the beak, with the head and mandibles bent down towards the tail, the hind paws crossed over the mandibles, and the tail turned up; thus completing the rotundity of the figure. One of the figures in the plate displays the appearance of the animal in this posture, when the tail is pulled down, which can be done without disturbing it; and it may be closed again like the lid of a snuff-box[1].

Although furnished with a good thick coat of fur, they still seemed particular about being kept warm and comfortable. They would allow me to smooth their fur; but if the mandibles were touched they darted away immediately, those parts appearing to be remarkably sensitive. I could permit the young to run about the room as they pleased; but the old specimen was so restless, and damaged the walls of the room so much by attempts at burrowing, that I was obliged to keep her close prisoner in the box, where during the day she would remain quiet, huddled up with the young ones, but at night would become very restless, and eager to escape from her place of confinement. A general growl would issue forth from the group if disturbed when asleep.

There are a number of persons, both born in Australia and long resident there, who have been in the habit of shooting the *Water-Moles*, but who had no idea that they inhabited burrows in the banks; and many even of those who were aware that they resided in burrows, because the natives had told them so, still had no conception of their form and extent. The opinion of many was that they inhabited the water only, concealing themselves at the bottom of the rivers, and rising occasionally to the surface to play about, and to take in a supply of atmospheric air previous to their re-descent. This belief had induced some of them when they had obtained a living specimen to plunge it instantly into a tub of water. If the tub was half filled with water, they were surprised afterwards to find the animal dead; and if the tub was filled nearly to overflowing, equally surprised to find that it had escaped. I have always observed, when a living

[1] See Plate XXXIV. for sketches of the different positions of the animal when feeding, asleep, cleaning itself, &c.

specimen has been placed in deep water for even 15 or 20 minutes, without allowing it an opportunity to get into shallow water, that when taken out it has been much fatigued by its exertions.

I arrived with the little family of *Ornithorhynchi* safe at Sidney, and as they survived for some time, an opportunity was afforded me of observing their habits. The little animals appeared often to dream of swimming, as I have frequently seen their fore paws in movement as if in the act. If I placed them on the ground during the day, they ran about seeking some dark corner for repose; but when put in a dark corner or in a box, they huddled themselves up as soon as they became a little reconciled to the place and went to sleep. I found that they would sleep on a table, sofa, or indeed in any place; but, if permitted, would always resort to that in which they had previously been accustomed to repose. Still, although for days together they would sleep in the place made up for them, yet on a sudden, from some unaccountable caprice, they would shift their resting-place, and seek repose behind a box or in some dark corner in preference to their former habitation. They usually reposed side by side like a pair of furred balls, and awful little growls issued from them when disturbed; but when very sound asleep they might be handled and examined with impunity. One evening both the animals came out about dusk, went as usual and ate food from the saucer, and then commenced playing one with the other like two puppies, attacking with their mandibles and raising the fore paws against each other. In the struggle one would get thrust down, and at the moment when the spectator would expect it to rise again and renew the combat, it would commence scratching itself, its antagonist looking on and waiting for the sport to be renewed. When running they are exceedingly animated, their little eyes glisten, and the orifices of their ears contract and dilate with rapidity: if taken into the hands at this time for examination, they struggle violently to escape, and their loose integuments render it difficult to retain them. Their eyes being placed so high on the head, they do not see objects well in a straight line, and consequently run against everything in the room during their perambulations, spreading confusion among all the light and readily overturnable articles. I have occasionally seen them elevate the head as if to regard objects above or around them. Sometimes I have been able to enter into play with them, by scratching and tickling them with my finger; they seemed to enjoy it exceedingly, opening their mandibles, biting playfully at the finger, and moving about like puppies indulged with similar treatment. As well as combing their fur to clean it when wet, I have also seen them peck it with their beak (if the term may be allowed) as a *Duck* would clean its feathers. Between this and the combing of the hind feet, it is interesting to see them engaged in the operations of the toilet, by which their coats acquire an increased clean and glossy appearance. When I placed them in a pan of deep water, they were eager to get out after being there for only a short time; but when the water was shallow, with a turf of grass placed in one corner, they enjoyed it exceedingly. They would sport together, attacking one another with their mandibles, and roll over in the water in the midst of their gambols; and would afterwards retire, when tired, to the turf, where they would lie combing themselves. It was most ludicrous to observe these uncouth-looking little beasts running about, overturning and seizing one another with their mandibles, and then in the midst of their fun and frolic coolly inclining to one side and scratching themselves in the gentlest manner imaginable. After the cleaning operation was concluded, they would perambulate the room for a short time, and then seek repose. They seldom remained longer than 10 or 15 minutes in the water at a time.

At first I was inclined to consider them as nocturnal animals, but I afterwards found that their time of leaving their resting-place was exceedingly irregular, both during the day and night. They seemed, however, more lively and more disposed to ramble about the room after dark, generally commencing about dusk; but all their movements in this respect were so very irregular that no just conclusions could be drawn, further than that they were both night and day animals, preferring the cool and dusky evening to the heat and glare of noon. This habit was not confined to the young specimens, for the old ones were equally irregular, sometimes sleeping all day and becoming lively at night, and sometimes the reverse. I have often found one asleep and the other running about at the same period of the day, the male alone first leaving the nest and the female remaining asleep: he would, after feeding and running about for a short time, return, curl himself up, and sleep, and then the female would leave in her turn. Although, however, they frequently left thus alternately, at other times they would suddenly go out together. One evening, when both were running about, the female uttered a squeaking noise as if calling to her companion, which was in some part of the room behind the furniture, and was invisible; he immediately answered her in a similar note; and noting the direction from which the answer to her signal came, she ran at once to the place where he had secreted himself.

It was very ludicrous to see the uncouth little animals open their mandible-like lips and yawn, stretching out the fore paws, and extending the webs of the fore feet to their utmost expansion.

It often surprised me how they contrived to reach the summit of a bookcase or any other elevated piece of furniture. This was at last discovered to be effected by the animal supporting its back against the wall, and placing the feet against the bookcase, and thus, by means of the strong cutaneous muscles of the back and the claws of the feet, contriving to reach the top very expeditiously. They performed this mode of climbing often, so that I had frequent opportunities of witnessing the manner in which it was done.

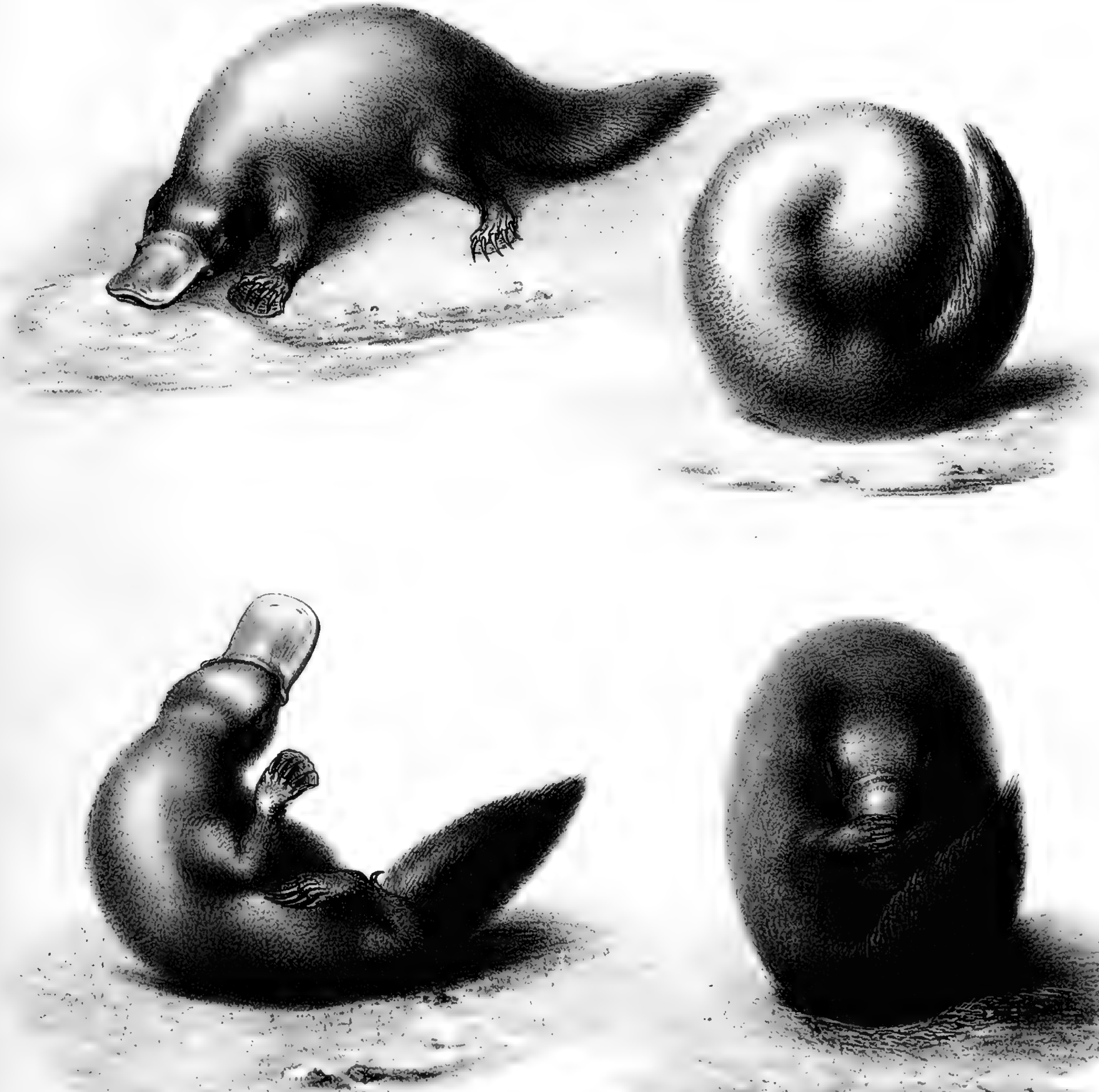
The food I gave them was bread soaked in water, chopped egg, and meat minced very small: although at first I presented them with milk, they did not seem to prefer it to water.

Some time after my arrival at Sidney, to my great regret, the little creatures became meagre; their coats lost the sleek and beautiful appearance which had before called forth so much admiration; they ate little; yet they ran about the room as before and appeared lively. But these external symptoms argued strongly against their being in a state of health. When wet, their fur became matted, never appearing to dry so readily as before; and the mandibles, and indeed every part of the animal, indicated anything but a healthy condition. How different was their appearance now from the time when I removed them from the burrow: then their plump and sleek appearance roused even the apathetic blacks; now the poor creatures could only excite commiseration for their reduced condition. The young female died on the 29th of January 1833, and the male on the 2nd of February, having been kept alive during the space of nearly five weeks, and thus my expectations of conveying them to England in a living state were frustrated.

PLATE XXXIV.

Ornithorhynchus paradoxus

sketched in postures which it assumes while sleeping, partially awakened, combing itself, and feeding.



Scharf lithog. Bennett del. Printed by Hullmandel.

Ornithorhynchus paradoxus

XXVII. *Description d'un nouveau Genre de* Mollusques *de la Classe des* Gastéropodes Pectinibranches. *Par* E. Rüppell, *M.D., Memb. Ext. L.S. & Z.S.*

Communicated September 9, 1834.

Animal. Tête à trompe allongée, mais qui est entièrement retractile, la bouche sans armure apparente ; deux tentacules applatis, triangulaires, courts, réunis à leur base interne, portant les yeux à la moitié de leur longueur sur leur coté externe. Pied médiocre, musculeux, sans opercule. Manteau à bord circulaire, sans aucun ornement, avec un foible prolongement du coté gauche. Cavité branchiale à ouverture assez large, la branchie composée d'un seul peigne formé de lames triangulaires serrées les unes contre les autres ; au fond de la cavité branchiale se trouve l'orifice des ovaires, dont les œufs sortent (au mois de Juillet) par paquets nombreux, enveloppés chacun dans un sac visqueux, applati, et de forme elliptique, long de 3 lignes.

Au milieu de la cavité branchiale du coté droit est l'orifice de l'*anus*. Sur le coté droit du cou, un peu en arrière du tentacule droit, il y a un autre orifice, qui pourrait être en relation avec les organes mâles de la génération.

La coquille est de forme subglobuleuse ; elle est mince, très fragile, translucide, à spire basse presque effacée par le surcroissement des lames du dernier tour. Ouverture grande, de forme subovale, les deux extrémités contournées en sens opposé, de sorte que l'ouverture a quelque ressemblance avec la lettre S retournée ; les deux bords non réunis, le bord droit mince à tout âge, et un peu evasé antérieurement, comme dans les *Ianthines* adultes. La columelle nulle, sans ombilique, sa partie antérieure tronquée et contournée.

	Adulte.	Jeune.	
Longueur de la coquille	$14\frac{3}{4}$ . . .	$7\frac{1}{2}$	lignes du pied de Paris.
Sa plus grande largeur	$12\frac{1}{2}$ . . .	6	

La couleur de la coquille qui sert de type à mon nouveau genre est constamment d'un blanc de lait un peu sale ; elle est sillonnée extérieurement par de nombreuses lignes longitudinales ondulées, très rapprochées entre elles, les nouveaux tours empiétant sur la spire des antécédents. Les individus de tout âge ont la coquille mince et fragile ; on les trouve constamment enclavées dans la masse calcaire des polypiers, ne communiquant avec la mer que par une ouverture médiocre. Ces polypiers sont presque toujours une espèce de *Meandrina* (*Meand. Phrygia*), la même dans laquelle se trouvent dans la Mer Rouge les *Magilus*, les *Pedum*, les *Vénérupis*, les *Coralliophages*.

D'après le peu de mots que M. Rang dit des jeunes *Magilus*[1], il me parait que ce

[1] Man. de l'Hist. Nat. des Mollusques, Paris 1829, p. 188.

naturaliste a eu sous les yeux le genre que je viens de décrire: il n'en connoissoit pas l'animal, ni celui du *Magilus*. Mais il suffisait de bien comparer les coquilles de ces deux genres pour distinguer que les deux bords sont chez le *Magilus* toujours réunis, et chez mon genre nouveau toujours désunis. Leurs animaux se distinguent par le manque et la présence de l'opercule, et la différence dans la trompe; le *siphon* du *Magilus* ne se trouve pas non plus au genre *Leptoconchus*[1], dénomination que je propose pour le distinguer.

Quant à la place systématique que doit prendre ce genre, je hazarde de l'avoisiner des *Ianthines*. Le nombre des tentacules, la trompe orale, le manteau sans *siphon*, les branchies pectinées à pyramides adossées, et le manque d'opercule les rapprochent, ainsi que quelques analogies de la coquille. Mais les différences dans leurs habitations sont trop grandes pour venir à l'appui de ce rapprochement, chose que je sens parfaitement bien, sans pouvoir y remédier par d'autres combinaisons.

PLATE XXXV.

Fig. 9. La coquille, vue en avant.
10. La même, vue en arrière.

[1] De λεπτὸς mince, et κόγχος coquille.

XXVIII. *On* Clavagella. *By* W. J. Broderip, *Esq., Vice-President of the Geological and Zoological Societies, F.R.S., L.S., &c.*

Communicated October 14, 1834.

In the fifth volume of the 'Histoire Naturelle des Animaux sans Vertèbres,' published in 1818, Lamarck established the genus *Clavagella*, placing it with good judgment between *Aspergillum*, Lam., and *Fistulana*, Brug., and recorded four species, all fossil, referring at the same time to the 'Annales du Muséum,' where he had described and figured the first of them under the name of *Fistulana echinata*. The following is Lamarck's definition of the genus.

"Vagina tubulosa, testacea, anticè attenuata et aperta, *posticè in clavam ovatam, subcompressam, tubulis spiniformibus echinatam terminata: clavâ hinc valvam detectam in pariete fixam prodiente; altera in tubo libera.*"

Mr. George Sowerby, whose attention had been attracted to a recent specimen in the British Museum, which he took for an *Aspergillum*, inclosed in a mass of stone, requested Mr. Children to allow a close inspection; and that gentleman, with his usual liberality and readiness to apply that part of the national collection committed more immediately to his care to the advancement of knowledge, its true and legitimate use, permitted some of the earthy part to be scraped away, when *Clav. aperta*, the first recorded recent species, was seen as it is described and figured in Mr. Sowerby's 'Genera of recent and fossil Shells.'

Mr. Sowerby's definition is nearly the same as Lamarck's.

Upon the return of Mr. Samuel Stutchbury from his voyage to some of the islands of the Australian and Polynesian groups, Mr. George Sowerby, in his appendix to the catalogue of subjects of natural history brought home by Mr. Stutchbury, described and figured, in the year 1827, a second species under the name of *Clav. Australis*. Three specimens were obtained with great difficulty by Mr. Stutchbury, who discovered them at North Harbour, Port Jackson, in a siliceous grit, like that of the coal measures, just beneath low-water mark, by their ejecting the water from the opening of their tubes with considerable force. The specimen figured by Mr. Sowerby is in the British Museum, and another is in Mr. Norris's collection at Manchester.

Soon after the publication of the latter species, Isaac Lyon Goldsmid, Esq., became possessed of a mass of coral (*Astræopora*, Blainv.), part of a collection which he had purchased at Aix la Chapelle. In 1829 Mr. Henry Stutchbury, to whom Mr. Goldsmid assigned the task of arranging this collection, observed an aperture which he concluded to form part of the chamber of a *Clavagella*; and having obtained permission to break the mass, he laid open, by a well directed blow, two specimens of this rare genus, together with *Petricola*, Lam., and *Gastrochæna*, Spengl.: a small bivalve, the *umbones* of which have all the appearance of those of *Lithodomus*, Cuv., appeared also in the wall of one of the chambers occupied by one of the *Clavagellæ*. These specimens, by the kindness of Mr. Goldsmid, are now before me[1].

In the second edition of the 'Règne Animal' (1830) Cuvier mentions *Clavagella*; but he notices only one recent species, in these words: "Il s'en trouve une espèce vivante qui se tient dans les Madrépores des mers de Sicile et qui a été décrite par M. Audouin." This description I have not seen; nor does Cuvier give any reference. I now proceed to give the reader all the information which I have been able to collect as to this living species described by M. Audouin.

In the 'Annales des Sciences Naturelles'[2], the following paragraph appears: "179. Clavagelle vivante. Opercule des Magiles.—M. Audouin a adressé à l'Académie des Sciences dans la séance du 29 Juin 1829, ses observations sur les coquilles des genres *glycimère* et *siliquaire* déjà annoncées dans cette revue, pag. 31 et 47; et il y a ajouté 2 nouveaux Mémoires sur une espèce de Clavagelle vivante et sur l'opercule des Magiles. Dans le 3e Mémoire, dit M. Audouin dans sa lettre d'envoi, je fais connaître avec détails l'organisation d'une coquille singulière qui, au premier abord, paraît se rapporter au genre *Clavagelle*. Les conchyliologistes et les géologues savent que cette coquille, qui vivait enfoncée dans les Madrépores et dont une des valves leur était adhérente tandis *que l'autre restait con*[3]stamment libre, n'avait encore été rencontrée qu'à l'état fossile. L'espèce que je fais connaître dans mon Mémoire se trouve dans les mêmes circonstances, mais elle habite encore aujourd'hui les mers de Sicile. J'ai pu l'étudier avec soin sur deux individus, dont l'un appartient au Muséum d'Histoire Naturelle qui en a fait dernièrement l'acquisition, et l'autre à M. le duc de Rivoli, qui possède en même temps l'animal."

I have consulted the 'Mémoires de l'Académie Royale des Sciences,' and also the 'Mémoires des Savans Etrangers[4]', down to the present period, the twelfth volume of the former and the fourth of the latter being the last publications that I have seen: these contain memoirs of a later date than June 1829, but I do not find the memoir of M. Audouin.

In the 'Manuel des Mollusques,' published in 1829, M. Sander Rang, under the title *Clavagella*, speaks of "la Clavagelle Râpe, seule espèce connue à l'état vivant, et que

[1] Plate xxxv. Figg. 1—4.

[2] Tom. xvii. p. 78. (Revue).

[3] The words and syllable here printed in italics are transposed to the top of the column by an error of the printer.

[4] Mémoires présentés par divers Savans à l'Académie Royale des Sciences.

nous venons de découvrir à l'île de Bourbon[1] :" he adds[2], " Quant à l'animal, nous ne le connaissons pas."

M. Sander Rang finishes the article on *Clavagella* with the following paragraph: " On a découvert récemment dans les mers de Sicile une coquille assez voisine des Clavagelles, mais que, selon nous, on ne doit pas rapporter à ce genre. Cette coquille, logée dans une cavité particulière creusée dans les pierres, a ses valves libres, tandis que l'ouverture de cette cavité est munie supérieurement d'un tube faisant l'effet d'une cheminée, bordé à son orifice d'une manchette analogue à celle de certains Arrosoirs. Cette coquille ne peut point appartenir aux Clavagelles, qui ont une valve soudée; nous pensons plutôt qu'elle devra former un genre dans le voisinage des Gastrochènes, car probablement le tube ne s'élève pas seulement à l'orifice de sa demeure. Il y a lieu de croire que, comme dans les Gastrochènes, il se prolonge inférieurement dans cette cavité qu'il tapisse, et par ce moyen enveloppe la coquille; ce serait donc avant les Gastrochènes, et dans la division *c*), qu'il faudrait la placer.

" *c*) Quelquefois un tube enveloppant toute la coquille et non soudé[3]."

If M. Sander Rang here allude to the species communicated by M. Audouin to the Académie des Sciences, and if the description of the former be an accurate account of the " Clavagelle vivante" of M. Audouin, the species cannot be that which I am about to describe in this memoir under the name of *Clav. Melitensis*; for my species has "une valve soudée :" but I regret that I have not access to M. Audouin's memoir, which would probably relieve me from the doubt that I may possibly be describing his Sicilian *Clavagella* under the name of *Clav. Melitensis*.

Mr. Cuming, in the course of his voyage, dredged up from a depth of eleven fathoms, at the island of Muerte, in the bay of Guayaquil, a fragment of calcareous grit, of modern appearance, such as Mr. Samuel Stutchbury found forming the solid reefs which bound the islands designated by him as " mineral," in contradistinction to those which are, superficially at least, coral. In this calcareous grit was the greater portion of the chamber and tube, both valves, and the soft parts of a very fine *Clavagella*[4]. These parts are now in the able hands of my friend Mr. Owen, and form the subject of the interesting memoir which follows this paper.

A close examination of the recent species has convinced me, that though one valve is always fixed or imbedded in the chamber, and soldered, as it were, to the tube, so as to make one surface with it, the tube is not necessarily continued into a complete testaceous clavate shape. In Mr. Goldsmid's best and largest specimen[5], the fixed valve is imbedded in the coral[6], and, though continued on to the tube or siphonic sheath[7], is surrounded by the wall of the coral chamber at its anterior extremity[8]. In the other specimen[9] the fixed valve is also continued on to the tube.

[1] p. 339. [2] p. 341. [3] p. 342. [4] Plate xxx. Figg. 8—16. [5] Plate xxxv. Fig. 1.
[6] Ibid. *a'*. [7] Ibid. *d*. [8] Ibid. *a*. [9] Ibid. Fig. 2.

In the first-mentioned specimen, at the anterior or greater end of the ovate chamber, an insulated shelly plate has been secreted with the tubular perforations[1]; that part of the chamber having afforded (apparently at a former period) the best communication with the ambient fluid: but a calcareous deposit having almost entirely cut off that communication, the animal appears to have been compelled to secrete a second shelly plate towards the anterior ventral edge of the fixed valve, where the perforation of some other shell (a *Lithodomus* probably) secured the necessary influx of the water[2]. Nor is this the only instance of the secretion of a second tubular plate which has fallen under my notice.

In the last-mentioned or smaller specimen, the perforated shelly plate joins the anterior ventral edge of the fixed valve laterally[3], that point of the chamber being evidently the most practicable for communicating with the water by means of the tubules: the rest of the anterior edge of the fixed valve is surrounded by the coral wall.

In Mr. Cuming's specimen the fixed valve is continued on to the tube[4]. The anterior edge of this valve is surrounded by the naked wall of the chamber, and the greater end of the chamber, or that part of it which is opposite to this anterior edge, being impracticable, from its thickness, as a water communication, (with a small exception[5], which, not improbably, had ceased to be available,) the animal has been driven to secrete the perforated shelly plates not far from the throat of the tube on either side, where the chambers of *Petricolæ* or *Lithodomi* opened a passage to the surrounding water[6]. As a further proof of this, Mr. Owen informs me that the mantle is torn at these particular points.

I feel the difficulty of laying down specific characters from the specimens belonging to Mr. Goldsmid and Mr. Cuming. The tubes, or siphonic sheaths, of each of them are broken, and nothing is left sufficiently distinct to show the form of the aperture when it was perfect. The valves being nearly, perhaps altogether, excluded from the light, colour, at best but a treacherous guide, is absent entirely. I cannot conceal from myself that the shape of the chamber and of the valves, together with the comparative roughness or smoothness of their outer surfaces, may depend upon the greater or less degree of hardness of the material in which the chamber is formed. With such data, however, as these specimens afford, I shall endeavour to characterize them; and if, hereafter, they should prove to be mere varieties, the descriptions and drawings may at all events assist in elucidating the natural history of the genus.

[1] Plate xxxv. Fig. 1. *e*.
[2] Ibid. Fig. 2. *e*.
[3] Ibid. Fig. 2. *x*.
[4] Plate xxx. Fig. 8. *d*.
[5] Ibid. *e''*.
[6] Ibid. *e'*, *e'*.

Clavagella elongata.

Tab. XXXV. Figg. 1—4.

Clav. camerâ elongato-ovatâ; valvâ liberâ elongatâ, subtrigonâ, convexâ, externè concentricè valdè rugosâ, intùs nitente; umbone acuto.

Hab. in Oceano Pacifico?

Mus. Goldsmid.

The *Astræopora* in which this *Clavagella* is chambered approaches very closely to one brought by Mr. S. Stutchbury from Bow Island, or Hao, in the Pacific Ocean, and I have therefore suggested that Ocean as its probable locality. The wall of the coral chamber against which the free valve rested, gives as exact an impression of the external rugosities of that valve as if it had been applied to a surface of wax.

Clavagella lata.

Tab. XXX. Figg. 8—10 (Testa); 11—16 (Animal).

Clav. camerâ rotundato-ovatâ; valvâ liberâ latiusculâ, subtrigonâ, subconvexâ, externè concentricè rugosâ, intùs nitente; umbone subrotundato.

Hab. in Oceano Pacifico.

Mus. Cuming.

Both valves are nacreous internally, and the muscular impressions[1], especially in the fixed valve, are very strong.

Clavagella Melitensis.

Tab. XXXV. Figg. 5—8.

Clav. testâ subrotundatâ, rugosâ, intùs subnitente; tubo longitudinaliter corrugato.

Hab. ad Melitam.

Mus. Cuming, Miller.

Mr. G. B. Sowerby, finding that I was writing upon this subject, forwarded to me, with his usual liberality, two specimens of *Clavagella* from Malta. They are in an argillo-calcareous tufa? One of them belongs to Mr. Cuming, the other to T. Miller, Esq., Surgeon R.N., who brought them to this country.

The loose valve of Mr. Cuming's specimen[2] is not so much rounded as that of Mr. Miller's[3], nor are its corrugations so large and distant. Mr. Cuming's specimen has a considerable portion of the longitudinally corrugated tube[4] still projecting from the rock; but Mr. Miller's appears to have been abraded till it became even with the sur-

[1] Plate xxx. Figg. 8 & 10, f'., g'., & h'.

[2] Plate xxxv. Fig. 5.

[3] Ibid. Figg. 6—8.

[4] Ibid. Fig. 5. *a*.

face. The inside of the loose valve of the latter specimen[1] is almost nacreous, and the distant and broad corrugations appear upon the internal surface. In both, the casts of the backs of the loose valves may be seen on the stony chamber as if they had been impressed on wax. A great portion of the fixed or "soldered" valves, which are continued on to the tubes in both specimens, appears to have been surrounded by the naked chamber; and the situation of the secretion of the tubules[2] (the area of which is very extensive in Mr. Cuming's specimen) appears to have been varied according to the necessities of the case. In Mr. Miller's specimen, a perforated shelly plate is situated close to the tube and to the *umbones* of the valves[3], so that it comes against the upper part of the back of the loose valve, which almost hides it from view when in its place; and tubules are visible at various points.

We are left to conjecture the causes which operate to determine the animal in the choice of its abode, if indeed it can be called choice, for most probably *Clavagella* is the creature of circumstances; and if, soon after its exclusion from the parent, (when I suppose it to be furnished with its two valves only, and to float free, with some voluntary impulse perhaps,) it arrives at the vacant hole of some small *Petricola*, *Lithodomus*, or other perforating *Testacean* which suits it, one valve soon becomes attached to the wall of the hole, and then the animal, being sedentary, proceeds to secrete the siphonic sheath or tube, to enlarge the chamber according to its necessities, and to form the shelly perforated tubular plate which is to give admission to the water at the practicable part of the chamber.

How the excavation is carried on is also a matter of doubt. The chambers of the individuals of *Clav. Australis* were formed in a siliceous grit, those of *Clav. elongata* in the substance of an *Astræopora*, that of *Clav. lata* in a calcareous grit, and those of *Clav. Melitensis* in an argillo-calcareous tufa. If the excavation be the work of a solvent secretion, it must be a solvent of extensive power. The situation of the glands detected by my friend Mr. Owen, leads me to think that they minister in some way to this operation; and I do not see how the anterior or greater end of the chamber, at all events, can be operated on by mere mechanical attrition with such parts as must have been contiguous to it.

It has been objected that any solvent which would act on a calcareous rock would equally act on the calcareous shell of the animal; but there is, perhaps, more of point than of strength in this objection. Without laying too much stress on that law of nature by which chemical and vital forces are placed in a state of hostility[4], and which may or may not be applicable to such a substance as shell, the gland for the secretion

[1] Plate xxx. Fig. 7. [2] Ibid. Figg. 5, 6. [3] Ibid. Fig. 6. *a*.

[4] John Hunter's paper in the 'Philosophical Transactions' for the year 1772, "On the Digestion of the Stomach after Death," and Spallanzani's experiments on that organ, will readily occur to the reader.

of the supposed solvent, as well as the organ for applying it, may be so placed as that the solvent shall only come in contact with the inorganic or dead substance to be acted on, without touching the shell.

Again, it has been asked, what solvent would act equally on a calcareous and on a siliceous substance? To this it may be answered, first, that it is not pretended that the nature of the supposed solvent is known; secondly, that, in siliceous grits, there is more or less calcareous matter by which the mass is held together, and that the solution of the calcareous particles would be followed by the disintegration of the stone.

The fossil species are numerous, and as yet do not appear to have been detected below the supracretaceous group. One observation, arising from the various depths at which the recent species have been found, will not perhaps be deemed irrelevant. *Clav. Australis* was so near the surface at low water, that it was detected by its ejection of the fluid; *Clav. elongata*, from the nature of the coral in which it is chambered, could not have been living far beneath the surface; whereas *Clav. lata* was dredged up from a depth of sixty-six feet. Any inferences, therefore, as to the state of submersion of a rock during the life of the fossil species of *Clavagella* which there occur, should be made with caution by the geologist.

In conclusion, it may be observed, that though this genus is now rare in cabinets, it is, in all probability, widely diffused; and collectors cannot be too astute in examining masses of coral and submerged perforated rocks, with a view to the further elucidation of the habits and structure of these interesting animals.

PLATE XXXV.

Figg. 1, 2. The interior of the two parts of Mr. Goldsmith's specimen of *Astræopora*, containing two individuals of *Clavagella elongata*. The several points represented at α, β, γ, δ, come in contact when the two parts are placed together.

1. *a*. Anterior wall of the cavity in which the larger individual is situated.
   - *d*. Broken termination of the posterior tube or siphonic sheath.
   - α. Anterior portion of the cavity of the smaller individual.
   - β. Portion of a cavity occupied by a *Petricola*.
   - γ. Anterior edge of the wall of the coral chamber.
   - δ. A broken group of *Serpulæ*.
   - *e*. Insulated shelly plate, with tubular perforations at the anterior end of the ovate chamber.
   - *a'*. Fixed valve imbedded in the coral.
2. α. Cavity of the smaller individual.
   - +. Perforated shelly plate of the anterior ventral edge.

β. Portion of a cavity occupied by a *Petricola.*

γ. Portion of the cavity of the larger *Clavagella elongata.*

δ. Broken group of *Serpulæ.*

e. Group of tubules proceeding from the insulated shelly plate, fig. 1. *e.*

Fig. 3. Internal view of the free valve of *Clavagella elongata.*

4. External view of the same.

5. Mr. Cuming's specimen of *Clavagella Melitensis.*

d. Termination of the posterior tube or siphonic sheath.

e. A large group of tubules opening into the perforated shelly plate, at the anterior ventral part of the cavity.

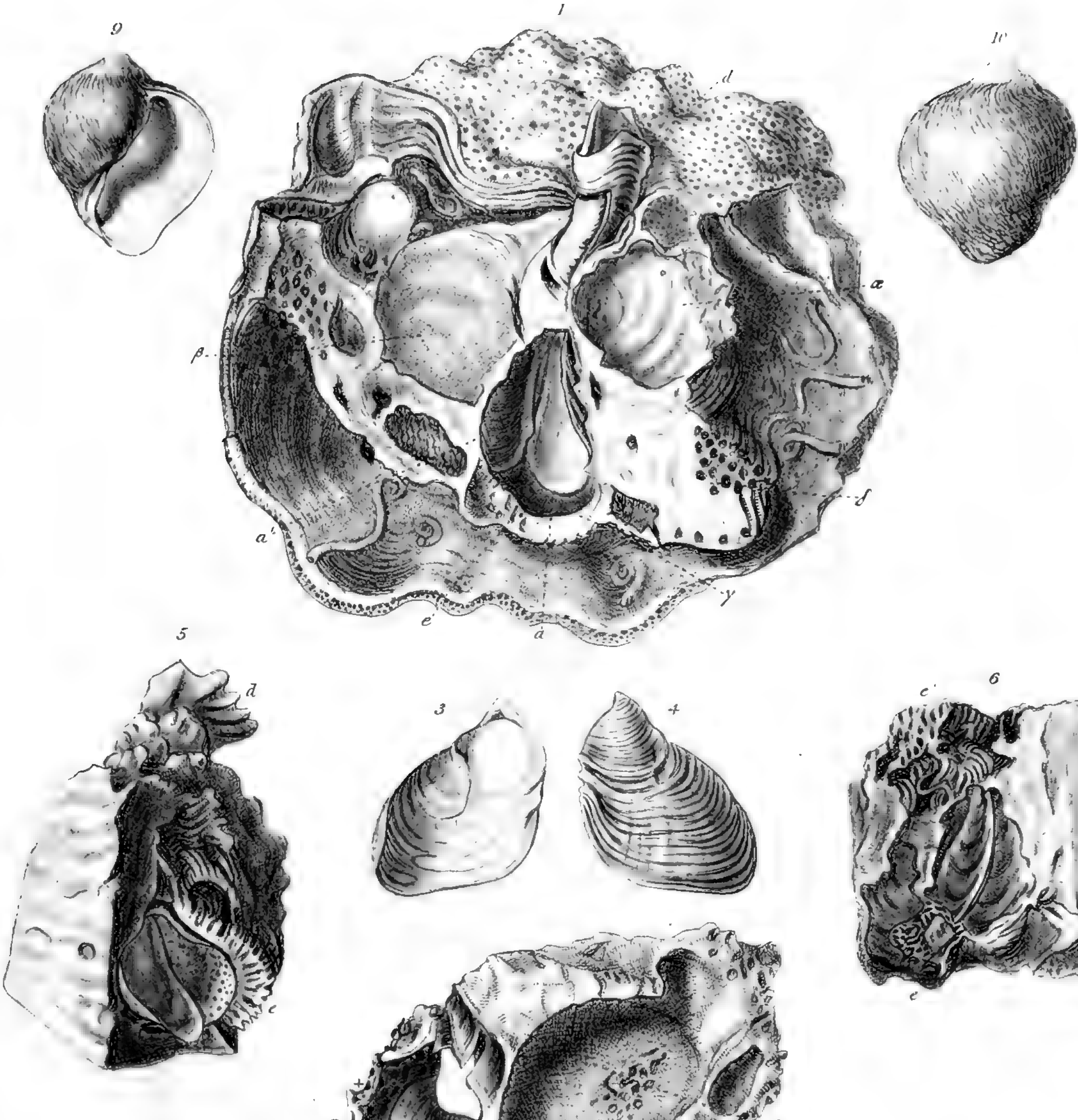
6. Mr. Miller's specimen of *Clavagella Melitensis.*

e'. A large group of tubules opening into the perforated shelly plate on the right side of the throat of the posterior tube.

e. Another group of tubules opening into a perforated shelly plate at the anterior part of the cavity.

7. Internal view of the free valve of Mr. Miller's specimen of *Clavagella Melitensis.*

8. External view of the same.



G.B. Sowerby. del. et sc.

1-4. Clavagella elongata. 5-8. Clavagella Melitensis.
9-10. Leptoconchus striatus.

XXIX. *On the Anatomy of* Clavagella, *Lam.* *By* Richard Owen, *Esq., F.R.S. & Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated September 23, 1834.

THE specimen of *Clavagella* which forms the subject of the following description was dredged up by Mr. Cuming, and belongs to the species which my friend Mr. Broderip has characterized and named *Clavagella lata.*

The soft parts of this specimen were placed in spirit by Mr. Cuming soon after it was captured, and were thus transmitted in good state for examination to this country. They differ considerably from the form which the soft parts commonly assume in other *Bivalves*, being, as it were, aggregated into an irregular quadrate, or transversely oblong mass, convex anteriorly, compressed laterally, and contracting towards the posterior end of the body, which is formed by the smooth rounded *siphon* containing the anal and branchial canals. The exterior layer of the mantle, which envelopes the soft parts, is a thin lacerable membrane, with two openings, one anterior, contracted to a very small size, for the passage of the rudimentary foot, the other posterior, corresponding to the respiratory and excremental outlets.

When the soft parts are replaced in their natural position in the clavate chamber[1], and exposed by the removal of the outer layer of the mantle, they present the appearance delineated in Plate XXX. Fig. 11. Much less of the organization of the animal is by this means brought into view than in most other *Bivalves*, in consequence of the great development of the muscular margin of the mantle. The true foot is wholly concealed, and only the extremities of the labial appendages and a small part of the right gill are seen protruding through the interval between the anterior muscles of the mantle and those which go to form the *siphons*: a small part of the ovary may be seen between the anterior and posterior adductor muscles.

The relative position of the animal of *Clavagella* to the rocky chamber which it inhabits is as follows. The mouth is turned towards the closed end of the chamber marked *a*, which is consequently the anterior part. The heart and *rectum* are nearest the side where the valves are connected by the ligament *b*, or the dorsal part: the visceral mass projects towards the opposite or ventral side *c*, while the *siphon* extends into the commencement of the calcareous tube *d*, which leads out of the anal or posterior part of the chamber. The fixed valve, which covers the rough surface of the porous rock or coral, like the tiling of a chamber floor, and affords a smooth polished surface for the support and attachment of the animal, is the left valve: the right valve

[1] Plate xxx. Fig. 8.

remains free, or is connected only to the soft parts and cardinal ligament, in order to assist in the excavating and respiratory actions.

That these actions are of a powerful kind is to be inferred from the remarkable development of the muscular system in the *Clavagella*. The impression of the great or posterior adductor[1] is carried 2 lines beneath the surface of the chamber posteriorly, but gradually rises to the level of the valve. The impression of the smaller anterior adductor[2] is fainter, and is continued into the sinuous pallial impression[3], which follows the contour of the anterior margin of the valve at about 2 lines' distance from it. In the free valve[4] the last two muscular impressions are separate.

The shelly substance of the fixed valve passes without interruption into that of the tube: a slight ridge circumscribing the entry of the tube into the chamber may be regarded as the line of separation; unless the extent of the valve be limited to that of the internal nacreous deposition.

The area of the tube is of an oval form, in diameter 7 lines by 5. The calcareous *parietes* are $\frac{1}{50}$th of an inch in thickness at the outlet of the tube, and about $\frac{1}{30}$th at the opposite extremity. As far as it is preserved in the present specimen no perceptible increase is recognizable as it approximates the chamber.

The free valve is an unequal triangle, with the angles rounded off, about the thickness of a sixpence, moderately concave towards the soft parts, striated only in the direction of the layers of increment on the outer surface, as in most of the *Pyloridean Bivalves* of M. de Blainville. The layers of increment of the free valve gradually increase towards the dorsal edge for a little more than one half of the valve, beyond which the layers continue of almost equal breadth. This growth of the valve corresponds to the direction in which the chamber is enlarged, which is principally on the dorsal, dextral, and anterior sides: now this is the mode of enlargement best adapted for the full development of the ovary; so that it would seem that the *Clavagella* continues for a certain time to work its way into the rock without material increase of size, leaving behind it a calcareous tube, which marks its track; after which it becomes stationary, and limits its operations to enlarging its chamber to the extent necessary for the accomplishment of the great object of its existence.

The mantle envelopes the body like a shut sac, but is perforated, as before mentioned, for the *siphon* and foot, the opening for the latter part being reduced to a small slit[5]. An analogous orifice was observed by M. Rüppell in the corresponding part of the mantle of *Aspergillum*, viz. that which is next the sunken sieve-like extremity of the tube, and by which he supposes the water necessary for respiration to be received when the retreating tide leaves exposed the expanded siphonic extremity.

This cannot, however, be its use in such species of *Clavagella* as reside, like the present, at depths too great to allow of their being ever left with the siphonic aperture

[1] *f'*. Figg. 8, 10.
[2] *g'*. Figg. 8, 10.
[3] *h'*. Figg. 8, 10.
[4] Figg. 8, 10.
[5] *. Figg. 12, 13, 14.

out of water. It must serve, however, to keep up a communication between the chamber and its inhabitant; and it is seen that the chamber has always a communication with neighbouring cavities in the rock by means of the calcareous *tubuli*[1], the formation of which is determined by the proximity of those cavities. When, therefore, the *Clavagella*, by a sudden contraction of its adductor muscles, has forcibly expelled the branchial currents from the *siphon*, as was observed to take place by Mr. Stutchbury, the space between the free valve and the walls of the chamber would be simultaneously filled, either by water rushing in through the *tubuli*, or forced out from the branchial cavity through the small anterior orifice of the mantle.

The outer dermoid layer of the mantle is extremely thin, and where it does not line the valves it is mottled with minute dark spots, less numerous than those on the skin of *Cephalopods*, and presenting a glandular appearance under the microscope. The muscular layer, after forming the *siphon* and its retractors, is confined to the anterior part of the mantle, where it swells into a thick convex mass of interlaced and chiefly transverse fibres, attached to the valves along the sinuous submarginal depression above mentioned, and forming, I should suppose, one of the principal instruments in the work of excavation. No fibres could be detected in other parts of the mantle; nor could any longitudinally radiating muscles be expected in a mantle which had no lobes to be retracted.

The *siphon*, in the contracted state which it presented in the specimen, formed a slightly compressed cylindrical tube, half an inch in length, and the same in the long diameter. It is traversed longitudinally by the branchial and anal canals, which are separated from each other by a muscular *septum*, extending to the end of the *siphon*, beyond which the two tubes do not separately extend outwards; and in this respect *Clavagella* agrees with *Gastrochæna* and *Aspergillum*. The muscular *parietes* of the *siphon* were 2 lines in thickness; the *septum* separating the branchial and anal canals was 1 line in thickness; the diameter of each canal about 1 line: the inner extremity both of the anal and respiratory tube is provided with a valvular fold. Their terminations are beset with short *papillæ*. The retractor muscles attach the *siphon* to the posterior adductor on one side, and to the anterior extremity of the oval mass of muscular fibres above mentioned on the other, leaving an intermediate space on both sides the body, which exposes part of the gills and labial tentacles. The muscular mass which bounds the anterior part of the animal's body is of an oval form, 1 inch 3 lines in length, 8 lines in breadth, and varying in thickness from 2 to 3 lines: it is smooth and convex externally, and hollowed out within to lodge the *viscera* at the base of the foot, for the passage of which it leaves the small orifice above mentioned. The margins attached to the valves are more or less irregular; that which is affixed to the loose valve is the broadest, being at the ventral extremity 3 lines in breadth; it may here be regarded as a third adductor. Posteriorly it is continued into the small adductor muscle. This muscle is marked

[1] *e.* Fig. 9.

in Figg. 11 & 12: the great adductor is marked *f*. Their chief peculiarity is their powerful development in so small a *Bivalve*.

The digestive system of *Clavagella* accords with the structure of the same part in other *Acephalous Mollusks*. The mouth[1] is a transverse slit, the upper and lower labial boundaries of which are continued in the form of two transversely striated pointed *tentacula*[2] on either side: each of these prehensile, sensitive, and probably respiratory organs measures 6 lines in length and about 1½ line in breadth. No masticatory or salivary organs are connected with the mouth; the *œsophagus*, after a course of 2 lines, dilates into a stomach[3], the sides of which are perforated by the large hepatic ducts. The intestine, after a course of 8 lines, forms a small *cæcum*[4] about 1 line in length: this may be the rudiment of a *pancreas*; or perhaps is the analogue of the blind sac containing the peculiar amber-coloured style, which projects into the pyloric end of the stomach of some *Bivalves*. The little *cæcum* here contained the same brown granular material as distended the rest of the canal. The intestine, after making three close turns upon itself in the mass of *ova* and hepatic follicles at the base of the foot, passes in immediate contact with, but not through, the heart, and then below the posterior adductor, to opposite the posterior orifice of the anal tube. The exterior of the intestine has an irregular honeycombed appearance, from the close adhesion to it of the capsules of the *ova*. The liver[5] has the same divided follicular structure and green colour as in other *Bivalves*.

The gills have the same laminated structure as in other *Bivalves*; they are broad and short, corresponding to the form of the animal; and the *laminæ* are arranged in three layers instead of two on either side the foot.

These rows of *laminæ* are not thin compressed layers, but are broad, and project little from the sides of the visceral mass. They commence at the sides of the mouth, between the labial appendages, and extend backwards towards the inner orifice of the respiratory tube, where they meet, join, and terminate in a point, which is unattached for about one eighteenth part of the entire gill. The branchial veins are continued from the concave side of the gills, a few lines behind their anterior extremities: these veins are joined by others from the muscular part of the mantle, and then terminate in two large membranous dark-coloured auricles. These communicate with a fusiform ventricle, single externally, but divided within, by a longitudinal *septum*, into two compartments, corresponding to the auricles; which compartments communicate together at the *apex* of the ventricle, from which the principal artery is continued.

A large and conspicuous nervous *ganglion* is situated at the posterior part of the base of the foot, just above the orifice of the anal tube. Two nervous cords extend from this *ganglion* on either side the foot to the mouth: other branches radiate in the opposite direction to the siphonic and adductor muscles.

[1] *o*. Fig. 16.
[2] *n*. Figg. 11, 12, 13, 14, 16.
[3] *q*. Fig. 16.
[4] *r*. Fig. 16.
[5] *w*. Fig. 16.

The ovary[1] is of a grey colour, forming a mass at the dorsal aspect of the body above the great adductor muscle, and extending ventrad on either side the *œsophagus* and stomach to the opposite end of the base of the foot.

All this mass of intestinal folds, hepatic follicles, and *ova* was covered by a thin membrane. The little muscular process, or foot[2], which passes through the anterior slit of the mantle is but 4 lines long, and half a line in breadth: its possible use may be to apply a solvent to the rock in which the chamber is excavated.

The organization of *Clavagella*, like that of *Aspergillum* described in the 'Reise von Afrik' of Dr. Rüppell, is thus seen to be modelled on the type of the *Acephalous Bivalves*, and follows most closely, in the variations from that type, the modifications which have been observed in *Gastrochæna*.

The lengthened worm-like figure of *Aspergillum* is exchanged in *Clavagella* for a shorter form, with greater lateral development: and instead of the small rudimentary valves, which are enchased, as it were, in the calcareous sheath of *Aspergillum*, we find them here largely developed, and one of them always remaining at liberty, to be applied by a powerful muscular apparatus to those offices which are essential to the forcible expulsion of the fluid in the branchial cavity, and probably to assist in the excavation of its secure abode.

PLATE XXX.

Fig. 8. A portion of the rock (calcareous grit), containing the attached valve and part of the tube of *Clavagella lata*. The chamber has been so laid open as to show its greatest dimensions, both in length and breadth.

9. Outside view of the right or free valve of the same specimen.

10. Inside view of the same, showing the corresponding muscular impressions to those of the left or fixed valve.

11. Soft parts of *Clavagella lata* viewed from the right side, the dermal layer of the mantle, *e*, being removed.

12. Soft parts of *Clavagella lata*, seen from the left side, or that which is in contact with the fixed valve. (The extremities of the left labial appendages only are here seen, no part of the gill being protruded. A bristle is placed in the *rictus*, or opening of the mantle.)

13. Anterior view of the soft parts of *Clavagella lata*, after the removal of the outer or dermal layer of the mantle.

14. The same, with the anterior muscular mass reflected to show its internal surface; the visceral mass, composed of the liver *w*, intestine *s*, and ovary *x*, from which the foot *y* is continued.

15. Posterior extremity of the *siphon*.

16. The principal *viscera* displayed.

[1] *x*. Figg. 12, 14.

[2] *y*. Fig. 14.

The same letters indicate the same parts in each figure.

a. Anterior wall of the chamber.
b. Dorsal wall. The letter is placed on the hinge of the fixed valve.
c. Ventral wall.
d. Posterior or siphonic outlet.
e. Tubular communications with a neighbouring cavity, here sent off from the posterior part of the mantle.
e', *e'*. Calcareous tubes secreted by the above processes and extending into the cavities contiguous to the throat of the tube.
e''. A cavity communicating with the anterior part of the chamber.
f'. Impression of the posterior adductor muscle.
g'. Impression of the anterior adductor muscle.
h'. Impression of the pallial muscle, or third adductor.
f. Posterior or large adductor. (The single adductor of the *Ostracea*, &c. corresponds to this. The following are superadded in other families of *Bivalves*.)
g. The anterior, antero-dorsal, or smaller adductor.
h. The pallial or antero-ventral adductor.
i. The convex muscular mass continued over the anterior part of the body, and reducing the *rictus* of the mantle to the small slit *, through which a bristle is placed in fig. 12. (This mass is an inordinate development of what forms the muscular margins of the mantle lobes in other *Bivalves*.)
k. Muscular fibres of the *siphon*.
l. The respiratory, or ingestive, siphonic canal.
m. The anal, or egestive, siphonic canal; *m'*. (fig. 16.) its valve. (These are indicated by bristles in fig. 14.)
n, *n*. The labial or buccal appendages.
o. The mouth, exposed by dividing the superior labial process.
p. The *œsophagus*.
q. The stomach, showing the orifices of the hepatic ducts.
r. The *cæcum*.
s. The intestine.
s'. The *anus*.
t. The gills: in fig. 11 the right gill is seen partially protruded between the muscular parts of the mantle.
u, *u*. The auricles, *v*. the ventricle, of the heart.
w. The liver surrounding the *œsophagus*, the stomach, and part of the intestine.
x. Part of the ovary.
y. The foot.

XXX. *On* Nycteribia, *a Genus of Wingless Insects. By* J. O. Westwood, *Esq., F.L.S., &c. Communicated by the Secretary.*

Read November 25, 1834.

In every group of animated nature, even down to the ranks of families and genera, there exists a certain number of objects (generally of limited extent) which, from the anomalous character of their organization with reference to that of the group to which they naturally belong, have not ceased to perplex the systematist as to their true situation. If this has been the case after the real nature of their organization has been made known, the difficulty has been far greater when, unaided by the light of minute analysis, the naturalist has contented himself with a rapid *primâ facie* examination.

Thus, if we look at the great divisions of the Animal Kingdom, we find the *Tunicata*, *Cephalopoda*, *Zoanthida*, *Cirripeda*, and *Annelida* affording examples of such groups. If we descend a step, we find the *Pycnogonida*, *Oniscida*, *Stomapoda*, *Nycteribia*, and the *Trilobites* oscillating amongst the classes of the *Annulose* subkingdom; while in like manner the *Strepsiptera* and *Dermaptera*, and the families *Thripsidæ* and *Pulicidæ* amongst the orders of the *Ptilota*, and the genera *Zoea*, *Nebalia*, *Hippa*, *Mysis*, *Limulus*, *Nymphon*, *Galeodes*, &c. amongst those of the *Aptera*, have afforded endless opportunities for exercising the ingenuity of systematists. To carry the observation still lower among the families of an order, I need only refer to such genera as *Omophron*, *Urania*, *Xyela*, *Trictenotoma*, *Acentropus*, &c.

With respect to such groups, it is to be noticed that they seem to be generally characterized not only by their limited extent, but also by the comparative smallness and rarity of the objects composing them; and that they appear to constitute a series of stepping-stones whereby the transition from the structure of one group to that of the adjoining ones is effected, many of them, in fact, forming the osculant groups of the 'Horæ Entomologicæ'. Another peculiarity seems to consist in the generally unattractive appearance of the objects of which they are composed, which has caused them (notwithstanding the great interest possessed by them on account of the peculiarity of their characters) to be comparatively neglected by the majority of authors.

Among these groups, perhaps no more striking instance could be adduced than the genus *Nycteribia*, Latr., inasmuch as we here find a single genus, considered as osculant, not between the families, or even the orders of a class, but between two of the classes themselves of the *Annulose* subkingdom; thus, while Hermann, in his 'Mémoire

Aptérologique', regarded it (under the name of *Phthiridium*[1]) as one of the *Aptera*, and Dr. Leach, in the 'Supplement to the Encyclopædia Britannica,' formed for its reception a distinct order, *Notostomata*, in the class *Arachnides*,—Latreille, with that remarkable sagacity which he so constantly displayed, placed it in the order *Diptera*, next to *Hippobosca*, with the remark, "on croiroit que c'est une araignée à six pattes." Hence Mr. MacLeay regarded it as occupying the osculant situation betwen the classes *Arachnida* and *Haustellata*.

But the genus *Nycteribia* is worthy of the attention of the naturalist on account of another peculiarity. To say that the insects of which it is composed are parasitic upon certain *Vertebrata*, would be insufficient to distinguish it from numerous other parasites; but when it is stated that this genus is exclusively confined to that equally anomalous group—*Quadrupeds* we can scarcely call them—the *Chiroptera*, the evident intention of Nature in preserving the system of osculant divisions cannot be overlooked.

Many of the singular peculiarities of structure of this genus have been ascertained and described by some of the most celebrated entomologists, and the memoir of Hermann above noticed, that of Dr. Leach inserted in the 'Zoological Miscellany'[2], the article *Nycteribie* by Latreille in the 'Nouveau Dictionnaire d'Histoire Naturelle'[3], the memoir by M. Leon Dufour upon this genus published in the 'Annales des Sciences Naturelles' for April 1831, and the figure and description of *Nyct. Latreillii* contained in Mr. Curtis's 'British Entomology'[4], are especially to be referred to.

Still, however, some of the most important characters of these insects remain involved in uncertainty, either from the silence of authors respecting them, or from the inaccurate or insufficient manner in which they have been described: among which are to be noticed the nature of the transformations which they undergo; the distinction of the sexes, and consequently the sexual characters and the different organization of the *abdomen* in the sexes; the structure of the mouth, *antennæ*, and eyes; the separation of the *metasternum* and *abdomen*; the situation and construction of the spiracles; and the nature of the serrated organs between the base of the anterior and intermediate legs: upon all which points I hope to be able to offer to the entomologist satisfactory details.

For the materials enabling me to do this, I have to express my obligations to Lieut.-Colonel W. H. Sykes, who has kindly permitted me to examine three female specimens of the largest species of the genus, brought home by himself from the East Indies, and preserved in spirit; to the Rev. F. W. Hope, for permission to examine two male specimens of a large species from Bengal; to the Rev. Leonard Jenyns, who has presented me with a male of a very distinct and moderate-sized species from China pre-

[1] Published in 1804. Latreille had previously established the genus under the name of *Nycteribia* in his 'Précis des Caractères Génériques', 1795, and in his 'Histoire Naturelle des Insectes et des Crustacés', tom. iii. An X. (1802).

[2] Vol. iii. [3] Nouv. Edition, 1818. [4] Plate 277.

served in spirit; to J. F. Royle, Esq., who has permitted me to examine a smaller Indian species collected by himself; and to J. F. Stephens, Esq., who has granted to me the loan of his specimens of *Nyct. Hermanni* and *Nyct. Latreillii*, which he obtained from Dr. Leach himself. I have likewise examined Dr. Leach's three specimens of his *Nyct. Latreillii*, three of his *Nyct. Hermanni*, a specimen apparently of the latter species received by him from Bonelli, and the original specimen of his *Nyct. Blainvillii*, all contained in the cabinets of the British Museum.

As Colonel Sykes's specimens have afforded the clue to the determination of the sexes, in consequence of their being in different stages of gestation, and as they are of a large size, and moreover preserved in spirit, thus affording the means of a more satisfactory examination, I propose, in the first place, to notice their structure in detail, comparing it with that of the already described species, and endeavouring to clear up the various difficulties existing in the works of previous observers; in the second, to describe more concisely the structure of the other species which I have myself examined; and in the third place to attempt a synopsis of the various species.

The three individuals of Colonel Sykes's East Indian species, which I have inscribed with his name, vary somewhat in size, according to the degree of gestation, from 2 to $2\frac{1}{2}$ lines in length, and about 7 lines between the extremities of the anterior and posterior legs when stretched out.

The body is of a crustaceous texture, with the exception of the *abdomen* and upper teguments of the *thorax*, which are of a leathery nature.

The head (contrary to the character given of the family by Dr. Leach, "Head united with the *thorax*,") is a very distinct part of the body, although when at rest it is thrown backwards, its upper surface being brought into contact with the dorsal membrane, and its under surface consequently being upwards. It is affixed to the anterior part of the *dorsum*, a short distance behind its front margin, by means of a leathery attachment, which, when dried, assumes the appearance of a distinct neck, thus enabling us to account for Latreille's statement of the head of his misnamed *Nyct. Blainvillii* being "emplanté, au moyen d'un article très court, servant de pedicule, sur le dos du thorax;" by this means the head is not only raised perpendicularly, but is also advanced in front until it assumes a horizontal direction. The head itself is small, and, as Latreille has well described it, in the form of a reversed cone; but it is crustaceous, and not coriaceous. M. Dufour states that its place of insertion is "dans l'échancrure antérieure du corselet justement entre les hanches des pattes de devant;" but in no individual which I have examined is the anterior margin of the *thorax* at all emarginate, being on the contrary quite rounded, and the head affixed behind rather than between the fore legs. The anterior superior margin of the head is slightly emarginate, but much more deeply on the under side, where the large base of the central apparatus of the mouth is attached. The upper margin (forming the base of the reversed cone) is furnished with *setæ*, the remainder of the head being smooth and depressed.

In all the three individuals under examination, on each side of the head, near the anterior angles, an eye is placed, composed of two small raised black tubercles. Latreille describes these organs in his *Nyct. Blainvillii* as possessing a somewhat similar construction, being "noir et composé de petits grains réunis;" but Mr. Curtis characterizes the genus with "eyes and ocelli none?"; and M. Dufour, in his description of the species which he names *Nyct. Vespertilionis*, seems to consider Latreille's account erroneous, stating that the eye in that species is "d'un blanc grisâtre, très-lisse et parfaitement simple." We shall subsequently see, from the description of my Chinese species, that both Latreille and M. Dufour are correct.

Fabricius, Hermann, and Mr. Curtis characterize the genus as being destitute of *antennæ*; and M. Dufour states that "les investigations les plus scrupuleusement réitérées ne m'ont pas fait découvrir le moindre vestige d'antennes" in his *Nyct. Vespertilionis*. Latreille, however, describes his *Nyct. Blainvillii* as being furnished with two *antennæ*, inserted in the superior emargination of the front of the head, very short, contiguous, advancing parallelly, and two-jointed, the last joint being the largest, and subtriangular, but rounded externally. M. Dufour therefore considers, without much regard to the weight of analogy, that these organs are exclusive to *Nyct. Blainvillii*. In the species under examination they exist precisely in the form described by Latreille, which I need not repeat; as well as in all the individuals of other species which I have been able satisfactorily to examine. As these organs are flat and closely applied together at the interior margin, we may probably not be far from correct in considering that M. Dufour has overlooked them as distinct organs, regarding them as the produced front of the head.

The structure of the mouth next demands our attention. The description of it given by Fabricius is very inaccurate, since he describes it "os parum prominens—vaginâ bivalvi—valvulis obtusiusculis—palpi triarticulati," &c. With the exception of the two large external organs, which they have considered as *palpi*, Latreille and M. Dufour were unable to ascertain the structure of the oral apparatus; and the figure given by Mr. Curtis of the head does not convey an adequate idea of its organization.

At the lateral anterior margins of the head, and extending beneath a short distance into its inferior emargination, are attached a pair of elongated crustaceous organs, strongly setose, which are advanced in front of the head, with their extremities somewhat dilated and brought into contact, serving, in fact, as a lateral defence of the *antennæ*. Their interior surface is smooth; but the external *setæ* vary considerably in length, some of them being as long as the organ itself, and having a divergent direction. As to the nature of these organs I may observe, that having discovered the existence of distinct *antennæ*, I am not compelled to enter with M. Dufour into those philosophical speculations as to the gradual degradation and transposition of the functions of various organs which originated in the supposed want of *antennæ*, and the employment of the supposed *palpi* as such. By Mr. Curtis they are doubtingly considered as *maxillæ*; which term he also in like manner applies to the two protruded lateral organs of the mouth of the *Hippoboscidæ*. That these organs are perfectly analogous, Latreille had long ago implied by describing them both under the same dubious appellation, "*palpi?*" As to their real analogies among the organs of a mandibulated mouth, I however offer no opinion, observing only that in defending the delicate central inferior spiculate apparatus of the mouth, they appear to perform the functions of the articulated sheath of the *rostrum* of the *Hemiptera*. This apparatus of the lower part of the mouth of *Nycteribia* consists at first sight of a large basal bulb-like organ, terminating in an elongated slender and horny style, precisely similar, in fact, to the same organ in *Hippobosca*. On each side of the base of the style, in the species under examination, there are two or three fine hairs as long as the style itself. The style in two individuals appeared to be composed of two demi-sheaths, although in the other specimen it formed only a single undivided canal, which from analogy with *Hippobosca* is evidently its real construction. It is not a simple organ, but contains, like its representative in *Hippobosca*, several *setæ*. I found that it inclosed at least two *setæ*, of equal length with the canal itself, one of which was more robust than the other; indeed in one specimen the more robust one appeared divisible into two *setæ*, while in another this was not only the case, but the more slender one also presented the same appearance. Analogy, however, with *Hippobosca* would induce us to suppose that there are but two *setæ*, as above described, inclosed in the canal. Latreille, quoting the observation of Hermann that he had not clearly observed the structure of the mouth, but had noticed four *palpi*, two short and thick, and two longer and more slender, excuses the supposed inaccuracy of that author on account of the minuteness of the animals. It is evident, however, from Hermann's figures that the two short and thick organs were the *antennæ*.

The *thorax* exhibits a very remarkable structure. It is flat, and of a form somewhat between oval and round; its upper surface is of a whitish coriaceous substance, divided into compartments by narrow crustaceous ridges. This structure was admirably described by Linnæus under the term "thorax angulatus cruciatus;" notwithstanding which, Hermann, evidently judging from the inaccurate figures referred to by Linnæus, conceived that the description was not intended by that author for an insect of this genus. The inferior surface extends in a plate beneath the place of insertion of the legs, the *femora* of which are consequently prevented from being brought below the level of the under surface of the *thorax*, although they possess a considerable power of upward motion, this being effected by the soldering of the *coxæ* and trochanters of the four hind legs with the dorsal region of the *thorax*, whereby, as Latreille observes, the back of the *thorax*, in fact, becomes the breast. On examining the anterior and superior extremity of the *thorax*, a minute raised line is seen to extend in a curved direction on the outside of the base of the fore legs, immediately behind the place of insertion of the head, somewhat in this shape, . Taking, therefore, into consideration the almost rudimental state of the *prothorax* in the true *Dipterous Insects*, it seems clear (especially when the remaining portions of the *thorax* are examined) that the space inclosed by this fine line constitutes all that remains of the *prothorax*, giving insertion, however, to its ordinary attachments, viz. the head and the pair of anterior legs.

The central portion of the *dorsum* of the *thorax* is inclosed by a narrow crustaceous line, and is occupied by an oval plate, rather dilated towards the *abdomen*, and composed of a brownish coriaceous membrane, slightly depressed in the middle in a dried specimen, and offering a slight transverse elevation in the centre. Latreille describes this portion as forming a dorsal channel, and having its posterior extremity terminated in the common French species "par une partie élevée, formant le capuchon," in which the head, when thrown back, is received. I have seen nothing of this *capuchon*, and but little of the channel, in any of the specimens which I have examined, and quite agree with M. Dufour in regarding them merely as being occasioned by the desiccation of the insects after death: the "groove down the middle [of the *thorax*] to receive the head," described by Mr. Curtis, is doubtless attributable to the same cause.

On each side of this central portion, about midway on each side, is to be observed another slender crustaceous bar, directed obliquely towards the head, and extending to the sides of the *dorsum* of the *thorax*, whence it is prolonged nearly in a line to the place of insertion of the fore legs, thus inclosing on each side an elongate and somewhat triangular plate of a whitish colour, the anterior margins of which do not extend to the margin of the *thorax*, permitting the *pectus* to be seen from above. To the narrow posterior extremity of this lateral portion is attached the base of the intermediate pair of legs; and behind these, on each side, a pair of short and narrow portions, similarly separated, are to be observed, to the exterior of which the basal portion of the posterior legs is attached. Hence it appears to me that the central and anterior lateral triangular plates represent the *dorsum* of the *mesothorax*, and the small posterior lateral ones that of the *metathorax*.

The disposition of these portions of the *thorax* is, however, very different on the ventral surface. This is quite flat, and of a uniform crustaceous texture, of a somewhat oval form, without the least indication of the insertion of the legs, and having a central longitudinal line running from the anterior to the posterior extremity. M. Dufour describes it as "un plastron d'une seule pièce;" but I have uniformly found an impressed line of division extending from the posterior base of the intermediate legs, and running parallel with the anterior margin, thus exhibiting the *pectus* of the *mesothorax* in the form of a lunate plate, and that of the *metathorax* as much more extensive.

But the most remarkable organ connected with the *thorax* is a pair of pectinated processes placed between the base of the anterior and intermediate legs, and received in a cavity (formed by the lateral productions of the *dorsum* and *pectus* of the anterior parts of the *thorax*), one on each side of the *thorax*. On detaching one of the intermediate legs the corresponding process is also detached, being affixed to the internally elongated trochanter at its base: it is horny, lunate, and very small, and externally armed with about sixteen obtuse teeth, directed upwards and backwards. This organ was first noticed by Hermann, by whom it was figured. Mr. Curtis thus describes it: "Wings none, but there is a narrow appendage ciliated with short strong bristles, on each side at the base of the middle pair of legs;" adding, that these ciliated appendages "may cover spiracles for breathing, organs for hearing, or they may be the analogue of rudimentary wings." That the latter of these suppositions is correct, I feel induced to conceive, notwithstanding their extraordinary form and our ignorance of their uses, from their situation and evident attachment to the internal base of the intermediate legs. The supposition that they are organs of hearing seems to have arisen from the supposed want of *antennæ*, and cannot therefore be maintained, as those organs exist; while the idea that they may be connected with spiracles for breathing requires more notice, from having been entertained both by Latreille and M. Dufour, the latter of whom has entered at some length into the reasons which have induced him to adopt such idea: these consist, 1. in the position of this pectinated organ; 2. in the asserted absence of any other point which might be considered as a respiratory orifice; and 3. in the evident analogy between *Nycteribia* and the *Hippoboscidæ*. Now although the first of these reasons is certainly in favour of such opinion, the latter two are incorrect, the *abdomen*, as will subsequently be described, being furnished with a series of spiracles, and the *thorax* itself exhibiting a pair of minute oval points, which appear to me to be evidently spiracles, and which exist in the elevated crustaceous ridge between the central and anterior lateral portions of the *thorax*, immediately behind the insertion of the head, which organs I have noticed not only in Colonel Sykes's insects, but also in my Chinese species. As to the analogy existing between *Nycteribia* and the *Hippoboscidæ*, it is to be observed, that from the totally distinct organization of the *thorax* it is difficult to trace the situation in *Nycteribia* which is analogous to the position of the spiracles in the *Hippoboscidæ*. These, it is to be observed, vary in their location; but in none are the anterior pair placed between the anterior and intermediate legs, as are the pectinated processes in *Nycteribia*, but, on the contrary, in a higher and more dorsal position, which would probably occur in *Nycteribia* nearer the base of the head[1].

The legs offer several remarkable peculiarities: they are very long and strong, and

[1] M. Dufour has proposed the employment of the position and structure of the spiracles as affording characters, "aussi solides que faciles à explorer," for the establishment of families and genera, and has given an account of their structure in the *Pupipara*. That they would afford solid characters cannot be questioned; but some notion may be obtained of the difficulty attending their adoption, when it is stated that M. Dufour has overlooked the entire series of abdominal spiracles of the *Hippoboscidæ*. See Lyonnet's Posthumous Researches, pl. 1. f. 2. & 3.

furnished with strong bristles; they are all similarly formed, and of a similar size; and the sexes appear to offer no variation in respect to their structure. They are inserted, as above stated, at the anterior and lateral margins of the *thorax*, the pectoral shield extending beneath their bases, so that their motions have necessarily an upward direction. In the anterior pair the *coxæ* are distinct, bristly, and somewhat elongated. I cannot, however, perceive in Colonel Sykes's species the coronet of bristles noticed by M. Dufour as being placed at the extremity of the "premier article de leur hanche;" but this part in the two hinder pairs is soldered to the sides of the *thorax*. The trochanter is very short; the *femora* are thickened and compressed, having a transverse impression before the middle of the limb, as indicating a rudimental articulation. The *tibiæ* are more slender, but not longer, than the *femora*, having three rudimental articulations towards the base, and not being furnished with spurs at the tips. The basal joint of the *tarsi* is very long, and appears to be annulated. The three following joints are very short, whilst the terminal one is much larger, and furnished with a pair of large *pulvilli* and two strong curved claws, dilated at the base beneath; a small portion of the base of each claw being less crustaceous, and differently coloured from the remainder.

Dr. Leach, regarding the *coxæ* as portions of the *femora*, and overlooking the trochanter, described the *femora* as composed of two joints. In like manner he regarded the long basal joint of the *tarsi* as a portion of the *tibiæ*, which he also described as two-jointed, while he considered the terminal joint of the *tarsi* as forming two joints, evidently regarding the differently-coloured base of the *ungues* as a distinct articulation.

The structure of the *abdomen* and its appendages varies considerably in the sexes of *Nycteribia* as well as in the different species. This circumstance, united to the uncertainty as to the determination of the individuals of each sex, has been the source of great confusion in almost every description hitherto given of the genus. This confusion I am enabled, by the assistance of Colonel Sykes's specimens, to clear up. I have said that these specimens were females in various stages of gestation. In none were traces of articulation visible on the upper surface except a single one at the base, which, on the under side, is very conspicuous, being flattened, horny, and of the same colour as the under side of the *thorax*, while the rest of the *abdomen* is coriaceous and of a dirty whitish colour. This segment is terminated by a transverse series of very strong and blunt black bristles, which exist in all the individuals of the genus which I have examined. By Dr. Leach and Mr. Curtis it was regarded as the *postpectus*; but that it is a portion of the *abdomen* is evident by its terminal series of bristles being continued laterally and extending a short distance across the upper surface of the base of the *abdomen*, as represented in my figures: indeed, sometimes, according to Latreille, it is entirely continuous, both on the upper and lower surface, at the extremity of this basal articulation.

The *abdomen* itself is of an oval form and very convex when distended, being slightly contracted behind the basal articulation. Its coriaceous part in Colonel Sykes's insects is covered, both above and beneath, with minute shining black tubercles, four of which, on the centre of the *abdomen*, are of a larger size, and occupy a small naked portion. It is, moreover, densely clothed, on the upper side only, from about one third of the distance from the extremity to the tip, with long and strong dark reddish bristles, each arising from a similar tubercle: at each side above, between the basal corneous articulation and the setose terminal portion, three circular spiracles are to be observed. Another spiracle of a similar size exists on each side in the midst of the bristly region, and a pair more minute near the *anus*: thus at least five pairs of abdominal spiracles exist, although no traces of articulation are visible. It is to be observed, however, that the tubercles, in two or three places, are arranged in transverse lines, so as to give the appearance of indication of segments: these lines, however, do not appear to correspond with the spiracles.

The *anus* is situated at the extremity of the body. It is circular, slightly protruded, and consists of two lateral horny lunate plates, behind which a smaller circular space is observable, with a smaller and more distant pair of corneous flattened plates.

Such is the organization of the *abdomen* of the female: and in order to remove any doubts which might remain as to the identity of the sex, I shall now proceed to notice the nature of the transformations which the insects undergo. No direct statement derived from actual observation has hitherto been made upon this subject. Some authors have, indeed, correctly surmised, from their evident connexion with the *Hippoboscidæ*, that they were pupiparous; but Latreille regarded them as differing from that family in this respect, "il paroît cependant qu'elle ne subit pas de métamorphoses, qu'elle croît à la manière des poux, des araignées, ayant trouvé en même tems, sur une chauve-souris, des individus de cet insecte très-petits et peu âgés"[1]; an opinion which he expressed in several of his subsequent works. Anxious to ascertain the correctness of this supposition, I selected the specimen whose *abdomen* was most distended; and on making an aperture on its under side, I extracted without difficulty a hard organized mass, of a white colour and nearly as large as the *abdomen* itself, of an oval form, convex above and flattened beneath, with the broadest extremity offering three small circular spots placed in a triangle, with two smaller ones placed at a greater distance from them: the sides of the body also exhibited the traces of five articulations. That this was the young of the *Nycteribia* in its *pupa* state, similar to that of the *Hippoboscidæ*, cannot be doubted. I regret that it was not in a sufficiently forward state of organization to allow of my opening it, with the view of extracting the inclosed *Nycteribia*.

Bearing in mind, therefore, that in the only individuals of the genus whose sex has thus been ascertained, the *abdomen* of the female is distinguished by the want of articu-

[1] Hist. Nat., tom. xiv. p. 401.

lations, let us examine the statements of authors as to the structure of this part of the body in the previously recorded species of the genus.

Hermann describes three kinds of individuals. The first, to which he applies the specific name of *Vespertilionis*, has the *abdomen* obovate, convex, and attenuated behind, with the terminal segment entire and rounded at the extremity, and furnished beneath with a pair of incurved styles. He also describes minutely another organ, which, upon compression, "sort entre les deux avant-derniers anneaux," of a fleshy substance, terminated by two small oval lobes, and from the extremity of which, upon further pressure being applied, another organ was protruded, furnished beneath with a curved *seta*. The second kind of individuals were regarded by him as specifically identical with the former, differing only in having the last segment deeply emarginate and simple: the body also seemed larger, and the legs shorter. In this species the *cilia* of the extremity of the basal abdominal segment are continued along the upper side of this part of the body as well as beneath. Now it is evident that the individuals first described were males, not only from the articulation of the *abdomen*, but from the possession of an exserted masculine apparatus; but the other individuals (of which Hermann had only two old dried specimens), in the simple and emarginate character of the *abdomen*, seem to approach the females of *Nyct. Latreillii* subsequently described: and it is to be observed that Hermann does not state that their *abdomen* was articulated like that of the former, but merely points out the characters in which they were observed to differ. Neither does he give any opinion as to the sexes of his insects[1]. His third kind of individuals, specifically named *biarticulatum*, precisely agree with Montagu's species, described by Dr. Leach under the trivial name of *Hermanni*, having a pair of exserted styles at the superior extremity of the *abdomen*. Latreille seems entirely to have overlooked Hermann's description of the latter insect in his account of the structure of the genus, assigning to Hermann's second kind of individuals a character not stated by Hermann, namely, that of the *abdomen* being eight-jointed, and giving the *biarticulatum* as the male of his *Nyct. Vespertilionis*. Dr. Leach, evidently taking his characters from his *Hermanni*, thus describes the *abdomen*: "In utroque sexu 8-articulatum.—Fœminæ? segmento primo dorsali producto, segmenta quatuor sequentia tegente; segmento ultimo stylo apice setigero instructo;—Maris? segmento ultimo majore." And his figure of the supposed female of his *Hermanni* represents an insect with a large elevated and produced basal abdominal segment, the remainder of the *abdomen*, being the smaller portion, appearing inarticulate, and terminated by two long recurved piliferous diverging styles: the figure of the other sex has the *abdomen* six-jointed, the last joint being large

[1] If the *abdomen* in this second kind of individuals were really articulated, as in the former, I should feel little hesitation in regarding them as the males, probably of a different species, in which, from the dried and shrivelled state of the specimens, the male organs had become closely applied to the under surface of the body, and the terminal segment, for the same reason, had become emarginate.

and rounded. Montagu, however, who describes the *abdomen* of the styliferous specimens of the species from which Dr. Leach derived his characters as being apparently composed of three divisions, states that in another specimen the *abdomen* appeared four-jointed, more ovate, tumid, and destitute of posterior appendages; this he regarded as a female, and the former as a male. From my subsequent observations it will be seen that the supposition of Dr. Leach was the correct one. Latreille also differs in opinion from Dr. Leach, considering the styliferous individuals as males, and those with a greater number of articulations, and without exserted terminal appendages, as females; and he consequently describes the *abdomen* of the supposed female of his misnamed *Nyct. Blainvillii* as ovoid, six-jointed, the last joint being elongate-conic, narrowed to the tip, and truncate; but as he has not mentioned the existence or nonexistence of inflected styles or other male apparatus, a slight degree of doubt must remain as to the sex of his insect, notwithstanding that its six-jointed *abdomen* would induce us to suppose, with reference to the characters of Colonel Sykes's insect, that it must be a male; as, indeed, M. Dufour has presumed.

The last-named author [1] has described the *abdomen* of two kinds of individuals of his *Nyctéribie de la Chauve-Souris*, that of the female being cylindric-oval, apparently destitute of articulations, furnished on its upper surface with three pairs of pectiniform series of short hairs varying in their direction, and setose at its extremity: that of the male is smaller, oblong, and exhibits on the upper side six distinct segments, of which the last is slightly attenuated and truncate at the tip. He adds, "L'exploration la plus attentive de l'extrémité de l'abdomen ne m'a fait découvrir à celle-ci aucun appendice, aucun stylet, aucune soie particulière." He regrets, however, that he did not endeavour, by compression, to discover if these organs were not retracted. That the former of these descriptions is taken from a female insect is not to be doubted; and the other description is so different as to induce us to believe that it is taken from a male, notwithstanding the want of any visible male organs: these, however, as we shall subsequently see, are occasionally not prominent, but laid closely along the under surface of the *abdomen*. And I am so confident that this would be the case in the real males of M. Dufour's insect, that, should this author be perfectly correct in his descriptions, and not have overlooked the male organs, I should feel no hesitation in regarding his smaller insects, not as males having the masculine organs retractile within the last segment of the *abdomen*, (which I have never found to be the case,) but as females of the same or even of a different species, and most probably in an unimpregnated state; conceiving that gestation and subsequent parturition would materially alter the character of this part of the body.

[1] It should be observed that this author has misstated Dr. Leach's opinion in his observation, "Suivant M. Leach ce sont les individus qui ont moins de segmens à l'abdomen qui sont les mâles." He has evidently mistaken Latreille's conclusions upon this point, in the 'Dictionnaire d'Histoire Naturelle,' for the opinion of Dr. Leach.

Mr. Curtis thus generically describes the *abdomen*: "Conic-depressed, composed of 6 ciliated joints in the male, the last joint hollow beneath, producing a style in the centre, and terminated by two incurved pilose laminæ"; thus omitting all notice of the structure of the female *abdomen*. And his figure of *Nyct. Latreillii* exhibits a dilated six-jointed *abdomen*, the last joint being the longest, and rounded at the extremity, and with an additional transverse series of bristles at the base, indicating another basal segment. He has not represented the organs which he describes as belonging to the male.

I now proceed to notice more concisely the peculiarities of organization in the species which I have myself examined.

Mr. Hope's Bengal insects are somewhat smaller than Colonel Sykes's; but the structure of all their parts (except the *abdomen*) is so similar that I should even be inclined to regard the former as the males of the latter. The *abdomen* is elongate-ovate, and conically produced to the extremity, where it is shortly truncate. It is composed of five joints, the last of which is furnished beneath with two elongated and gradually attenuated styles, which, in the dried state of the insect, are incurved and laid flat upon the under side of the joint: they are very slightly pilose, and from their being laid close together it is impossible to obtain a knowledge of any other internal organ which they probably conceal.

In my Chinese species the *abdomen* is nearly oval, with the terminal segment somewhat narrowed. It is furnished above with six transverse series of bristles placed at equal distances, giving the appearance of seven segments; but on closely examining them, the *abdomen* certainly does not exhibit any corresponding articulations, in the ordinary acceptation of that word, the tegument being continuous. The terminal segment is furnished at its extremity with a pair of elongated styles, applied close together, bent downwards, and slightly pilose; and beneath these, arising from the base of the joint beneath, is an exserted and elongated fleshy style, dilated at the tip. This construction is very similar to that of Hermann's supposed males and to Mr. Curtis's description of the male of *Nyct. Latreillii*, and is evidently characteristic of the male sex. The bristles which arm the extremity of the *palpi* are very long, and the anterior *coxæ* are much shorter than in the preceding species.

In one of Mr. Stephens's dried specimens of *Nyct. Latreillii*, the *abdomen* is more linear than in Mr. Curtis's figure, but is divided into six segments of nearly equal size, except the last, which is more conical and truncate at the tip, and is furnished beneath with two *laminæ*, placed rather apart so as to exhibit a small central style. They are, however, closely applied to the under surface of the segment. This is evidently, therefore, a male: but the other specimen is very differently constructed; the *abdomen* is elongate-ovate, its upper surface exhibiting a large and smooth oval patch, ciliated at the extremity, and extending over more than one third of the base of the *abdomen*: this is followed by a densely pilose region extending beyond half the length of this part of the body; then follows another transverse region, denuded of hairs, but ciliated at its extremity, especially at the sides; and the *abdomen* is terminated by a distinct and considerably narrower segment, notched at the tip, as though formed of two united incrassated styles, having moreover, as it were, a raised longitudinal lobe along its centre. On the under side the basal segment is, as usual, very distinct and ciliated; then follows a large and nearly square region, (corresponding with the superior pilose portion,) having three transverse series of hairs, of which the last is the most distinct: this is succeeded by a transverse region similarly terminated, which is again followed by a lunate and ciliated portion, and the last segment is channelled down the middle. This insect must be regarded as a female, (its specific identity with the former being unquestionable,) notwithstanding that, from the existence and situation of the several transverse series of hairs, no less than seven segments are indicated on the under side.

Two of the specimens of this species in the British Museum are males; the third is a female, and exhibits more strongly the curious trilobed structure of the terminal segment of the *abdomen*.

Mr. Stephens's specimens of the species described by Montagu, and named *Hermanni* by Dr. Leach, are of one sex, and very differently constructed from any of the preceding insects; and I regret that their dried and shrivelled state prevents my so completely ascertaining their structure as I could have wished. The basal segment of the *abdomen* is much produced above and at the sides, but it does not appear to me to overlap any of the following segments, two of which immediately succeed, and are very short; the terminal fourth joint is large, semi-ovate, and from beneath its sides, at the extremity, arise two porrected styles, furnished at the tip with strong bristles. On the under side the basal segment is reduced to its ordinary and ciliated form and size; then follow two short segments corresponding with those on the upper side; which are succeeded by a large segment corresponding with the terminal superior one; and between the inferior margins of the latter and the extremity of the former is protruded a distinct and convex segment, having its upper margins armed with the two porrected styles above mentioned. I could not, however, distinguish any traces of a central lobe or style.

This description accords with Dr. Leach's characters of *Nycteribia* given above. Of Dr. Leach's three specimens of this species in the British Museum, two (as well as the specimen received by him from Bonelli) are of the same styliferous sex as Mr. Stephens's: but the other British specimen is, fortunately, of the opposite sex. It is, however, in too shrivelled a state to allow me to give a more minute description of its *abdomen* than that it is more robust than in the styliferous specimens, that its upper side exhibits four or five articulations, and that its extremity beneath is distinctly furnished with two incurved styles closely applied along the under surface of the terminal joint. These two organs, hitherto unnoticed by the describers of this species, thus clearly indicate the male sex, confirming the opinion of Dr. Leach, and proving that the female is organized, as respects the sexual characters, in a manner completely different from that of any of the other species, and that those individuals which exhibit the least traces of abdominal articulations are females.

It would seem that Montagu was induced to regard the externally styliferous specimens as males, not only from the existence of these styles, which he evidently regarded as masculine organs, but from the larger, tumid and ovate form of the *abdomen* of the other specimen, which he conceived to be a female. The latter circumstance, however, is visible in the specimen at the British Museum, and may easily be accounted for by supposing that the other specimens are females in an unimpregnated state.

It is also to be observed, that in the females of *Nyct. Latreillii* we have seen that the structure of the terminal portion of the *abdomen* exhibits somewhat of an incipient approximation to that of the styliferous *abdomen* of the female of Montagu's species.

Dr. Leach's specimen of *Nyct. Blainvillii*, preserved at the British Museum, is evidently a male: it has the *abdomen* of an elongated conical form, exhibiting five transverse series of bristles, and having the terminal joint somewhat larger than the preceding, with the extremity truncate and the angles not acute. Being gummed down upon paper, I could not examine its under side.

Mr. Royle's East Indian species is a male, having an elongate-conic *abdomen*, truncate at the tip, and with the under side of the terminal segment furnished with two incurved styles.

In conclusion, I beg leave to offer the following synopsis of the species, first premising, that in all probability, as in the *Pediculidæ*, the species are much more numerous than has hitherto been supposed; and that the accounts given by early authors are so deficient in minute precision that it is impossible to decide as to the species described by them. For this cause, as well as on account of its being applicable to the whole genus, I have followed the example of Dr. Leach in rejecting the specific name of *Vespertilionis.*

1. Nycteribia Sykesii.

Nyct. rufo-picea, thoracis tegumento dorsali abdomineque obscurè albicantibus; hoc tuberculis minutissimis nigris undique tecto quorum quatuor majora in quadrangulo centrali disposita, segmentis (unico basali excepto) destituto, apice pilis rigidis ferrugineis elongatis obtecto; pedibus elongatis, subcompressis, paullo dilatatis, breviter setosis, femoribus magis ferrugineis, coxis anticis elongatis tibiisque apicem versus attenuatis; pectinibus thoracis elongatis; oculis e tuberculis quatuor compositis. (♀)

Long. corp. lin. $2\frac{1}{2}$.

Hab. in Indiâ Orientali.

Mus. Dom. Sykes.

Species maxima.

2. Nycteribia Hopei.

Nyct. abdomine concolore nitido, in medio obscuriore, 5-articulato, ovato-conico, depresso, segmento ultimo conico-truncato, apice lateraliter setigero subtùs stylis duobus conico-elongatis inflexis armato. (♂)

Long. corp. lin. 2.

Hab. in Indiæ Orientalis Bengalâ.

Mus. Dom. Hope.

Præcedenti valdè affinis at minor. Forsan illius mas.

3. Nycteribia dubia.

Nyct. fusco-castanea, pedibus magis castaneis; coxis anticis elongato-conicis, femoribus tibiisque subcylindricis; thorace subtùs irregulariter rugoso; pectinibus thoracis lateralibus elongatis; abdomine ("♀," Latr., ♂?) *ovato, 6-annulato, segmento postico conïco-elongato posticè attenuato et truncato.* (♂?)

Long. corp. circiter lin. 2.

Nyct. Blainvillii, *Latr., in Nouv. Dict. d'Hist. Nat., xxiii. nec Leach.*

Hab. in Insulâ Isle de France dictâ. Latr.—India?

Mus. olim Latreille.

The alleged diversity of sex, the difference of *habitat*, and the nearly cylindric legs, induce the belief that this species is distinct from the last, with which, however, it offers a close resemblance both specifically and sexually.

The character given above is founded on that published by the original observer of the species[1].

4. Nycteribia Blainvillii.

"*Nyct. pedibus longis tenuibus, femoribus tibiisque apicem versus gradatim attenuatis;*" *obscurè ochraceo-livida, abdomine (apice excepto) fusco, elongato-conico, depresso, segmentis sex apice setigeris ultimo longiore subrotundato.* (♂)

Long. corp. lin. 1. ($1\frac{3}{4}$ secundum Leach.)

Phthiridium Blainvillii, *Leach, Zool. Misc., iii. p.* 55. 1.

Hab. in Insulâ Isle de France dictâ.

Mus. Brit.

"Minor Phthir. Hermanni." Leach, loc. cit.

[1] "D'un brun marron foncé avec les pattes plus claires, 2d article des deux hanches antérieures en cône allongé, cuisses et jambes presque cylindriques, dessous du corselet chagriné, les deux rangées des dents ou des peignes de ses extremités laterales et supérieures longues, abdomen ♀ [?] ovoide, de six anneaux, dont le dernier en forme de cône allongé rétréci en pointe et tronqué au bout. De l'ile de France. Longueur d'environ 2 lignes." Latr., loc. cit.

Latreille, in his 'Genera Crustaceorum, &c.', after describing his *Nyct. Vespertilionis*, stated, "Speciem alteram Indicam possideo;" and Dr. Leach observed of his *Phthiridium Blainvillii*, which he received from M. de Blainville, "This is probably the species alluded to by Latreille in his Genera"; whereupon Latreille subsequently described his insect, which he received from M. Cuvier, as identical with Dr. Leach's; giving at the same time as its *habitat* the Isle of France, instead of India, as previously stated by him. The species are quite distinct both in colour and size, as well as, it would seem, in locality.

5. Nycteribia Roylii.

Nyct. obscurè nigra, pedibus fuscescentibus, elongatis, vix compressis, coxis anticis brevibus; abdomine ovato-conico, depresso, 5-articulato, apice subtruncato, stylis duobus incurvis subtùs armato; capite compresso. (♂)

Long. corp. lin. $1\frac{1}{3}$.

Hab. in Indiâ Orientali.

Mus. Dom. Royle.

6. Nycteribia Dufourii.

Nyct. pedibus elongatis, coxis abbreviatis; oculis rotundatis sessilibus simplicibus; abdomine ♀ ovali, apice setigero, segmentis destituto, suprà paribus tribus serierum setarum brevium rigidarum instructo; ♂? oblongo, 6-articulato, apice subtùs stylis destituto?

Long. corp. lin. $1\frac{1}{2}$ ♀, lin. 1. ♂?

Nyct. Vespertilionis, *Duf., in Ann. des Sci. Nat., xxii. p.* 381. *pl.* 13. *fig.* 4.

Hab. in *Vespertilione murino* Galliæ.

7. Nycteribia pedicularia, Latr.

Nyct. fusca, corpore suprà pedibusque flavo-rufescentibus, thorace subtùs fusco-rufescente lineâ longitudinali medianâ nigrâ; pedibus longis arcuatis, coxis anticis brevibus subcylindricis, femoribus tibiisque valdè compressis ferè ellipticis; pectinibus lateralibus thoracis brevibus; abdomine setis rigidis armato.

Nyct. pedicularia, *Latr., Hist. Nat., xiv. p.* 403. *pl.* 112. *fig.* 14.

Nyct. Vespertilionis, *Latr., Gen. Crust. &c., iv. p.* 364. *pl.* 15. *fig.* 11. *et in Nouv. Dict. d'Hist. Nat., tom. xxiii.*

I have restored Latreille's original name to this species, considering it as distinct from any of the others, with the exception perhaps of Hermann's *Nyct. Vespertilionis*. His character, on which mine is founded, is subjoined[1].

[1] "Corps brun, dessus du corps et pattes d'un jaunâtre-roussâtre, dessous du corselet d'un brun rougeâtre avec un ligne noire au milieu, pattes longues arquées, 2d article des deux hanches antérieures court presque cylindrique, cuisses et jambes très comprimées presque elliptiques, les deux rangées des dents des extremités laterales et supérieures du corselet courtes, abdomen herissé de poils." Latr., Hist., loc. cit.

8. NYCTERIBIA VEXATA.

Nyct. pallidè ferruginea; pedibus elongatis, coxis anticis brevibus; abdomine ♂ 8-articulato, testaceo, ovato-conico, apice subrotundato, subtùs ad apicem stylis duobus incurvis alteroque intermedio armato.

Long. corp. lin. 1—1½.

Phthiridium Vespertilionis, *Herm.*, *Mem. Apt.*, *pl.* 5. *fig.* 1.

Hab. in *Vespertilione murino* Europæ.

OBS. Exemplar aliud (♂? siccitate contractum? vel ♀??) abdomine ad apicem emarginato a cl. Hermanno descriptum est.

I have no hesitation in considering the insect described by Hermann under the trivial name of *Vespertilionis*, as specifically distinct from our two British species, as well as from *Nyct. Dufourii*, in the structure of the male. It may possibly, however, be identical with Latreille's *Nyct. pedicularia.*

9. NYCTERIBIA JENYNSII.

Nyct. pallidè ochraceo-flavescens, setis pectinibusque thoracis et abdominis basi nigris; palpis longè setosis; oculis sessilibus, rotundatis, simplicibus; pedibus elongatis tenuibus, coxis anticis brevioribus, femoribus tibiisque paullò compressis; abdomine ovato, seriebus transversis setarum rigidarum (segmenta totidem indicantibus) notato, segmento ultimo laminis duabus elongatis incurvis contiguis styloque carnoso intermedio subtùs terminato. (♂)

Long. corp. lin. 1½.

Hab. in Chinâ.

Mus. nostr. Amicissimè communicavit Rev. Leonardus Jenyns.

10. NYCTERIBIA LATREILLII.

Nyct. pallidè ochracea; pedibus perbrevibus, femoribus tibiisque valdè dilatatis, setis obscuris elongatis, tarsorum articulo primo reliquis conjunctim vix longiore; thoracis pectore latiore et breviore; pectinibus thoracis unguibusque nigris; abdomine ♂ 6-articulato, segmento ultimo longiore conico-truncato, subtùs laminis duabus distantioribus elongatis incurvis ad ventrem adpressis styloque intermedio armato; ♀ ovali absque appendiculis, apice inciso, subtùs articulo basali distincto, seriebusque transversis setarum rigidarum instructo segmenta? indicantibus. (♂, ♀)

Long. corp. lin. ¾ (1¼ secundum Leach).

Nyct. Latreillii, *Curt.*, *Brit. Ent.*, *pl.* 277. ♂.

Phthiridium Latreillii, *Leach*, *Zool. Misc.*, *iii. p.* 55. 2.

Hab. in *Vespertilione murino* Angliæ.

Mus. Brit., Stephens, Jenyns, et Curtis.

The references of this species to Linnæus and others, given by Dr. Leach, must be considered as dubious. Frisch has represented an insect which from the shortness of the legs may possibly be intended for this species[1]. That it is not the one figured by Latreille in the ' Histoire Naturelle ' and the ' Genera Crustaceorum ' (with which it is doubtfully considered as synonymous by Dr. Leach) is evident from the length and slenderness of the legs in the figures contained in those works.

11. Nycteribia biarticulata.

Nyct. pallidè ochracea, abdomine obscuriore; pedibus elongatis, dilatatis, longè setosis, setâ unicâ ad basin tibiarum longissimâ, coxis anticis brevibus; abdomine ♀ quasi 2-articulato, segmento primo suprà longiùs producto, stylis duobus caudalibus elongatis cylindricis porrectis ad apicem longè setosis; ♂ 6?-articulato, subtùs ad apicem stylis duobus incurvis ad ventrem adpressis; thorace subtùs concolore. (♂, ♀)

Long. corp. lin. $1\frac{1}{4}$ (2 secundum Leach).

Phthiridium biarticulatum, *Herm., Mém. Apt., pl.* 6. *f.* 1. ♀.

Phthir. Hermanni, *Leach, Zool. Misc., iii. pl.* 144. ♂, ♀.

Celeripes Vespertilionis, *Mont., in Linn. Trans., ix. p.* 166.

Nycteribia Vespertilionis, *Mont., in Linn. Trans., xi. p.* 11. *t.* 3. *f.* 5. ♀.

Hab. in *Rhinolopho Ferro-equino* Angliæ, Germaniæ, Italiæ.

Mus. Brit., et Stephens.

Obs. Species distinctissima, sectionem peculiarem in genere constituens.

I have restored Hermann's name for this species, to obviate the confusion which has arisen from his chief description having been derived from a different species, as well as from a sense of justice to that author[2].

[1] Ins. Deutschl., vol. ii. part 5. pl. 5.

[2] Since the above Paper was read, Dr. Horsfield has been so kind as to afford me an opportunity of examining a large *Nycteribia*, collected by himself in Java, and contained in the collection of the East India Company, which differs from *Nyct. Sykesii* only in having the terminal abdominal *setæ* extending to some distance along the middle of the disc of the *abdomen*.

I may add that Dr. Perty has published the description and figure of a minute insect, which appears to be nearly allied to *Nycteribia*, in the ' Delectus Animalium Articulatorum Brasiliæ', under the name of *Lipoptera Phyllostomatis*. The description is not, however, sufficiently precise to enable me to judge with certainty of its real structure.

Plate XXXVI.

Nycteribia Sykesii ♀.

Fig. 1. The insect, of the natural size, seen from above, with the head extended.
2. The same, seen sideways, with the head thrown back in the ordinary position.
3. The same, highly magnified, seen from above.
4. The head, seen from above, exhibiting the spiculate style of the lower parts of the mouth.
5. The same, seen from beneath.
6. The same, seen sideways.
7. The double eye on one side of the head.
8. One of the *antennæ*.
9. The lower apparatus of the mouth, armed at the sides with several long and slender hairs.
10. One of the *palpi*? seen sideways.
11. The *palpi*? attached by membrane, seen after the removal of the lower apparatus of the mouth.
12. The base of the intermediate leg, showing the connexion with the *pectines*.
13. One of the *pectines* detached.
14. The terminal joints of the foot.
15. The spiracular aperture on each side of the neck.
16. The under side of the body, the base of the legs on one side only being represented.
17. The *abdomen* of one of the individuals, seen from above.
18. The upper side of the *abdomen* in an advanced stage of gestation.
19. The under side of the same.
20. The extremity of the *abdomen* seen from behind, showing the anal apparatus and the two posterior pairs of spiracles.
21. A portion of the skin of the *abdomen* more highly magnified, showing one of the third pair of spiracles.
22. The *pupa*, extracted from the *abdomen* represented in fig. 18., seen sideways.
23. The same, exhibiting its flattened under side.
24. The same, showing its convex upper side.
25. The broad extremity of the same, seen from behind.

Nycteribia Hopei ♂.

26. The insect, seen from above, highly magnified.
27. The under side of the *thorax* and *abdomen*.
28. The extremity of the *abdomen*, seen sideways.

NYCTERIBIA JENYNSII ♂.

Fig. 29. The insect, highly magnified.
30. The head, more highly magnified, showing the large oval sessile eyes.
31. The same, seen sideways.
32. The extremity of the *abdomen*, seen sideways.
33. The same, seen from behind.
34. The same, seen from beneath.

NYCTERIBIA ROYLII ♂.

35. The under side of the *abdomen*.
36. The extremity of the same, seen sideways.

NYCTERIBIA BIARTICULATA ♂, ♀.

37. The *abdomen* ♂, seen sideways, (after Dr. Leach).
38. The same, seen from beneath, (from the British Museum specimens).
39. The under side of the *thorax* and *abdomen* ♀.
40. The upper side of the *abdomen* ♀.
41. The *abdomen* ♀, seen sideways.

NYCTERIBIA BLAINVILLII ♂.

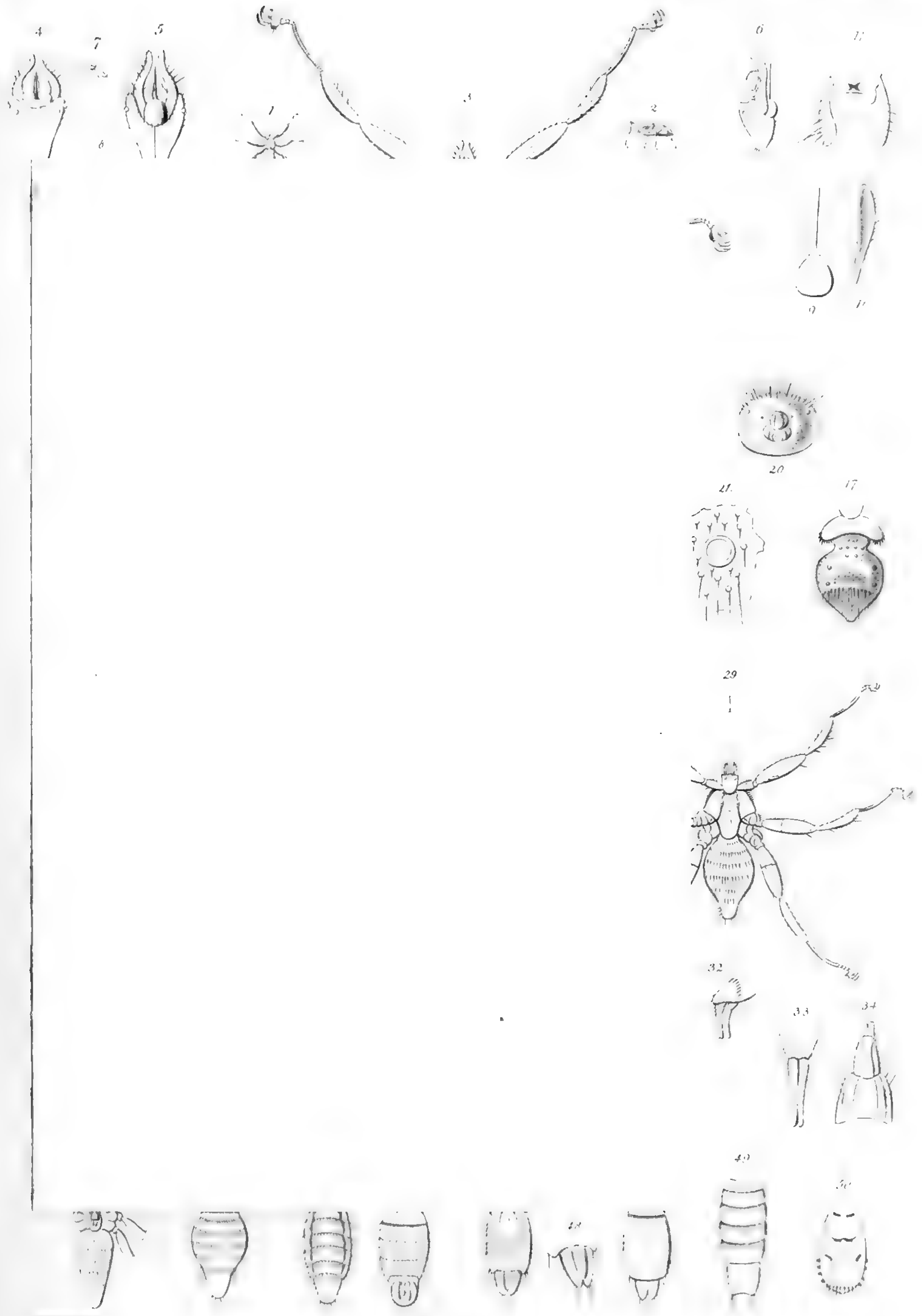
42. The insect, seen from above, the base of the legs on one side only being represented.

NYCTERIBIA LATREILLII ♂, ♀.

43. The *abdomen* ♂, (after Mr. Curtis).
44. The *thorax* and *abdomen* ♂, seen from beneath.
45. The *abdomen* ♂, (from Mr. Stephens's dried specimens).
46. The *abdomen* ♀, seen from above.
47. The same, from beneath.
48. The extremity of the same, from above.

NYCTERIBIA DUFOURII ♂, ♀, (after M. Dufour).

49. The *abdomen* ♂, seen from above.
50. The *abdomen* ♀, seen from above.



Nycteribia.

1-25. [illegible]

[illegible]

Westwood's figure
is bad.

Camera sketch of abdomen
of Nycteribia Hopei, Westw.
Type from Oxford Mus.
24/2/1900 Chas. O. W.

BRITISH MUSEUM (NATURAL HISTORY),

CROMWELL ROAD,

LONDON: S.W.

Westwood's figure
not so bad.

Camera sketch of abdomen
of Nycteribia Sykesii, Westw.
Type from Oxford Mus.
24/2/1900. Chas. O. W.

NYCTERIBIA JENYNSII ♂.

Fig. 29. The insect, highly magnified

30. The

31. The

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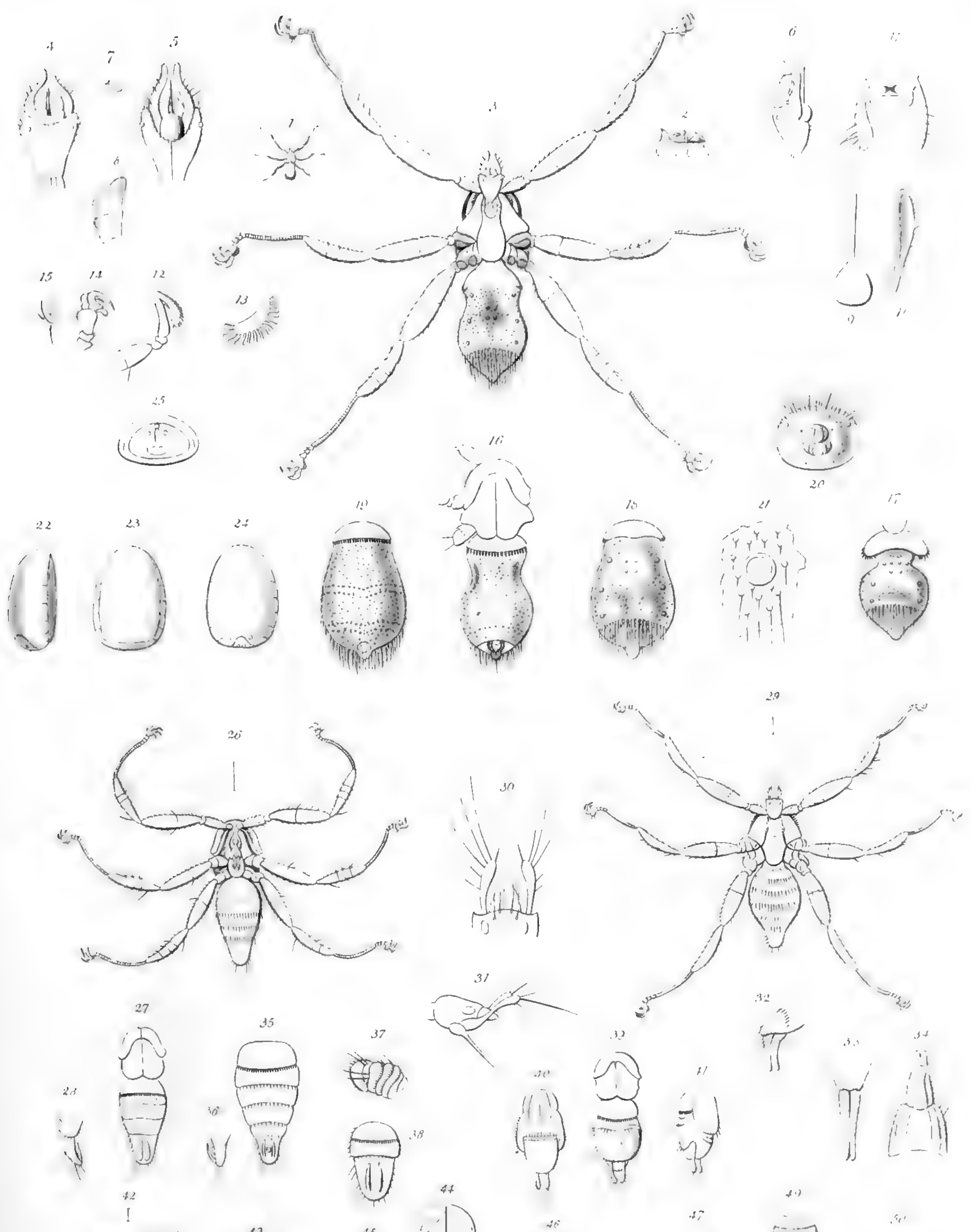


Agetidae

1–25. Agt. Sykesii. 26–28. Agt. Hopei. 34. Agt. Jenynsii.

37–41. Agt. [illegible] 42. Agt. Blainvillii. 43–48. Agt. Latreillii.

XXXI. *Some Account of* Macropus Parryi, *a hitherto undescribed Species of* Kangaroo *from New South Wales.* *By* E. T. Bennett, *Esq., F.L.S., Sec. Z.S.*

Communicated December 23, 1834.

A *KANGAROO*, recently brought from New South Wales by Capt. Sir Edward W. Parry, R.N., and presented by him to the Society, offers the type of a new species so well defined in its characters, and so distinct from all that have been recorded, as to merit a full description. Its distinctive characters may be expressed in the following terms:

Macropus Parryi.

Macr. rhinario lato; auriculis elongatis, nudiusculis; caudâ pilis rigidis brevibus incumbentibus vestitâ, corpore sublongiore: notæo griseo; gastræo pallido; fasciâ genarum, caudâque pro maximâ parte, albis, hâc ad apicem nigrâ.

The general form of the animal is that of the *common Kangaroo, Macropus major*, Shaw; it seems, however, as far as may be judged from a single specimen not seen by me until after its death, to be somewhat more slender in its proportions. Its size is about one third smaller; but the tail and ears are of greater proportional length, as will be seen by the comparative measurements hereafter given. The colour above is grey, differing little, except by its comparative lightness, from that of the common species; the long scattered hairs being entirely of a brownish grey, and the under fur dusky at the base and pale at the tips of the soft woolly hairs which compose it. The general hue is somewhat darker along the middle line of the upper part of the back, and at the base of the tail; but becomes paler on the shoulders, and still more so on the sides of the body: the under parts lose nearly all the tinge of grey, and are covered with a much thicker, longer, closer, and more woolly fur. The base of the tail above, for about 9 inches, is dark grey, and beyond this are several faint indications of a tendency to form half rings of that colour on the somewhat dirty white which occupies the remainder of that organ, with the exception of about 3 inches at the tip. The hairs on the tail are short, bristly, closely adpressed, and but thinly cover the surface of the skin. On the middle line of the under surface, however, they are closer and much longer. Like those of the upper surface these are of a dirty white; but about 7 inches from the tip they begin to change into a deep black, and mingling towards the extremity with the shorter hairs of the sides and upper surface, they give to the tail a black tip, intermixed with only a few scattered white hairs, which are scarcely seen except on a close examination. At the base of the tail its under surface is covered by white fur, continuous with that of the belly and pouch; and on the hinder part of the haunches on either side (or rather on a space bounded by the base of the tail, the *prymna*, and the *marsupium*,) is a broad patch of light yellowish brown. In the common species the hair of the tail is far less bristly, longer, softer, and by no means adpressed.

The head above is of a greyish mouse colour, more intense from the eyes forwards, where it becomes almost wholly of a dusky black. Bordering this darker colour below, on a level with the lower eyelid, a broad well-defined white band extends along the cheek from the posterior angle of the eye to the angle of the mouth. Below this is a similar but less strongly marked band of the common grey colour, which passes from the back and sides of the neck over the sides of the head, and is continued along the last-mentioned band to the angle of the mouth. The lips are grey, with an admixture of long black and white bristly hairs, and the latter are especially remarkable on the lower lip and chin. A broad whitish patch, with little of the grey mixture, occupies a space bounded by the edges of the lower jaw and extending to the upper part of the throat. The ears are mouse-coloured at the base, with a light grey patch on the *vertex* between them, grey in the middle, and dusky at their tips. Externally they are very thinly clothed with short scattered hairs, and internally they are almost naked, excepting a slight tuft of white hairs at the base of their anterior margin, and a narrow edging all round of short whitish hairs. This extreme thinness of the clothing of the ears renders visible on their inner surface, and also by transmitted light, a number of small glandular transparent pores. In the common species these organs are thickly clothed with hair on their outer surface, and are much less bare internally than in the animal brought home by Sir Edward Parry, and there are consequently no transparent pores visible in them: the hairs of the margin of the ears are also, in the common species, of a dark brown approaching to black.

On the limbs the hairs become gradually shorter and more rigid. The whole of the fore paw is black, with a slight admixture of grey on the metacarpal and carpal regions; and the claws also are black. On the hinder feet the two large outer toes are deep black, and covered with long rigid hairs as far as the base of the strong black hoof-like claws. The two small united toes are light grey, like the *metatarsus* and *tarsus*.

The comparative extent of the naked muzzle appears in this group, as in various tribes of *Ruminants*, to afford an excellent guide in the discrimination of species, and perhaps also of sections, without attaining, as in some other cases, a value of generic importance. In the species under consideration it occupies the whole space between the nostrils, and downwards to the fissure of the upper lip, spreading over the flattened extremity of the nose, and giving off on either side a rather broad margin to the upper edge of each nostril. It is covered with rather large and conspicuous *papillæ*. In this respect the animal is allied to the *Bush Kangaroo, Macr. Ualabatus*, Less.; and differs altogether from the *common Kangaroo*, in which the naked muzzle is limited to a narrow margin surrounding each of the nostrils, with a very slight band of connexion in front.

The measurements of *Parry's Kangaroo*, as compared with a specimen of the *common* or *greater Kangaroo* in the Society's Museum, are as follows:

	Macr. Parryi. Ft.	In.	*Macr. major.* Ft.	In.
Total length from the muzzle to the tip of the tail	5	4	6	8
Girth round the middle of the body	1	8	2	6
Length of the head		6		9
——— body	2	4	3	2
——— tail	2	6	2	9
——— ear		4		4½
Breadth of the ear		2		2¾
Length of the hinder foot from the *calcaneum* to the tip of the longest claw		10½	1	2
Length of the *tibia*	1	1		
——— fore arm and foot from the *olecranon* to the tip of the longest claw		9		

The two latter measurements are not given in the common species, the specimen compared being without bones in those parts, and consequently liable to contraction or distension under the hands of the stuffer. A second specimen of *Macr. major* in the Collection measures 3 feet in the length of the body, and 2 feet 8 inches in that of the tail.

Sir Edward Parry states the animal "to have been obtained at Stroud, near Port Stephens, in the latitude of about 30° South. It was caught by the natives, by whom it is called *Wōllăroo*; having been thrown out of its mother's pouch when the latter was hunted. At that time it was somewhat less than a rabbit; but having continued in the possession of Sir Edward Parry for more than two years in New South Wales, besides six months on the passage to England, it may be considered as fully grown. It was never kept in confinement until it was embarked for England, but lived in the kitchen, and ran about the house and grounds like a dog, going out every night after dusk into "the bush" (or forest) to feed, and usually returning to its friend the man-cook, in whose bed it slept, about two o'clock in the morning. Besides what it might obtain in these excursions, it ate meat, bread, vegetables, in short, anything given to it by the cook, with whom it was extremely tame, but would allow nobody else to take liberties with it. It expressed its anger when very closely approached by others, by a sort of half-grunting, half-hissing, very discordant sound, which appeared to come from the throat, without altering the expression of the countenance. In the daytime it would occasionally, but not often, venture out to a considerable distance from home; in which case it would sometimes be chased back by strange dogs, especially those belonging to the natives. From these, however, it had no difficulty in escaping, through its extreme swiftness; and it was curious to see it bounding up a hill and over the garden fence, until it had placed itself under the protection of the dogs belonging to the house, especially of two of the Newfoundland breed, to which it was attached, and which never failed to afford it their assistance by sallying forth in pursuit of its adversaries."

Captain Parry further observes, that, "like all other *Kangaroos*, this animal, when in active motion, never touches the ground with its tail, merely using it to form a tripod when standing erect. It seems to inhabit no part of the colony in the latitude of Sidney."

On his return to England Sir Edward Parry brought the animal with him; but soon after his landing it met with an accident by which its leg was broken, and which it survived for only a short time. Its body was presented to the Society while yet recent; and the following account of the particulars observed in its dissection is by my friend Mr. Owen.

"Having examined, at the request of my friend Mr. Bennett, the principal *viscera* of this new species of *Macropus*, I find that they present with few variations the same characters which belong to the anatomy of the *greater Kangaroo*, and which have been for the most part described and figured in the works of Home and Cuvier.

"The large sacculated stomach occupied the epigastric, left hypochondriac, and left lumbar regions; from this it passsed obliquely upwards and across the *abdomen*, and then turned, as in the *greater Kangaroo*[1], to terminate in the *duodenum*. The cardiac end was produced into two small *sacculi*, which were not so much separated from each other as in *Macr. major*, but were folded back upon the stomach. The cardiac extremity was situated sternad of the *œsophagus*, which was about 3 inches long after passing the diaphragm. The interior of the stomach presented the same disposition of cuticle, and series of glandular patches, and the *pylorus* was surrounded by the same thickened zone of glands, as in *Macr. major*. The *sacculi* were puckered up by two longitudinal bands extending from the *œsophagus* along either side of the smaller curvature, while in *Macr. major* a third longitudinal band extends along the line from which the great *epiploon* is continued to the spleen and transverse *colon*.

"There were two hair-balls in the stomach, of an oval shape, not rounded as they generally are in the *Ruminants*, which are most obnoxious to these formations. One of these hair-balls measured 3 inches in the long diameter; the other, 2 inches. They were entirely composed of the hairs of the animal, matted together and agglutinated by the mucus of the stomach. This occurrence of an inconvenience which is the occasional result of a necessary complication of the principal digestive organ, is interesting on account of the near approach to the *Ruminating* tribe which the *Kangaroos* make in the complexity of the stomach, and which is united with a corresponding simplicity of the *cæcum* and *colon*.

"I have more than once observed the act of rumination in the *Kangaroos* preserved in the *Vivarium* of the Society. It does not take place while they are recumbent, but

[1] Proceedings of the Committee of Science, Zool. Soc., Part I., p. 161.

when erect upon the tripod of the hinder legs and tail. The abdominal muscles are seen in violent action for a few seconds; the head is a little depressed; and then the cud is chewed by a quick rotatory motion of the jaws. This act was more commonly noticed after physic had been given to the animals, which we may suppose to have interrupted the healthy digestive processes; it by no means takes place with the same frequency and regularity as in the true *Ruminants*.

"The disposition and structure of the intestinal canal corresponded to that of the *greater Kangaroo*, in an adult specimen of which I measured carefully the intestines, and found the length of the small intestines 22 feet; of the large intestines, 9 feet; of the *cæcum*, 1 foot 10 inches: in *Macr. Parryi* the small intestines measured 9 feet; the large intestines 4 feet; and the *cæcum* 9 inches. The different segments of the canal have consequently nearly the same relative proportions; but the whole are shorter in proportion to the body than in the *greater Kangaroo*.

"There were several glandular patches in the *ileum*; the *villi* of this gut, viewed under the microscope, were thickly set, moderately long, and compressed, as in the *greater Kangaroo*. In the large intestines the mucous surface was devoid of *villi*, but presented, when magnified, a very fine reticulation. In the *greater Kangaroo* two longitudinal bands commence about one third of the distance from the end of the *cæcum*, and continue for about 2 feet along the *colon*, when they gradually spread over the gut and disappear; very faint traces of a similar structure were perceptible in *Macr. Parryi*: but in neither species do these bands draw up the intestine into pouches; nor is the *cæcum* or *colon* dilated to serve as a reservoir, the stomach here serving for the necessary accumulation and retention of the vegetable substances. In *Semnopithecus*, however, the *colon* is sacculated as in other *Quadrumana*, notwithstanding the complicated structure of its capacious stomach. I have observed in the *greater Kangaroo* that the contents of the *cæcum* are very soft, and so continue along the *colon* to the ends of the two longitudinal bands, beyond which they begin to be formed into cubical lumps about an inch square, with the margins rounded off.

"The liver in *Macr. Parryi* was situated wholly to the right of the mesial plane, as in the *Ruminants*, and from a similar cause, viz. the preponderating size of the stomach, which, with the spleen, fills the left *hypochondrium*. It presented the same form as in *Macr. major*, being more or less deeply cleft into five lobes exclusive of the *Spigelian appendix* or *lobulus*. The latter is not continued in the *Kangaroo* from the right lobe of the liver, as in most other *Mammalia*, but is a process of the left lobe, on account of the position of that part of the lesser curvature of the stomach to which it is adapted.

"The *gall-bladder* does not perforate the liver, as in the *Opossum*, but occupies a deep fissure, its *fundus* in both genera, however, projecting from the convex surface of the gland.

"The terminal portion of the *ductus choledochus* was surrounded and thickened by the same glandular structure in *Macr. Parryi* as in *Macr. major*; and was similarly joined by the duct of the *pancreas* immediately before penetrating the *duodenum*, which it enters in *Macr. Parryi* at 3 inches from the *pylorus*; and in *Macr. major* at 5 inches' distance from the same place. A similar glandular structure of the biliary duct is observable in some of the *Dibranchiate Cephalopods*; but in these the accessory *folliculi* are more developed, and were regarded by Hunter as analogous to a *pancreas*: the true analogue of this gland, however, exists in all the *Cephalopods* in the simple rudimental condition which it presents in the lowest *Vertebrata*. The *pancreas* in the *Macropi* extends from the spleen across the root of the mesentery to the *duodenum;* it sends off many branched processes into the posterior part of the *epiploon*.

"The *spleen* presents a singular figure, which might, at first sight, be supposed to relate to the extent and complexity of the stomach. It is a narrow, flattened, T-shaped body; one long strip extends down the left side of the great end of the stomach, and a shorter strip goes off at right angles to the smaller end of the stomach, and accompanies a large process of the *pancreas*. In *Dasyurus* and *Phalangista*, however, in which the stomach is of a simple form, the spleen is also characterized by a process extended at right angles from the longer portion or body of the gland which lies longitudinally in the *abdomen*. Now in these *Marsupial* genera the superadded process accompanies and is in close contact with a corresponding process of the *pancreas*, as in the *Kangaroo*, but both processes are comparatively shorter. The smaller or transverse portion of the spleen was much notched at its anterior trenchant margin in *Macr. Parryi*: I have always observed it entire in *Macr. major*.

"The kidney in *Macr. Parryi* presented one elongated *mamilla*, without the smaller accessory ones observable at its sides in the *greater* species. The situation of these glands, and of the suprarenal glands, is the same in both. In *Macr. Parryi* the kidneys were on the same transverse line, 6 inches above the brim of the *pelvis*.

"The *viscera* of the chest were as in *Macr. major*. The blood of the head and anterior extremities is returned to the right auricle by two superior *venæ cavæ*, as in the other *Marsupiata*.

"The uterine organs presented the same remarkable structure as in the *greater Kangaroo*, except that the *septum* of the mesial cul-de-sac of the *vagina* was not extended so low down. Traces of peritoneal canals were carefully searched for, but with the same negative result as on former occasions."

Plate XXXVII.

Macropus Parryi.

A side view of its teeth is subjoined, chiefly for the purpose of showing the form of the third incisor, which differs from that of *Macr. major* by its smaller extent and by the anterior of the two nearly equal portions into which it is divided being destitute of groove.

Macropus Parryi.

XXXII. *On the Genus* Chama, *Brug., with Descriptions of some Species apparently not hitherto characterized. By* W. J. BRODERIP, *Esq., Vice-President of the Geological and Zoological Societies, F.R.S., L.S., &c.*

Communicated December 23, 1834.

THE genus *Chama*, modified as it was by Bruguières, includes only that section of the Linnean genus of the same name, the animal of which, under the title of *Psilopus*, has been described and figured by Poli. Lamarck and Cuvier have both adopted this arrangement of a group which is natural, gregarious, and whose geographical distribution appears to be confined to the warmer seas, the Mediterranean being the locality of the lowest temperature where any of the species have been hitherto found. The shells are attached by their external surface to submarine bodies, such as corals, rocks, and shells, and have been observed at depths ranging from points near the surface to seventeen fathoms. These shells appear to be subject to every change of shape, and often of colour, that the accidents of their position may bring upon them. Their shape is usually determined by the body to which they are fixed; the development of the foliated *laminæ* which form their general characteristic is affected by their situation; and their colour most probably by the food and by their greater or less exposure to light. The *Chama* that has lived in deep and placid water will generally be found with its foliations in the highest state of luxuriancy, while those of the individual which has borne the buffeting of a comparatively shallow and turbulent sea will be poor and stunted.

Lamarck, with much reason, has placed the genus *Chama* properly so called between *Diceras* and *Etheria*; but he has divided the species into two sections, viz. first, those the *umbones* of whose shells turn from left to right, and, secondly, those whose *umbones* turn from right to left. M. Sander Rang, in his Manual, has adopted this division, to which I cannot subscribe, because it will not bear the test of examination. Two remarkable instances are now well known of regular *Bivalves* of the same species, in which one specimen may be regarded as being the reverse of the other, viz. *Lucina Childreni* and an inequivalve *Mytilus* in the British Museum; and, to come at once to the case before us, the same species of *Chama* is sometimes attached by the right, sometimes by the left valve; or, in other words, in one individual of the species the *umbones* will turn from left to right, while in another individual they will turn from right to left.

The fossil species are numerous, and occur in the supracretaceous group, particularly in the Subapennine beds, and those of Bordeaux and Dax; in the cretaceous group; and also in that of the oolite.

To me the distinction of the species of this genus appears to be difficult. Their variety is infinite, and I enter upon the task of describing the following specimens brought home by Mr. Cuming, and now in his cabinet, with considerable diffidence.

Chama frondosa.

Tab. XXXVIII. Fig. 1.

Chama testâ sublobatâ, lamellosâ, lamellis sinuosis frondosis, frondibus longitudinaliter plicatis et in utrâque valvâ cardinem versus biseriatis, maximis; intùs albâ, limbo purpurascente, crenulato.

Hab. ad Insulam Platam Colombiæ Occidentalis.

The ground colour of this beautiful *Chama* is a light pinkish purple, and the luxuriant and spreading longitudinally-plaited foliations are yellow, tinged and streaked with the ground colour. At the root of each foliation on its lower side there is generally a purplish transverse stripe. The inside of the valves is whitish, and their internal edge, which is crenulated all round, is bordered with dark purple, blending into yellow at the verge, but more intense at the posterior edge.

The specimen from which the figure and description were taken was dredged up by Mr. Cuming from a rock of coral, to which it was adhering at a depth of seventeen fathoms.

Var. α. *Lamellis crebrioribus, frondibus brevioribus.*

Hab. cum præcedente.

Found attached to coral at the same island where the specimen last described was obtained, and at about the same depth.

Var. β. *Tota purpurea, lamellis creberrimis, frondibus brevissimis.*

Tab. XXXVIII. Fig. 2.

Hab. ad Mexico. (Gulf of Tehuantepec.)

Dredged up from sandy mud attached to *Aviculæ* (*Meleagrinæ*, Lam., *Margaritæ*, Leach), at a depth of ten fathoms.

Traces of the lobated form and double series of foliations near the hinge will be perceived more clearly in variety α. than in variety β.; still I think that the latter is only another variety of *Chama frondosa*. Traces of the yellow colour may be seen, especially near the *umbo*.

Chama pellucida.

Tab. XXXVIII. Fig. 3.

Chama testâ albâ roseo seu rubro fucatâ vel strigatâ, lamellis frequentibus, frondibus elongatis pellucidis; intùs albâ, limbo crenulato.

Hab. ad Peruviam. (Iquiqui.)

This pretty species, when perfect, has its white, ruddy, or vinous elongated foliations transparent; and the white valves are striped or tinged externally with the same colours. In old specimens the foliations and *lamellæ* are completely worn down, and the shell has somewhat of a crystalline appearance; indeed it is always semitransparent.

Dredged up by Mr. Cuming, attached to stones, *Mytili*, and turbinated shells, at a depth varying from nine to eleven fathoms, from a bottom of coarse sand; and also found under stones at low-water mark.

Chama lobata.

Tab. XXXVIII. Figg. 4, 5.

Chama testâ albâ, lobatâ, subrhomboideâ, radiatim striatâ, lamellis creberrimis, fimbriatis, foliaceis, striatis; limbo interno crenato.

Hab. ad insulam Nevis.

This shell is of a dead white, and striated, in a radiated direction, from the *umbones* (which are sometimes tinged with brownish or yellowish) to the borders of the valves. The foliated fimbriations are close-set, and sometimes very much developed. The valves are sometimes tinged on the inside towards the *umbones* with yellowish and purplish; and the internal border is strongly crenated.

It was found attached to small stones and shells at Nevis in the West Indies in sandy mud, and at a depth ranging from four to ten fathoms.

Chama sinuosa.

Tab. XXXVIII. Fig. 6.

Chama testâ suborbiculari, posticè sinuatâ, lamellis mediocribus, plicatis, subdepressis, albâ rufo-spadiceo maculatâ; intùs albâ, limbo interno lævi.

Hab. ad Brasiliam.

This species, which in some points approaches the last, was brought from Brazil by J. Miller, Esq., Surgeon R.N. The differences are many, as will be seen on reference to the figure. The fine *striæ* of the crowded *lamellæ*, so remarkable in *Chama lobata*, are wanting in the comparatively distant *lamellæ* of *Chama sinuosa*, which has the internal borders of the valves smooth.

Chama Pacifica.

Tab. XXXIX. Fig. 1.

Chama testâ rubrâ, purpureâ vel luteâ, lamellis creberrimis, foliis seu squamulis brevioribus interdum albidis; limbo interno crenato.

Hab. in Oceano Pacifico. (Lord Hood's Island, Pearl Islands.)

The infinite varieties of this species in shape and colour defy description. In many points it agrees with Lamarck's *Chama florida*; but he describes the margin of that shell as entire, whereas the margin of *Chama Pacifica* is strongly crenated.

Mr. Cuming's specimens were obtained by diving. They were attached to *Aviculæ* (*Meleagrinæ*, Lam., *Margaritæ*, Leach,) at a depth ranging from three to seven fathoms.

Many shells of this species were brought to this country some years ago, from the Pearl Islands, by Mr. Samuel Stutchbury.

Chama imbricata.

Tab. XXXIX. Fig. 2.

Chama testâ lamellosâ, squamis imbricatâ, albidâ purpureo-fusco variâ; valvâ superiore subdepressâ, sublobatâ, sinu ab umbone usque ad limbum currente; intùs albidâ, limbo integro sæpissimè nigro-purpureo.

Hab. in Oceano Pacifico. (Lord Hood's Island, Pearl Islands.)

This grows to a large size, and was obtained by diving by Mr. Cuming, attached to *Aviculæ* at a depth ranging from three to seven fathoms. There is generally a purple spot at the tip of the *umbo* of the upper valve.

This also was brought home in considerable numbers by Mr. Samuel Stutchbury from the Pearl Islands, and I have more than once been inclined to think that it may be a variety of *Chama Pacifica*. But the internal edge of the former is always crenated, that of the latter, except towards the hinge-border, is smooth, and the depressed line of its upper valve is very strongly marked, however the external shape may vary.

Var. *α*. *Nana, castanea albo strigata, intùs alba.*

Tab. XXXIX. Fig. 3.

Hab. ad Insulas Gallapagos dictas.

The examination of an extensive series has led me to the conclusion that this dwarf, and at first sight widely differing, shell, is only a variety of *Chama imbricata*. The purple brown is changed into chestnut striped with white; and hardly any scales are to be found on its wrinkled surface except the double series which crown the ridge on each side of the depressed line, and sometimes a series or two on the affixed valve. This depressed line is not nearly so well marked as it is in the large variety, but it is to be observed on most of the specimens: some are absolutely without imbrications.

A figure of one of these turning from right to left (some specimens turn from left to right) is given.

This variety was found by Mr. Cuming attached to rocks and stones at low water.

Chama producta.

Tab. XXXIX. Fig. 4.

Chama testâ subpurpureâ, creberrimè lamellosâ, lamellis foliaceis, integris ; valvâ inferiore enormiter productâ ; limbo integro, purpureo.

Hab. ad Mexico. (Gulf of Tehuantepec.)

The closely set foliaceous *lamellæ* on the upper valve are almost entirely abraded in the specimen before me, which, it should be remembered, bears the marks of considerable age. Those on the enormously produced lower valve are, on one side, in good preservation, and are not unlike in appearance to those of some of the *Spondyli* when they have grown in the same fashion. The interior of the shell, which has something of the aspect of a *Gryphæa*, is white tinged with yellowish, and striped in the direction of the *lamellæ* with purple. The purple border on the smooth internal edge of the upper valve is of some width.

Dredged up by Mr. Cuming from sandy mud at a depth of ten fathoms, attached to stones.

Chama corrugata.

Tab. XXXVIII. Fig. 7.

Chama testâ corrugatâ, rubro-purpureâ albo variâ ; intùs atro-purpureâ, limbo integro.

Hab. in Americâ Centrali. (Real Lleijos.)

Found by Mr. Cuming attached to stones at low water. All the specimens which I have seen turn from right to left.

Chama echinata.

Tab. XXXIX. Fig. 5, (Junior) ; 6, 7 (Senior).

Chama testâ albidâ purpureo variâ, spinis fornicatis echinatâ ; intùs atro-purpureâ vel subrubrâ, limbo integro ; dente cardinali rubro.

Hab. in Americâ Centrali. (Puerto Portrero.)

The spines of this species, which are close-set and well developed in youth, are entirely abraded in age till nothing but corrugation is left externally. But as the animal advances in life, the interior of the shell is richly painted, till in old age it arrives to an intensity of dark purple difficult to imitate with colours however rich. At that period the cardinal tooth becomes of the hue of the bone of the *red Coral* (*Isis nobilis*), used for ornamental purposes. Fig. 6. represents the interior of the lower valve, and Fig. 7. the interior of the upper one.

Found at low water attached to rocks.

Chama spinosa.

Tab. XXXVIII. Fig. 8 (Junior); 9 (Senior).

Chama testâ albâ interdum roseo vel purpureo umbonem versus valvæ superioris pictâ, spinis fornicatis creberrimis horridâ; intùs albâ, limbo integro.

Hab. in Oceano Pacifico. (Lord Hood's Island.)

This pretty species was dredged up by Mr. Cuming attached to corals and *Aviculæ* at a depth ranging from three to seven fathoms.

The younger specimens are tinged towards the *umbo* of the upper valve with a delicate rose-colour. The *umbo* of the lower valve is often produced after the manner of that of *Chama unicornis*, Lam.

Chama sordida.

Tab. XXXIX. Fig. 8 (Junior); 9 (Senior).

Chama testâ albidâ subroseo variâ, vel totâ subroseâ, creberrimè striatâ, hinc et hinc foliaceâ; intùs albâ, limbo crenulato.

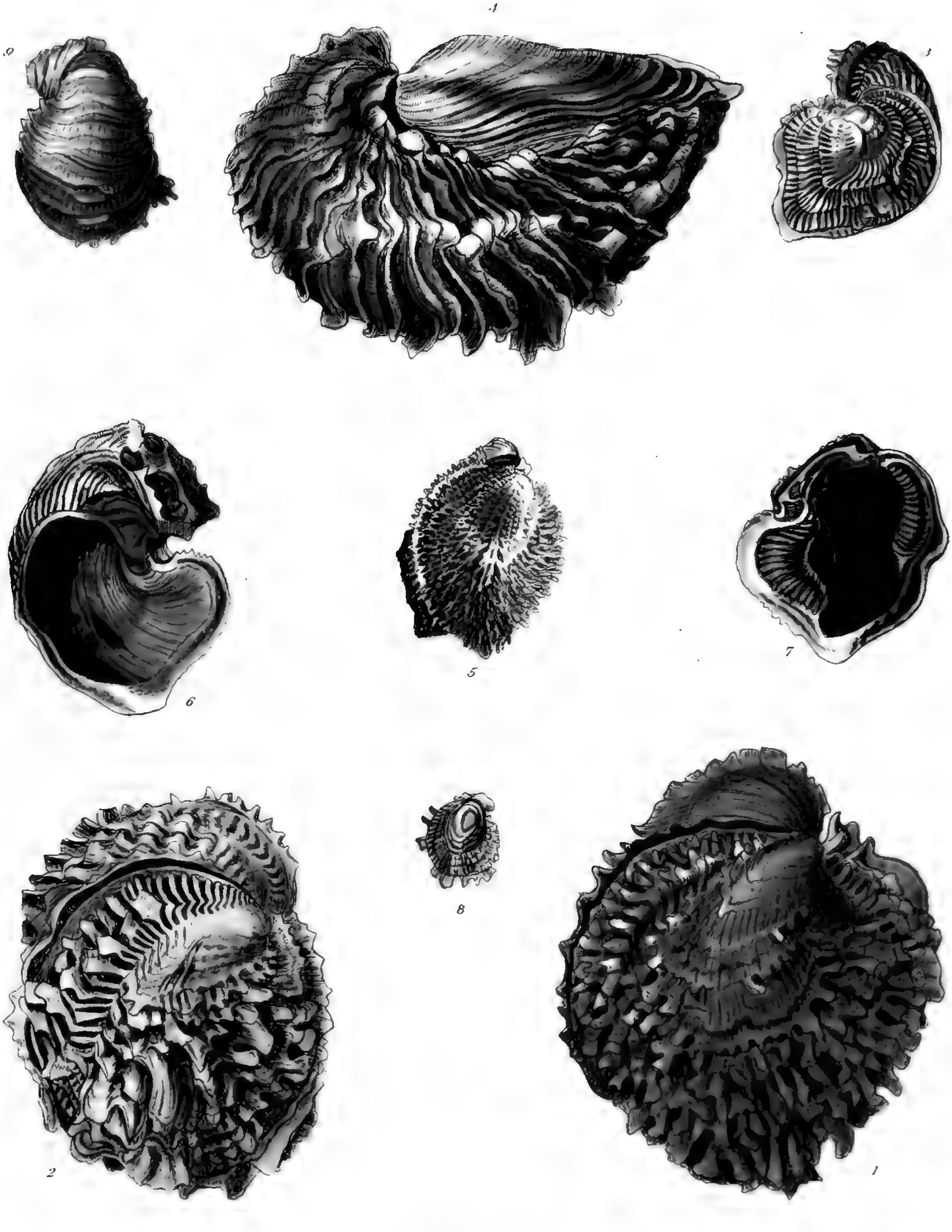
Hab. in Americâ Centrali. (Isle of Cuña.)

This species, which varies much according to its age, but never appears to grow to a large size, was dredged up by Mr. Cuming from a depth of eighteen fathoms, attached to rocks.

Old specimens have the lower valve often very much produced.

Chama.

1. 2. Chama frondosa. 3. Chama pellucida. 4. 5. Chama lobata.
6. Chama sinuosa. 7. Chama corrugata. 8. 9. Chama spinosa.



Chama.

1. Chama Pacifica. 2, 3. Chama imbricata. 4. Chama producta.
5–7. Chama echinata. 8, 9. Chama sordida.

XXXIII. *Characters and Description of a new Genus of the Family* Melolonthidæ. *By* John Curtis, *Esq., F.L.S., &c. Communicated by the Secretary.*

Read February 10, 1835.

In a collection of insects sent to me by Mr. A. Mathews, and formed by him in Lima and its neighbourhood, the following species appeared to me so peculiar in its structure that I thought it particularly worthy of being described and figured.

Ordo Coleoptera.

Fam. Melolonthidæ, *MacLeay.*

Genus Ancistrosoma [1].

Antennæ in utroque sexu similes, maris paulo majores, in clypei basin ante oculos insertæ, capite breviores, pilosæ, clavatæ, 9-articulatæ, articulo basali longo, crasso, clavato, pilosissimo, secundo parvo, tertio tribus sequentibus longiore, his subobovatis, sexto majore et subcyathiformi, tribus apicalibus clavam lamellosam mediocrem efformantibus.

Labrum transversum, semiovatum, crassum, setosum, in medio leviter emarginatum.

Mandibulæ subsimiles, ad basin crassæ, disco circulari plano, transversim sulcato, apice elongato, fortiter incurvato, obtuso et leviter bidentato, externè pilosæ, margine interno membranaceo, densè ciliato.

Maxillæ similes, dentibus quinque validis, lobi interioris apice sextum simulante. *Palpi maxillares* breves, 4-articulati, articulo basali reliquis minore, secundo clavato tertio longiore, hoc obtrigono piloso, quarto majore, ovato-conico.

Mentum concavum, pilosum, orbiculari-quadratum, in medio angulatum.

Labium breve, corneum, transversum, leviter emarginatum, ciliatum. *Palpi labiales* parvi, ad labii basin utrinque inserti, 3-articulati, articulo basali subgloboso, minutissimo, secundo paulo majore, tertio duplo longiore, elliptico, gracili.

Caput suborbiculare: *clypeus* incrassatus, ad apicem recurvus, maris profundè fœminæ leviter in medio emarginatus: *oculi* parvi, ovati, laterales, verticales, anticè emarginati. *Thorax* convexus, marginatus, hexagonus (præsertim in mare), ad angulos anteriores productus, angulis posterioribus subacuminatis, dente brevi in baseos medio lateribus-

[1] Ἄγκιστρον, *hamus*; σῶμα, *corpus*.

que ferè in medio angulos, in fœminâ minus conspicuos, efformantibus: *scutellum* semiovatum. *Corpus* cylindricum. *Elytra* ampla, subdepressa: *alæ* amplæ. *Abdomen* elytra longitudine superans, obtusum, ad apicem in mare rotundatum incurvum, segmento ultimo discum magnum, ovatum, convexum efformante; segmento basali (maris) anticè in medio dente valido instructo. *Pedes* longissimi, robusti (præsertim maris), in utroque sexu densè pubescentes: *femoribus* tibiis brevioribus, quæ (præsertim anteriores) dilatatæ, externè 3-denticulatæ, dente apicali longiore: *tibiis* quatuor posterioribus ad apicem breviter spinosis: *tarsis* totis pilis setosis vestitis, 5-articulatis, articulis basalibus quatuor brevibus, paris anterioris in mare dilatatis, articulo basali in fœminâ longiore et graciliore, reliquis ad apicem spinis validis, articulo terminali longiore, clavato, ad basin 6-spinoso, apice appendiculo longo linguiformi; tarsis posterioribus tibiis longioribus: *unguibus* tarsorum articulum terminalem subæquantibus, ad basin processu apice bisetoso instructis; fœminæ omnibus, maris posticis tantum, validis apice bifidis.

Ancistrosoma is distinguished from neighbouring genera by the stoutness of its legs and the sharp lateral edges of its *thorax*: the male is further characterized by an acute and rather long and slightly curved spine near the base of the *abdomen* beneath. Its natural situation is probably between *Diphucephala*, Dej., the males of which have a bilobed *clypeus*, and *Macrodactylus*, Latr., which is very similar to our insect in habit, and has very long, but slender, legs; but neither of these has the little tooth at the base of the *thorax*, lapping over the *scutellum*, and *Ceraspis*, Lep. and Serv., which has that character, is readily separated by its long *antennæ* and club, independently of the differences already mentioned.

Ancistrosoma Klugii.

Anc. ferrugineum suprà piceo-nigrum; thoracis margine elytrorumque strigis sex albidis.

Long. maris 12 lin.; fœminæ plerumque minor.

Hab. in Peruviâ.

Description. Ferruginous; base of the head blackish, punctured, and clothed with short ochreous hairs, with a waved elevated line across the middle, extending over the inner margin of the eyes: *thorax* piceous black, with a punctured channel down the middle, the margins punctured, ferruginous and whitish with short hairs; having two large dull ovate spots at the base in the female: *scutellum* clothed with ochreous hairs: *elytra* piceous black, with three broad punctured furrows on each, white with short hairs, the sutural one not reaching the base, but extending round the *apex*, the second neither extending to the base nor *apex*, and the outer one still shorter: legs thickly clothed with long orange or bright ochreous hairs, excepting the anterior *tibiæ*:

under side clothed with short whitish-ochreous pubescence, the sides variegated with shining stripes more or less piceous; apical joint of the *abdomen* shining and naked in the male.

I have the pleasure of dedicating this fine insect to Dr. Francis Klug of Berlin, who was so obliging as to transmit to me one of three cocoons, from which, according to Pavon, this beetle was bred. The cocoon is ovate, hard, and somewhat like those of *Trichiosoma Lucorum*, Leach, in texture; the *operculum* is semiorbicular, with a broad hinge and narrow rim: the shell of the *pupa* is similar to that of other *Melolonthidæ*.

The figure of the male beetle represented appears scarcely larger than some specimens that I have seen, but the females are generally considerably smaller: the latter sex is at first sight known by two dull spots at the base of the *thorax*, and by having all the claws bifid, whilst they are simple in the male excepting in the hinder pair of feet. It is difficult to imagine the use of the curious abdominal spine in the male, unless it be employed in sexual intercourse.

For a beautiful series of this insect I am indebted to Mr. A. Mathews, A.L.S., who is at present engaged in collecting the plants and insects of Peru: they were found by him on the blossoms of a species of *Mimosa* in Huanuco, a warm valley on the eastern side of the Andes, where sugar-cane is cultivated, and the climate and vegetation of the tropics commence.

PLATE XL.

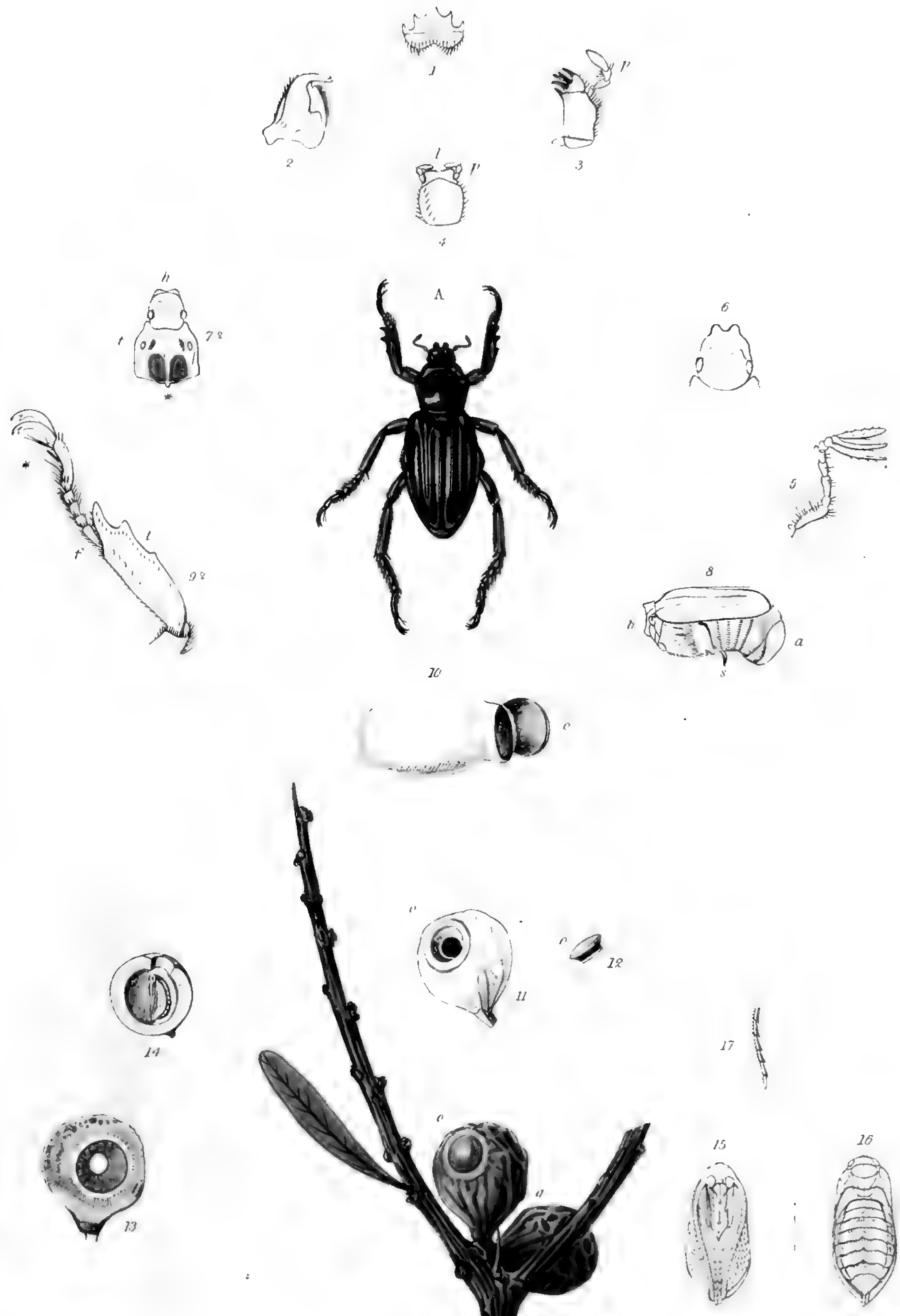
A. Ancistrosoma Klugii, ♂.

Fig. 1. *Labrum.*
2. Mandible.
3. *Maxilla: p, palpus.*
4. *Mentum: l, labium: p, palpus.*
5. *Antenna.*
6. Head of the male.
7. Head and *thorax* of the female: *h*, *clypeus: t*, angle of the *thorax:* *, spine at the base of the *thorax*.
8. *Abdomen* and *elytra* of the male: *a*, disc of the last segment: *b*, junction with the *thorax*: *s*, basal spine peculiar to the male.

Fig. 9. Anterior leg of the female: *t*, *tibia*: *f*, basal joint of the *tarsus*: *, linguiform *appendix* of the last joint of the *tarsus*.

10. Cocoon of the *pupa*: *o*, its *operculum*.

[All the dissections are from the male insect, except those numbered 7 and 9.]



A & 1–10. [illegible]
B & 11–17. [illegible]

XXXIV. *On a Species of Moth found inhabiting the Galls of a Plant near to Monte Video.* By JOHN CURTIS, *Esq., F.L.S., &c. Communicated by the Secretary.*

Read February 10, 1835.

I AM induced to lay the following observations and the accompanying drawing before the Society, rather with a desire of drawing the attention of those naturalists to the subject who may visit the country from whence the materials were brought, than with any hope of being able to explain the remarkable facts connected with the œconomy of the insect which is the object of these investigations.

Mr. Howship, who first showed me the curious galls and presented me with specimens, informed me at the same time that they were collected by Mr. Earle, who accompanied Captain Fitzroy in the Beagle gun-brig: he found them, I understand, in December, on a spot fifteen miles to the west of Monte Video, Rio de la Plata. The plant bearing the galls, which Mr. David Don thinks may be a species of *Celastrus*, forms a sort of underwood shrub, observed only in that part of the country.

The branch represented at B (Plate XL.) shows the situation of two galls: they are frequently smaller, and sometimes five or six are clustered together, but I have never seen more than two issuing from the same point. Those in the plate are wrinkled, owing, I suspect, to their having been in a young state when gathered, for many of the examples are smooth. The galls arise where the attachment of leaves or flowers is indicated, and are therefore most probably produced by the transformation of the buds themselves. On the side of the gall is a round aperture, with an *operculum* beautifully fitted to it, (Fig. B., *o*.) which may be easily picked out with the point of a penknife: this *operculum* is equally convex with the rest of the gall and is of the same thickness with it, but the diameter of the inside is less than that of the external surface, which forms a broader rim (Fig. 12, *o*.). In Fig. 11. the *operculum* has been removed to show the orifice, round which the margin is thickened and a little raised. At Fig. 13. a gall is divided longitudinally, showing its texture and the internal cavity, with the aperture on the opposite side, from which the *operculum* has been removed. At Fig. 14. another section is given to show the situation of a *pupa* that is attached by its tail to the base, with its head close to the *operculum*, which of course gives way by a slight expansion or elongation of the *pupa* when the insect is ready to hatch, and the skin is then left sticking in the passage.

Having explained the structure of these galls, it is necessary to observe that many insects belonging to the order *Hymenoptera* have the power of forming these excrescences; one of which, the *Diplolepis Gallæ-tinctoriæ*, is well known as the fly causing the galls employed in the manufacture of ink, &c.: but there is only one instance on record, I believe, of any *Lepidopterous Insect* having this property; and not being aware of it at the time I was pursuing my investigations, I was very much astonished, on examining the *pupæ*, to find that they belonged to the order *Lepidoptera*, none of which are parasitic in their œconomy; and this rendered the fact still more anomalous and perplexing. The under side of one of these magnified at Fig. 15. shows the *antennæ*, legs, and wings, folded in the usual manner, and Fig. 16. represents the back of the same.

Remarkable as these facts must appear to the naturalist, they are not more so than the astonishing contrivance for inclosing and protecting the *pupa*. In what way the *operculum* is formed to fit so beautifully that there is little doubt, when the plant is alive, this suture would be with difficulty discovered, is a question that nothing but actual observation can solve. It may certainly be fairly inferred that it is the operation of the caterpillar, since there are no galls wanting *opercula*, and the existence of the dead *pupæ* within them proves that it is not the work of the moth; neither have the *Lepidoptera* the means of cutting or biting except in the caterpillar state.

On reviewing the subject it appears probable that the female moth deposits her eggs in the buds; that the secretions of the caterpillars cause the formation of the galls, which, when fully grown, form, as it were, cocoons for the protection of the *chrysalides*; and that, in order that the moth may escape when hatched, the caterpillar cuts out an *operculum*, which forms a plug that can be easily removed by the moth when it bursts from the *chrysalis*. I shall not speculate further on the wonderful œconomy of this little insect; but in order to identify it I shall proceed to give its characters as well as I am able from the imperfect state in which it is found in the galls.

Ordo Lepidoptera.

Fam. Tortricidæ?

Genus Cecidoses[1].

Caput parvum.

Antennæ corpus longitudine æquantes, graciles, ciliatæ, articulis elongatis numerosis, in capitis vertice prope oculos insertæ.

Thorax squamulis depressis vestitus.

Abdomen subrobustum, ovato-conicum.

Pedes longi: *tibiis* anticis spinâ prope apicem munitis, intermediis posticisque ad apicem calcaratis, his densè squamulatis et in medio præterea bi-spinosis; *tarsis* 5-articulatis, articulo basali longissimo; *unguibus pulvillis*que minutis

Alæ sublanceolatæ.

[1] Κηκὶς, *galla*; σὴς, *tinea*.

Cecidoses Eremita.

Cec. cinereus; alis anticis saturatè brunneo maculatis, densè ciliatis; posticis albidis.

Hab. prope Monte Video. *Pupa* in gallis *Celastri?* abscondita.

From the stoutness of the body I am inclined to think that this moth is one of the *Tortricidæ*, but it may perhaps belong to the family of *Pyralidæ* or to that of *Crambidæ*; if so, however, one would expect to find the *palpi* more strongly developed, but I have not been able to discover either them or the *maxillæ*. Although not analogous in its œconomy, it may be here remarked that the maggot so often met with in apples is one of the *Tortricidæ*[1], and that there are many of the *Tineidæ*[2] that feed only on the *parenchyma* of plants.

The recorded instance of a similar occurrence to which I have referred above is that of an insect described and figured by Reaumur[3], which evidently belongs to the same group as the *Cec. Eremita.* This may be regarded as a most interesting coincidence, because Reaumur's insect was a native of the Isle of Cyprus. It differs, however, from the South American one in some material points, which I shall briefly notice.

Reaumur's insect formed galls, on what he terms a species of *Limonium,* about the size of those of *Cec. Eremita*; but although they have a sort of little head or crown opposite to the stalk, no mention is made of an *operculum.* In his Figure 1. a circular space is marked, and there is either a small excrescence in the centre, or the *pupa* is represented sticking out. This acute observer never saw the caterpillar alive, but he has no doubt of its piercing the gall to allow of the subsequent escape of the moth. The caterpillars spin a cocoon of white and shining silk, which occupied the inside of the galls, and formed a beak that entered the outlet. It appears to be a larger insect than ours; and it is worthy of remark, that in more than three fourths of the galls silk was discovered, formed by the *larvæ* of other insects which had devoured the caterpillars of the moth.

This circumstance gives rise to another question, namely, Are the insects of temperate climates more subject to the attacks of parasites than those inhabiting more tropical regions; or were the Oriental galls so frequently infested owing to the *pupæ* being only protected by a cocoon at the outlet, rendering the ingress of parasitic insects more easy than in the others, which were completely inclosed and protected by the gall? This, however, not forming a part of our present inquiry, may be deferred for future discussion. I shall therefore only add, that I found nothing but perfect *chrysalides* in all the galls that I had an opportunity of examining, which amounted to six or seven, from the liberality with which I was supplied with additional specimens by A. B. Lambert, Esq., during my investigations.

[1] *Tinea Pomonella,* Linn.

[2] *Gracillaria anastomosis,* (Curt., Brit. Ent., vol. x. pl. 479,) &c.

[3] Mém. pour servir à l'Hist. des Ins., tom. iii. p. 448. pl. 39. f. 1–4.

PLATE XL.

B. Branch of *Celastrus?* with two Galls of CECIDOSES EREMITA: *g*, the gall: *o*, its *operculum*.

Fig. 11. One of the galls: *o*, the aperture, from which the *operculum* has been removed.

12. The *operculum* of the gall detached, showing its expansion towards its outer surface, forming a distinct rim, *o*.
13. One of the galls longitudinally divided, showing its thickness and aperture.
14. One of the galls divided, exhibiting the *pupa* of the Moth.
15. Under side of the Moth removed from the *pupa* case.
16. Back of the same.
17. Terminal joints of one of the *antennæ*.

XXXV. *Description of a Microscopic Entozoon infesting the Muscles of the Human Body.*

By RICHARD OWEN, *Esq., F.R.S. & Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated February 24, 1835.

UPWARDS of fifteen distinct kinds of *Entozoa*, or internal parasites, are already known to infest the human body; but none have been found of so minute a size, or existing in such astonishing numbers, as the species about to be described.

The body of an Italian, æt. 50, who had died in St. Bartholomew's Hospital, was brought into the dissecting-room, and it was observed by Mr. Paget, an intelligent student, that the muscles presented an uncommon appearance, being beset with minute whitish specks. This condition of the muscles had been more than once noticed by my friend Mr. Wormald, the Demonstrator of Anatomy, in subjects dissected at St. Bartholomew's during previous anatomical seasons. His attention had been especially called to it on account of a gritty sensation sometimes perceived in dissection, from which circumstance, and the rapid blunting of the scalpels employed, he was induced to consider the appearance as being caused by a deposition of specks of earthy matter. Mr. Wormald having acquainted me with this fact, I expressed a desire to be furnished with portions of muscle so affected, and through my friend's prompt attention, I soon received ample materials for microscopical examination from the subject above mentioned[1].

With a magnifying power of an inch focus the white specks in the muscle are seen to be cysts of an elliptical figure, with the extremities in general attenuated, elongated, and more opake than the body (or intermediate part) of the cyst, which is, in general, sufficiently transparent to show that it contains a minute coiled-up worm. On separating the muscular *fasciculi* the cysts are found to adhere to the surrounding cellular substance by the whole of their external surface, somewhat laxly at the middle dilated part, but more strongly by means of their elongated extremities, so as to render it generally a matter of some difficulty to detach them: When placed upon the micrometer they measure $\frac{1}{50}$th of an inch in their longitudinal, and $\frac{1}{100}$th of an inch in their transverse diameter; a few being somewhat larger, and others diminishing in size to about one half of the above dimensions. They are generally placed in single rows, parallel to the muscular fibres, at distances varying from half a line to a line apart

[1] The existence of the *Entozoon* was at the same time satisfactorily determined by Mr. Paget, with the assistance of Mr. Brown and Mr. John Bennett, at the British Museum.

from one another; but sometimes a larger and a smaller cyst are seen attached together by one of their extremities, and they are occasionally observed slightly overlapping each other. If a thin portion of muscle be dried and placed in Canada balsam, between a plate of glass and a plate of talc, the cysts become more transparent, and allow of the contained coiled-up worm being more plainly seen.

Under a lens of the focus of half an inch the worm appears to be inclosed within a circumscribed space of a less elongated and more regular elliptical form than the external cyst, as if within a smaller cyst contained in the larger, like the yolk of an egg surrounded by its albumen and shell. The worm does not occupy more than a third part of the inner space. A few of these cysts have been seen to contain two distinct worms; and Dr. A. Farre, who has paid much attention to the subject, has shown me a drawing which he made of one of the cysts containing three distinct worms, all of nearly equal size.

The cysts vary in form as well as size, being more or less elongated, and the opake extremities being further extended in some than in others: in a few instances only one of the extremities is thus produced. Occasionally the tip of one of the extremities is observed to be dilated and transparent, as though a portion of the larger cyst were about to be separated by a process of gemmation; and these small attached cysts are seen of different sizes, as it were, in different stages of growth. This appearance, however, I conceive to be explicable without a reference of a power of independent vitality to either of the adherent cysts.

Besides size and figure, the cysts also differ in structure: in general they are composed of condensed and compacted *lamellæ* of cellular tissue, but a few are hardened by the deposition of some earthy salts, so as to resist the knife, and to break with a gritty sensation under pressure[1].

In order to detach the worm from the cyst, which from the minuteness of the object is a matter of some difficulty, I have found it best to select a portion of muscle which has been placed for a short time in spirits of wine. After separating the cysts from the surrounding *fasciculi* of muscle, and placing them, moistened with a little water, on a slip of glass, I have generally succeeded, on cutting off the end of the cyst, or tearing it open with the point of a needle, in ejecting the worm and the surrounding fluid in which it floats, by gently pressing on the cyst.

The little worm is usually disposed in two or two-and-a-half spiral coils: when straightened it measures from $\frac{1}{25}$th to $\frac{1}{30}$th of an inch in length, and from $\frac{1}{700}$th to $\frac{1}{800}$th of an inch in diameter: a high magnifying power is consequently required for its examination. It is cylindrical and filiform, terminating obtusely at both extremities, which are of unequal sizes, tapering towards one end for about a fifth part of its length,

[1] This change is probably dependent on the death of the inclosed worm, the traces of which are either very obscure, or altogether wanting in these ossified cysts.

but continuing of uniform diameter from that point to the opposite extremity. It is only at the larger extremity that I have been able to distinguish an indication of an orifice; but this indication has been so constant in a number of individuals, examined under every variety of circumstance, that I have no hesitation in ascribing a large transverse linear mouth to the great extremity, which I therefore consider as the head.

A recently extracted worm, seen by a Wollaston's doublet before any evaporation of the surrounding moisture has affected its integument, presents a smooth transparent exterior skin inclosing a fine granular and flaky substance or *parenchyma*; and after carefully testing various appearances of more complex organization, that have on different examinations presented themselves, I now believe that the only structure that can safely be ascribed to this minute *Entozoon* is the simple one above described. It is not of a rigid texture, but is extremely fragile, and exhibits when uncoiled a tendency to return in some degree to its former state.

It is curious to watch the variety of deceptive appearances that successively present themselves as the worm dries by evaporation. One of the most constant is a succession of minute transverse *rugæ*, especially at the concave sides of the coils, which give a finely annulated character to the worm, but of which no trace can be perceived in the plump recent specimens when observed by a good doublet. Another appearance, which is more difficult to be accounted for, results from one and sometimes two longitudinal lines extending over a greater or less proportion of the body; but these are not to be perceived in worms examined under circumstances least liable to cause deception. As evaporation proceeds, the wrinkling of the integument produces an appearance of the body being occupied by minute tortuous tubes, and a beautiful microscopical effect is thus obtained; but the fallacy of this appearance and its true cause are easily detected.

The test of coloured food could not be applied to elucidate the form of the digestive organs in the present instance: there was not any indication of the polygastric structure, which, indeed, was hardly to be expected, since it does not exist in those *Entozooid Infusoria* which most nearly resemble the parasitic species in question. There was no appearance of the *parietes* of an alimentary canal floating in a visceral cavity and distinct from the integument of the body, as in the higher organized *Nematoid Entozoa*; nor could a trace of an orifice, or *anus*, be observed at the smaller extremity. I have been equally unable to detect a projecting *spiculum*, or hook, at either extremity, or any appearance of the worm having been torn from an attached cyst. The natural transparency of this species is such as not to admit of a doubt as to its wanting the ovarian and seminal tubes and other characteristics of the complicated structure of *Filaria*, *Ascaris*, and the *Nematoid Entozoa* generally.

Three species of small *Nematoid Worms* are described by Zeder as inclosed in cysts or capsules, and hence were termed by him *Capsularia*. Rudolphi, however, whose authority on this subject cannot be lightly disregarded, does not sanction or admit this genus in his 'Systema Entozoorum', but refers the three species described by Zeder to the genera *Filaria* and *Ascaris*. The *Capsularia Halecis*, or *Filaria Capsularia* of Rudolphi, infests the abdominal viscera of the *Herring*, and measures from half an inch to an inch in length: the intestinal canal is distinct, and is dilated at one extremity into a stomach. In the males the intromittent *spiculum* protrudes from the anal extremity, which is the largest. The *Capsularia Salaris* and *Capsularia trinodosa* of Zeder represent, according to Rudolphi, a single species of *Ascaris* (*Asc. Capsularia*, Rud.). They are about an inch in length, and are inclosed in a spiral form in cysts attached to the cellular surface of the *peritoneum* of the *Salmon*. The *Capsularia Halecis* figured by Zeder[1] exhibits a straight alimentary canal and longitudinal lines, probably nervous filaments, which resemble those lines observable under certain circumstances in the present microscopic species, but no further correspondence in internal structure can be traced between them.

The circumstance of being inclosed in cysts is common to many very differently organized genera of *Entozoa*. There are few indeed, with the exception of those which live upon the mucous surfaces of the body, that do not, by exciting the adhesive inflammation, become inclosed within an adventitious cyst of condensed cellular substance analogous to the galls produced by the irritation of *larvæ* developed in the substance of a living vegetable.

The simple type of structure, which the minute animal here described exhibits, approximates it to the lower organized groups of the *Vers Intestinaux Parenchymateux* of Cuvier; and both from its locality and the constancy of the cyst inclosing it, it manifests a relation of analogy to the order *Cystica* of Rudolphi. From all the genera of this order, however, it differs in the want of the complex armature of the head and of the dilated vesicle of the tail. At first sight it might seem indicative of an annectant group, which would complete the circular arrangement of the *Entozoa*, by combining the form of the *Filariæ* of the first, with some of the characteristics of the *Cysticerci* of the last, of Rudolphi's orders. Unfortunately, however, the class *Entozoa* as it now stands is so constituted that an animal may be referred to it without much real or available knowledge of its organization being thereby afforded: it embraces animals with the molecular and animals with the filiform conditions of the nervous system; conditions which are accompanied by different types of the digestive system, and which indicate not merely differences of class, but of primary division in the animal kingdom.

The organic form in the natural system, to which I consider the animal under consideration as being most nearly allied, is that exhibited by the lower organized *Vibriones* of Müller, and of which Ehrenberg has composed his genera *Vibrio*, *Spirillum*, and *Bacterium*: so that the present species may be regarded as affording, with the seminal *Cercariæ*, a second example from the lowest class of the animal kingdom having its

[1] Naturgeschichte der Eingeweidewürmer, tab. i. figg. 3, 4, 5.

habitat in the interior of living animal bodies. Referring it, however, provisionally, to the class *Entozoa* of Rudolphi, in which it would indicate a new order, its generic character may be thus given:

Genus Trichina.

Animal pellucidum, filiforme, teres, posticè attenuatum: os lineare; anus nullus; tubus intestinalis genitaliaque inconspicui. (*In vesicâ externâ, cellulosâ, elasticâ, plerumque solitarium.*)

Trichina spiralis.

Trich. minutissima, spiraliter rarò flexuosè incurva; capite obtuso; collo nullo; caudâ attenuatâ obtusâ. (*Vesicâ externâ ellipticâ, extremitatibus plerumque attenuatis elongatis.*)

Hab. in *Hominis* musculis (præter involuntarios) per totum corpus diffusa, creberrima.

With respect to the case in which this singular parasite has been met with, Dr. Roupell, Physician to St. Bartholomew's Hospital, has obligingly forwarded to me the following notes.

"Paolo Bianchi, an Italian, by trade a barometer-maker, about 50 years of age, of a sallow complexion, with black hair and eyes, was admitted under my care on the 4th of December, 1834. When admitted he was much emaciated and weak, his countenance was haggard, and his look depressed. His legs were œdematous; his urine contained albumen, was sweet, and when evaporated yielded a residue like treacle: he had pain in the back. His appetite was deranged, and his liver was felt beyond its natural limits. He had cough, but without urgent distress or hurry in the breathing or expectoration; on auscultation pectriloquy was detected in the upper part of the lungs: his bowels were relaxed. The general treatment was to give him strength by tonic and sedative medicines, with a nutritious but not stimulating diet, and leeches were applied to the loins: for a time he appeared to gain ground, the œdema disappeared, and he gained some strength, being able to get out of bed and dress himself. But his appetite rather suddenly failed him; his diarrhœa increased; his abdomen became tense and painful; his stools passed unconsciously and contained blood; and having received extreme unction from his priest, he died on the 29th of January, 1835, in a state of extreme debility and emaciation. There had not been observed any eruption on the skin, or any greater loss of muscular power than related to the debility caused by the disease of which he died.

"He was examined thirty-six hours after death. Tuberculous cavities were found in the upper lobes of the lungs on both sides, and specks of tubercles in both. The kidneys presented in a marked degree the change described by Dr. Bright. The liver was enlarged and fatty. The mucous membrane of the small intestines was ulcerated to a great extent."

About a fortnight after the dissection of the above subject, a second was brought into the rooms, similarly affected; respecting which Mr. Paget, who first noticed the parasites in the Italian, has favoured me with the following note.

"The second body was that of a poor Irishwoman, who had been in Mr. Lawrence's ward for six weeks. She had died in a state of extreme emaciation, produced by a large sloughing ulcer just below the knee, by which a considerable portion of the head of the tibia had been exposed. She had had occasional severe diarrhœa, and obstinate vomiting."

As regards the seat of the *Trichinæ*, they occur in all the voluntary muscles, and in those which have been termed semi-voluntary or respiratory, as the diaphragm. My friend Mr. Wormald examined and detected them in the minute muscles of the *tympanum*; as many as twenty-five were lodged in the *tensor tympani*. I could perceive no trace of them in portions of the muscular coat of the small or large intestines, neither could I detect any in the *detrusor urinæ* or in the substance of the heart.

A portion of the muscle of the first subject which was sent to me being in a state of incipient putrescence, I preserved it in spirit of wine for three days before examining it; yet after macerating a small portion in water, and separating the cysts, the worms when pressed out continued, to my surprise, to exhibit motions, which, though languid, were sufficiently evident, tightening and dilating their coils. I suppose that, being buried in the flesh and defended by the dense exterior cyst, the spirit had not penetrated so as to act sufficiently upon them to destroy their vitality; for on adding a drop of alcohol to the expressed worms, and afterwards moistening them with water, the motions of coiling and uncoiling ceased. More languid motions than those above described were afterwards noticed by Mr. Wormald and myself in some specimens that were examined a fortnight after the death of the subject infested by them: but it is difficult whether to refer these to hygrometrical influence or to irritability.

The tenacity of life or irritability manifested by these low-organized *Invertebrata*, has attracted the attention of almost every entozoologist. Rudolphi especially takes notice of the power which the *Entozoa* possess of resisting the deadly effect of ardent spirits[1], and relates many other singular instances of their tenacity of life, of which not the least remarkable is that which is manifested by the *Filaria Capsularia* before referred to. When the hard-frozen herrings which are sent packed up in ice to Berlin are thawed for use, these *Filariæ* or *Capsulariæ* revive and exhibit lively motions[2]. The same remarkable property is occasionally forced upon the notice of individuals not

[1] Synopsis Entozoorum, p. 595.

[2] "In Harengas congelatas rigidas et glacie textas frigida affusa reviviscere viderim."—Hist. Entoz., tom. ii. p. 62.

immediately engaged in physiological investigations. It recently happened that two medical gentlemen having sat down to partake of a cod's head and shoulders, were disagreeably interrupted in their repast by the appearance of a large lively round worm, which on the first cut into the fish escaped therefrom, and began to coil and uncoil itself on the edge of the dish. Now this worm must have been submitted to the temperature of boiling water for at least half an hour, and the *Entozoa* would thus appear to endure with impunity extremes alike of cold and heat.

With respect to the cyst of *Trichina spiralis*, I was at first inclined, from the prevailing regularity of its figure, to believe it to be the *Entozoon* itself, or a part of the *Entozoon* analogous to the dilated tail of the *Cysticerci*. Mr. Hilton, Demonstrator of Anatomy at Guy's Hospital, who appears to have first recorded this affection of the human muscles[1], ascribed it to the presence of a minute species of *Cysticercus*, not being aware of the existence of the animal to which the presence of the cysts in question is owing. The difference, however, between the parasitic animals under consideration and the *Cysticerci*, is at once obvious; the true *Cysticerci* are always inclosed within an adventitious cyst of cellular membrane, in which the *Hydatid* either freely floats, or at most adheres to the inner surface by the mouth only; whereas the present cysts, besides the absence of the peculiar structure and pearly subtransparency which characterize the true *Hydatid*, adhere to the surrounding parts by the whole of their exterior, which is covered by a cellular flocculency.

But admitting the similarity of the outer cyst of *Trichina* to the outer adventitious cyst of *Cysticercus*, it may be contended that the inner cyst is part of the organization of the inclosed worm. Its analogy to the second cyst of the genus *Anthocephalus*, within which the elongated body of that worm is seen, readily occurs, but will not hold good on a close examination. The elongated body of *Anthocephalus* is always found in organical connexion with the second cyst; and Rudolphi observes, that the point of continuity is indicated externally by a depression occasioned by the inversion of the body at that part. In the *Cysticerci* a similar appearance is frequently observed, from the inversion of the head and body within the terminal cyst; and in the *Cœnuri*, where the corresponding bladder is common to many armed heads, some of these are generally found inverted, while others are projecting externally. In all these cases, however, besides the difference of structure between the second and outer cyst, they are always perfectly distinct from each other, and readily separable. But I have never been able to effect a corresponding separation between the outer and supposed inner cyst of *Trichina*, or to demonstrate satisfactorily the existence of the latter as a distinct

[1] See 'Medical Gazette' for February 2, 1833, p. 605. In a letter from Mr. Hilton to Thomas Bell, Esq., which the latter distinguished naturalist has kindly communicated to me, it is stated that three subjects, with the muscles similarly affected, have been brought to the dissecting-room at Guy's Hospital during the present season (1834—5).

part: it appears to be a layer only of the external cyst, which, as is often seen in cysts of corresponding structure not formed by *Hydatids*[1], is more or less detached from the outer layer.

In almost every instance in which I have succeeded in opening the cyst without injury to the worm within, it has been expelled entire, together with the fluid matter surrounding it, by pressure upon the cyst. Occasionally, however, a part of the worm remains adherent; but this has been accompanied with a glairy adhesive state of the fluid secretion of the cyst, and has been, I believe, dependent upon it; for when the broken pieces have been extracted and examined with a high power, both extremities have presented the same entire surface and uniform rounded appearance as in the worms which are extracted whole.

The structure and relations of the cyst, therefore, and the absence of all organical connexion between it and the contained worm, lead to the conclusion that the cyst is adventitious, foreign to the *Entozoon*, and composed of the cellular substance of the body infested, morbidly altered by the irritation of the worm.

From the tenacity of irritability manifested by the *Trichina* under circumstances so opposite to those under which it was developed, from its small size compared with the cavity of the cyst, and from the quantity of fluid in which it is immersed, it is highly probable that in its natural condition it enjoys active powers of motion. If in such movements the extremities of the worm were repeatedly pressed against the surrounding capsule, this would yield and become elongated in the directions where there was least resistance; viz. where the muscular *fasciculi* would most readily separate, and observation shows that it is in the direction of the *fasciculi* that the cysts are elongated. If the germ of a *Trichina*, or a portion of the worm separated by spontaneous fission, be deposited at the end of one of the elongated axes of the cyst, it might in the process of development excite the adhesive inflammation, which would then cut off the communication between the smaller cyst and that of the parent worm, while the former would be stimulated to secrete from its inner surface a serous fluid, and so go on enlarging in size, through the influence of the same causes as occasioned the formation of the cyst of the parent. Smaller cysts of different sizes are occasionally seen thus attached to one end of larger cysts, and I am inclined to account in this manner for their formation.

Cysts filled with opake matter are also occasionally seen. In these the worm may have perished, or its germ, after exciting the cyst to secrete, may not have been developed, and the enlargement of the cyst may be occasioned by the accumulation of its own secretion. But these appearances are not sufficient to establish the independent vitality or existence of the cyst, in opposition to those analogies which so plainly point out its true nature and origin.

[1] This separation of cysts alternating with a secretion of fluid is the cause of the *Pill-box Hydatid* of Mr. Hunter, which is not a distinct animal or true *Entozoon*.

I have seen, in two pieces of the diseased muscle, groups of minute oblong vesicles, about $\frac{1}{500}$th part of an inch in length; and these may by possibility be germs of the *Trichina*: they are pellucid, and without internal spot or other structure.

Although the parasites which have been described are of such minute size, their number is so immense, and their distribution throughout the muscular system so extensive, that they must occasion debility from the quantity of nutriment required for their support. It is satisfactory, however, to believe, and the history of the two cases which have afforded the materials of the present communication encourages the belief, that the *Trichinæ* are productive of no other consequence than debility of the muscular system; and it may be questioned how far they can be considered as a primary cause of debility, since an enfeebled state of the vital powers is the probable condition under which they are originally developed. No painful or inconvenient symptoms were present to lead the medical attendants to suspect the condition of the muscular system which dissection afterwards disclosed; and it is not improbable that in all cases the patient himself will be unconscious of the presence of the microscopic parasites which are enjoying their vitality at his expense.

An inspection of the muscles of recently amputated limbs might afford the opportunity of examining this interesting species under peculiarly favourable circumstances; and the occurrence of two cases in the same dissecting-room within so short a period of each other, with the recollection of similar appearances being not unfrequently present in subjects dissected in the same establishment, render it highly probable that a sufficient number of observations will soon occur to elucidate this curious disease in all its relations.

It is one, and by no means the least important benefit of the present system of providing subjects for anatomical purposes, that the histories of the uncommon appearances which may present themselves can be traced, and the circumstances to which the appearances relate be accurately determined. Many an interesting pathological condition has been wholly lost to science from the want of such regulations as are now in operation; and it is not unreasonable to suppose that the unfavourable condition in which subjects were formerly for the most part obtained, may have contributed to prevent due attention being paid to the appearance which has been described, and which results from so singular and unexpected a cause.

PLATE XLI.

Figg. 1 to 9. Trichina spiralis.

Fig. 1. A portion of the *flexor carpi ulnaris* of the Italian subject, showing the capsules of the *Trichinæ* scattered over the muscle and tendon, of the natural size.

Fig. 2. One of the cysts, magnified 20 diameters, containing two *Trichinæ*: the extremities of the cyst are more than usually elongated.

3. Another cyst, magnified 20 diameters, containing a single *Trichina*, with one of the extremities of the cyst slightly expanded and transparent.

4. Another cyst, magnified 20 diameters, torn open, and the *Trichina* with the surrounding granular secretion let out.

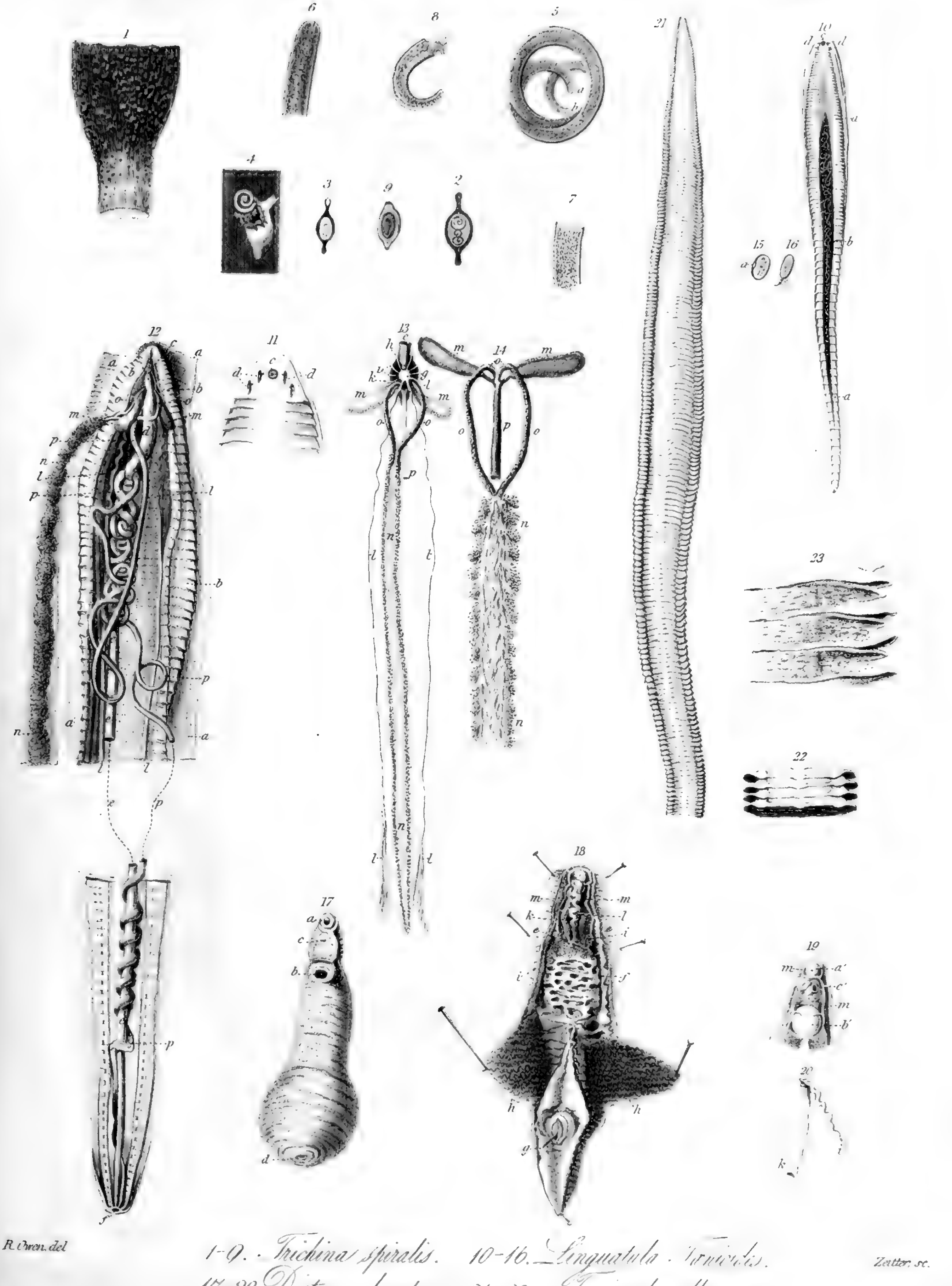
5. The *Trichina*, magnified 200 diameters.
   a. The head, showing the linear mouth.
   b. The tail.

6. The head of another specimen of *Trichina*, magnified 300 diameters, seen by a Wollaston's doublet.

7. The middle of the body, seen through the same microscope. A granular substance, inclosed in a pellucid integument, is all the structure that this view discloses.

8. The tail of the same specimen.

9. A cyst, with calcareous *parietes*, magnified 20 diameters, filled with opake matter.



R. Owen. del

Zetter sc.

1–9. *Trichina spiralis.* 10–16. *Linguatula Tænioides.*
17–20. *Distoma clavatum.* 21. 22. *Tænia lamelligera.*

APPENDIX.

Note to Art. XXXV.

At this early period of the first anatomical season which has commenced since the description of the *Trichina spiralis* contained in the present volume was written, another example has occurred at the dissecting-rooms of St. Bartholomew's Hospital of a male subject, with the muscular system similarly infested with this most interesting and remarkable parasite. Its numbers exceed, if possible, those in the cases already mentioned, every part of the voluntary muscles teeming with the minute white cysts in which the worm is contained. These cysts differ from those I have before examined in being more opake and gritty, so that the presence of the contained worm would not be suspected from a simple examination of their exterior, and it is probable therefore that the cysts first described in the Medical Gazette were in this state. The examples in which two worms are present in one cyst, are more common in this case than in the preceding. The *Trichinæ* when extracted were more lively than I have ever seen them; and in every instance they have presented an opake or dark-coloured spot, about one fifth of the length of the body from the anterior extremity. On breaking across the recently extracted specimens, I have observed in several a retraction of the outer skin, leaving the substance which it envelopes protruding.

Dr. A. Farre, who has observed the same appearances in several of the *Trichinæ* of the present subject, is of opinion that the projecting substance is the alimentary canal. I have not as yet been able to satisfy myself of its tubular structure. In one case the dark-coloured spot formed part of the protruded string. Is this body the ovary? If it be determined that there is an alimentary canal contained within, and distinct from the outer skin, then the *Trichina* would rank higher in the scale than I have placed it, and form a genus of the *Cœlelmintha*. I have not, however, in any instance seen a trace of an excretory or anal orifice.—R. O.

November 18, 1835.

XXXVI. *On the Anatomy of* Linguatula Tænioides, *Cuv.* *By* Richard Owen, *Esq., F.R.S. & Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated February 24, 1835.

HAVING lately, through the kindness of Mr. Langstaff, had an opportunity of dissecting a fine specimen of *Linguatula Tænioides*, Cuv.,[1] I am induced to submit to the Society a few observations on the internal structure of this highly organized *Entozoon*. The anatomy of *Linguatula* has already been treated of by Cuvier and Rudolphi: the former briefly subjoins the results of his dissection to the character of the genus in the 'Règne Animal'[2]; the latter has distributed his latest observations in the different sections of the anatomical Mantissa of the 'Synopsis Entozoorum'[3]. Besides these authors I am not aware of any other who has published on this subject; and I have not yet met with any figures of its internal structure[4].

The specimen here described was 3½ inches in length, compressed, beginning with a round obtuse head, widening gradually for the first inch, where it measured 3 lines in lateral diameter, and from this part regularly becoming narrower to the posterior extremity, which ends obtusely, and is half a line in diameter.

The whole body is invested with a smooth, transparent, rather firm or crisp cuticle, which, from maceration, and probably slight decomposition, had become detached in the individual examined, leaving a considerable interval between it and the contracted *cutis*, or muscular *parietes* of the body. There are no marks of an annulate structure in this *epidermis*. The *cutis* is distinctly divided into segments, most of which, as in the *Entozoa Cestoidea*, are slightly imbricated, the anterior margin of each division being just overlapped by the posterior margin of the segment before it. This disposition is most distinct along the sides of the body, where the integument is thickest and most muscular; while on the dorsal and ventral aspects the divisions are gradually lost; and here the *parietes* are so thin and transparent as readily to permit the contained parts to be seen through them. The great difference between *Linguatula* and the *Cestoidean* worms, among which Chabert, on account of the outward resemblance, first ranked this species, obtains in the condition of the generative organs, which, instead of being as distinct and numerous as the segments, form one continuous system, extending from one end of the body to the other. From the *Trematoda*, in which order Rudolphi and Bremser still place this genus, *Linguatula* differs, in as much as both the generative and

[1] The specimen escaped, as was supposed, from the cavity of the *cranium* of a *Dog*, but it had more probably been lodged in the frontal sinus, in which situation this species is usually developed.

[2] tom. iii. p. 254.

[3] pp. 432, 577, 584, 593.

[4] The figures given by Rudolphi (Hist. Ent., tab. xii. figg. 8—11.) show only so much of the internal structure as is discernible through the integument.

the assimilative organs are not merely excavated in the *parenchyma* of the body, but consist of tubes with well-organized *parietes*, which lie loose in a distinct abdominal cavity, as in the *Nematoidean* and *Annulose* worms. It is owing to this structure that Cuvier has separated *Linguatula* (the *Pentastoma* of Rudolphi) from among the *Vers parenchymateux*, or *Sterelmintha*, and placed it in the *Cœlelminthic* division, or *Vers cavitaires*. Rudolphi, however, remaining uncertain as to the structure of the digestive organ, is unwilling to adopt this arrangement; he observes[1]: " *Pentastomati* CUVIERUS, vir summus, tubum intestinalem rectum adscribit, ideoque et ob systema nerveum Nematoideis addit; specimen autem, quod dissecui, me dubium reliquit; ab anteriori etiam parte duo intestinula cæca[2] sunt complicata, posteriora versus canalis tenuis albus decurrit sed non cuti affixus, qualis Nematoideis esse solet, sed undique ovariis circumvolutus, neque ejusdem fines cognoscere potui; quam ob causam rem in medio relinquam."

In the specimen here described, the tube, which Cuvier rightly considers as the alimentary canal, was readily traceable from its commencement to its termination. It begins at the central *foramen*, or true mouth, and runs straight to the opposite extremity of the body, terminating immediately above the orifice of the genital tube. It is concealed in the greater part of its course, as in many of the *Nematoidea*, by the tortuosities of the oviduct; but on separating the coils of the latter its course may be satisfactorily ascertained. The *œsophagus* is one third of a line in length, and opens into a suddenly dilated canal, which continues with little variation of diameter to the *anus*: the coats of the canal are thin, of a white colour, and not transparent.

With respect to the generative organs, Cuvier observes: " L'intestin est droit; les vaisseaux génitaux longs et entortillés. Les uns et les autres ont leur issue à l'extrémité postérieure." M. de Blainville also observes: " Les oviductes sont longs et entortillés." Rudolphi, in the 'Synopsis Entozoorum', merely observes on this subject: " *Pentastomata, androgyna*, vasis nutritiis Trematodum more divisis instructa," &c.; but in the 'Historia Naturalis Entozoorum'[3], he gives the following description: " Mediam corporis partem *ovaria* ferruginea replent, infra poros inferiores, (duas circiter lineas infra apicem anticum,) e glomere in sinistro abdominis latere, margini fere continuo, oriunda, tum in mediam corporis partem ad caudæ fere apicem descendentia, in latiore vermis parte magis convoluta et coacervata, in parte tenuiore sensim simpliciora, ut in ultimo tandem apice decolora tantum conspiciantur; ovaria ista si explicarentur certe aliquot pedes longa forent, cute firmiore constant, nec facile disrumpunt; aperturam genitalem nullibi vidi, qua ovaria terminarentur, sed ipsa Polystomatis cutis facile rumpitur, ut illa prolabantur, et stato forsan tempore ova effundant. Hæc elliptica, magna, flava et ovario aperto magno numero emittuntur, nunquam autem libera, sed tunica tenuissima candida laxa involuta sunt, qualem in nullo Entozoorum genere viderim. Præter ovaria, alia quoque vasa adsunt, candida (*nutritia*) tam superne in

[1] Syn. Ent., p. 584.

[2] These are the fecundating organs, and communicate with the oviduct, not the intestine.

[3] tom. ii. pars 1. p. 442.

dorsi carina, quam versus caudæ apicem conspicua e poris forsan oritura; ab his saltem, uti supra monui, striæ quædam decedunt, sed hæc extricare mihi nondum concessum est." From this description an idea is conveyed that the *ova* are formed, as in the *Nematoidea*, in the same tube by which they are ultimately conveyed out of the body; but there exists in *Linguatula* a distinct ovary in addition to the oviduct, the convolutions of which are formed by a single tube, and not, as in the *Ascarides*, by two distinct oviducts: the following is the result of my dissection of the generative system of the *Linguatula*.

At the distance of a line posterior to the mouth, on the ventral aspect of the body, the narrow extremities of two elongated pyriform vesicles adhere firmly to the integument, the remainder of the vesicle hanging freely in the abdominal cavity on either side of the commencement of the alimentary canal. These vesicles are 3 lines in length, and more than half a line in diameter; they are composed of a tough white semitransparent membrane, and contain a white pulpy secretion; they communicate with the commencement of the oviduct, and might be considered as an anterior bifurcated prolongation of that tube, but that their dilated form, their mode of communication by means of narrow ducts, and the nature of their contents, proclaim them to be distinct organs, and analogous to the impregnating glands of the hermaphrodite *Rotifera*, &c. One of these vesicles was distended with its secretion, the other had parted with its contents, which had passed into the commencement of the ovarian tube, and were blended with the darker-coloured *ova*.

The ovary is a thin narrow minutely granulated body, continued along and adhering to the mesial line of the dorsal *parietes* of the body for the extent of the two anterior thirds. It terminates about half an inch from the anterior extremity, where it gives off two slender capillary tubes, which pass on each side of the alimentary canal, over the lateral nerves and the male organs, and converging immediately anterior to the ducts of the latter, unite below the origins of the lateral nerves, and enter the commencement of the oviduct.

This tube is very narrow after its commencement, which is formed by the junction of the two preceding ducts and those of the seminal vesicles: it passes for the space of an inch straight down the body, at first ventrad, then dextrad, and afterwards dorsad of the alimentary canal: it then makes a sudden bend upwards, and soon begins to twine around the intestine, ascending to within a few lines of its commencement; there the coils alter their course, and descend, winding round the intestine in the interspaces of the former coils. At about the middle of the body the gyrations are extremely numerous and complex, quite concealing the alimentary canal, which, however, is easily distinguished on separating the coils, on account of its white colour, which contrasts with the ferruginous tint of the oviduct. Towards the lower third of the body the coils of the oviduct become fewer and more distant from each other; and here the brown *ova* are seen in scattered masses; at length the duct runs parallel with the intestine straight to the *anus*, terminating close to the intestine at the posterior end of the body. It is widest at the commencement of the coils, where the contents gradually assume the ferruginous colour; it then becomes narrower, and afterwards continues of the same diameter to its termination at the *anus*.

When a portion of the oviduct is viewed through the microscope, its coats are seen to be thin and transparent, and not closely embracing the *ova*, but thrown into folds here and there. When cut across, the *ova* cannot be squeezed out, but adhere to the oviduct and to each other by a fine connecting cellular substance. They are of a slightly flattened oval form, about $\frac{1}{250}$th of an inch in the long and $\frac{1}{400}$th in the short diameter, filled with a clear yellow finely granular substance. This is invested with its proper membrane, and on one side this membrane recedes from the outer coat, leaving a clear space, where doubtless the *cicatricula*, or germ, is situated. The *ova* are of a firm resisting texture, and do not lose any of their form or contour by drying. Hence they may probably remain long under very different circumstances, preserving their vitality, and ready to take on the actions of development when in a fit situation.

Cuvier rightly observes of *Linguatula Tænioides*, "C'est le ver intestin où l'on voit le mieux le nœud cérébral et les deux filets nerveux[1]." M. De Blainville, who adopts the observations of Cuvier on the other parts of the anatomy of *Linguatula*, is silent with respect to the nervous system. Rudolphi seems doubtful as to the nature of the chords which Cuvier describes, and confesses his inability to detect a nervous *ganglion*. This part was, however, very conspicuous in the specimen here described, such as it is delineated in the accompanying figure of the nervous system. It is situated between the mouth and the commencement of the oviduct, and consequently is subœsophageal, and not cerebral. Eight pairs of nerves may be distinguished, going from it in a radiated manner. The two anterior filaments pass forwards on either side of the *œsophagus*, but they could not be traced to a junction above that tube. The small lateral filaments terminate at the bases of the *fossa* on either side of the mouth. The posterior pair are the largest; they pass over the ducts of the ovaries and *testes* immediately before these join the oviduct, and then run down the sides of the ventral aspect of the body, about a line apart from each other, at first wavy, where we may suppose the contractions of the body to be greatest, and afterwards straight, gradually becoming wider and less distinguishable from the longitudinal fibres of the integument.

This form of the nervous system is similar to that which Cuvier originally ascribed to the genus *Ascaris*, in which he considered as nerves the two white chords which are continued separately along either side of the abdominal region, from one end of the body to the other[2]. But repeated examination of this and other genera of *Nematoidea*, instituted for the purpose of determining a preparation of the *Ascaris Lumbricoides* dissected by Mr. Hunter, to display its nerves, has subsequently demonstrated the correctness of M. Otto's description of the nervous system in those *Entozoa*. In this respect, as well as in the condition of the generative system, *Strongylus*, *Ascaris*, and other *Nematoidea*, differ so widely from *Linguatula* that the latter ought to constitute the type of a distinct order in the class *Cœlelmintha*.

The disposition of the nervous system in *Linguatula* is in some respects similar to

[1] Règne Animal, ed. 1., tom. iv. p. 35.

[2] Leçons d'Anat. Comp., tom. ii. p. 357.

that in the *Slug* (*Limax*), in which the nerves of the body radiate nearly in a symmetrical manner from a single subœsophageal *ganglion*, the two posterior filaments being the longest, and extending almost parallel to each other to the posterior extremity of the body. It may also be observed, that the disposition of the muscular system in *Limax* is analogous to that of *Linguatula*, being most developed at the sides of the foot, and least along the middle line, which is thin and semitransparent when viewed against the light. If one might be permitted to trace further the analogy of form subsisting between genera so widely separated in other important particulars, the two *fossæ*, with their little hooks, on either side of the mouth of *Linguatula*, might be compared with the two depressions which, when the tentacles are retracted, appear in the same situation in the head of the *Slug*. It is the superior organization of these parts which renders necessary the further development of the nervous system of the *Slug*; and the completion of the cerebral ring and the development of the supraœsophageal *ganglion* constitute the chief difference subsisting between it and *Linguatula* in this part of their organization.

The superior powers of locomotion with which the *Slug* is endowed render it necessary that it should have organs of sense sufficiently developed to explore and take cognisance of the various circumstances in which it may be placed. The action of the muscles occasions waste, and demands a proportionate supply of new material for its continuance: hence the necessity of the superaddition of a vascular system for the carriage of the restorative molecules, of a more complex digestive apparatus for their supply, and of respiratory and secretory organs for the elimination of the waste parts of the body.

In *Linguatula*, on the contrary, the sphere of action being limited to a dark cavity in the interior of another animal's body, the necessity for these superadded structures does not exist. Its food, being already animalized, requires only a simple canal to complete its assimilation, without the assistance of teeth or salivary or biliary organs. Neither heart nor vessels are perceptible, and it is probable that nutrition is effected by transudation and imbibition; and here we may notice the admirable arrangement of the oviduct with reference to the reception of the materials for the full development of the myriads of *ova* which it contains.

Living in a cavity to which external air has access, it might be expected that the vital phenomena of *Linguatula* would be more energetic than in other *Entozoa*. With respect to its muscular actions, Rudolphi observes: "Motus peculiares, vermium teretium tamen agitationibus maxime accedunt, partem nimirum tam anticam quam posticam continuo vel reflectit vel inflectit, minore tamen, quam illi, corporis vi utitur, neque cutis musculorum apparatum notabilem continet. A Trematodum, vel Distomatum, vel Amphistomatum et Monostomatum, vel etiam Polystomatis uncinulati, motibus quam maxime recedit, neque cum Tæniis ullo modo comparari potest [1]."

[1] Hist. Ent., tom. ii. p. 443.

PLATE XLI.

Figg. 10 to 16. LINGUATULA TÆNIOIDES.

Fig. 10. *Linguatula Tænioides*, of the natural size, as seen from the ventral aspect.

a. The serrated muscular lateral parts of the body.

b. The thin semitransparent mesial integument.

c. The circular mouth.

d, d. The oblong pits containing the hooks.

11. The anterior part of the worm, magnified three diameters, showing the round central mouth, and the lateral pits and hooks.

12. The anterior and posterior parts of the body of the *Linguatula* magnified four diameters, with the dorsal *parietes* of the abdominal cavity removed, to show the alimentary canal, impregnating glands, convoluted oviduct, and nerves *in situ*.

13. The nervous and generative systems removed from the body; the uterine tube cut short.

14. A part of the generative system, showing the junction of the oviducts and *vesiculæ seminales*.

The same letters indicate the same parts.

a. The external or epidermic layer of the integument.

b. The muscular layer.

c. The *œsophagus*.

d. The dilated part of the alimentary canal or stomach.

e. The intestine, surrounded by the coils of the oviduct.

f. The *anus*.

g. The single subœsophageal *ganglion*.

h, h. The anterior pair of nerves passing on either side of the *œsophagus*.

i, i. The second and third pairs of lateral nerves, going to the *fossæ* and hooks.

k, k. The fourth lateral pair of nerves, supplying the genital organs.

l, l. The fifth or posterior pair of nerves, supplying the body.

m, m. The male organs or glands secreting the impregnating fluid.

n, n. The ovary.

o, o. The oviduct.

p. The *uterus*, or tube formed by the union of the oviducts and *testes*.

15. An *ovum* of *Linguatula Tænioides*, magnified 300 diameters, showing its breadth and the recedence of the vitelline from the cortical membrane at *a*.

16. An *ovum*, showing its thickness, or lesser transverse diameter, with part of the connecting substance adhering to it.

XXXVII. *Additional Remarks on the Genus* Lagotis, *with some account of a second Species referrible to it. By* E. T. Bennett, *Esq., F.L.S., Sec. Z.S.*

Communicated May 26, 1835.

THE brief notice which I am about to lay before the Society may be regarded as supplemental to the communication 'On the *Chinchillidæ*' made to it in the spring of 1833, and published in the First Part of the 'Transactions'[1]. Its object is to characterize a second species of the genus *Lagotis*, a genus originally proposed by me in the summer of 1832, and described in detail in the paper referred to; in which were included an account of the external form, the visceral anatomy, and the osteology of the genus, as observed in the only individual which I had seen of the single species then comprised in it. A skin of a second species has since come into the possession of the Society, having been acquired by purchase from Mr. Gould, who bought it out of a collection believed to have been brought from the Chilian Andes: this skin furnishes the sole materials within my reach for the elucidation of the characters of the animal in question.

Lagotis, it will be remembered, differs externally from *Chinchilla* by the possession of four toes on each of its feet, instead of five on the anterior and four on the posterior; and by the greater length of its tail, which is nearly equal to that of the body and head taken together, while in *Chinchilla* the length of the tail, exclusive of the hairs, is scarcely more than one half of that of the body and head. To these characters I had formerly added that derived from the greater length of the ears in *Lagotis* as compared with those of *Chinchilla*, these organs being in *Lag. Cuvieri* equal in length to the distance interposed between their base and the muzzle of the animal, while in the latter they scarcely exceed three fourths of that distance; but as this character does not obtain in the animal before me, it can no longer be regarded as generic. In the second species of *Lagotis* the ears have nearly the same comparative length as in *Chinch. lanigera*; but they do not possess the amplitude of lateral development which distinguishes those of the latter animal.

This diminished length of the ears in the second species of *Lagotis* affords, perhaps, the most readily appreciable distinguishing mark between it and *Lag. Cuvieri*; but there are other characters of distinction between them which may be thus expressed:

[1] p. 35.

Genus Lagotis, *Benn.*

1. Lagotis Cuvieri, *Benn.*

Lag. auriculis caput longitudine æquantibus ; vellere longiore ; caudæ setis albidis nigrisque ; pedibus cinereis.

Hab. in Peruviâ.

2. Lagotis pallipes.

Lag. auriculis capite brevioribus ; vellere brevi ; caudæ setis ferrugineis ; ventre pedibusque fulvescentibus, his pallidioribus.

Hab. in Chiliæ montosis.

The general form of the body of *Lag. pallipes* is apparently similar to that of *Lag. Cuvieri*, but the comparative brevity of the fur will probably deprive the animal, when seated in its usual position, of much of that resemblance to a ball of wool which may be fancied to exist in *Lag. Cuvieri*. The long and remarkable whiskers are scarcely so heavy, so numerous, so rigid, or so long as those of *Lag. Cuvieri*; and some of the less elongated of the bristles composing them are entirely white, whereas in *Lag. Cuvieri* the whole of the bristles of the whiskers are jet-black. The want of naked muzzle and the form and direction of the nostrils correspond in both species: the position of the eyes is also similar. The ears have the parallelogrammic form of those of *Lag. Cuvieri*, and are about two inches in length by three quarters in breadth, the length of the head anterior to their base being two inches and a half: the folds of the ears and the supplementary auricle are the same in both species. The outside of the ear is sparingly clothed with short dark adpressed hairs, which become more numerous towards the margins; their inner side is also sparingly furnished with hairs, which are longer and looser than those of the outer surface, and are nearly white: the darkly coloured hairs of the outer side project slightly beyond the upper edge of the ear, forming a fringe to the extremity of its lobe.

The general proportion of the limbs to the body and to each other is apparently similar to that which obtains in *Lag. Cuvieri*. On the anterior feet the toes, similar in number, are similarly covered above with stiff hairs, which pass down between them, and also conceal the short, sharpish claws: the pads of the sole equally correspond in number and position. The hinder feet are also like those of *Lag. Cuvieri*, in the number and relative proportion of the toes, in their mode of covering, in the form of the claws (including the widening and flattening of the inner one, adapted, with its overhanging covering of stiff, horny, comb-like bristles, for the cleaning and disentangling of the fur), and in the number, form, and position of the pads of the soles.

The fur of *Lag. pallipes* is, perhaps, even softer to the touch than that of *Lag. Cuvieri*; a feel which is probably owing to its being less dense, on account of the comparative shortness of the hairs composing it: the fur of *Lag. Cuvieri* imparts to the hand the sensation of fullness and consequent firmness, that of *Lag. pallipes* is yielding with its softness. The hairs in both species, especially those which form the mass of the fur, are wavy for the greater part of their length, their tips only being straight: those of the middle of the sides measure, when their natural waves are not interfered with, three quarters of an inch in *Lag. pallipes*, and an inch and a quarter in *Lag. Cuvieri*. The longer and more bristle-like hairs, the black tips of which project slightly beyond the general mass of the fur, are rather more numerous in *Lag. pallipes* than in *Lag. Cuvieri*: but, notwithstanding this, the general tint of the colouring is nearly the same in both animals, a greyish ash-colour tinged with yellowish and varying in intensity in undulations; along the middle of the back the black-tipped hairs prevail to an extent which causes an indication of a darker-coloured line. The individual hairs have the same colour in both species; and it is essential to remark that their basal portion is dusky and by no means brown. The under surface of *Lag. pallipes* is of a rather pale fulvous colour, all the hairs being tipped with that tint, though they are equally dusky at the base with those of the upper surface: the fulvous colour extends along the under surface to the mouth, becoming paler as it advances forwards, and fading almost into white under the lower jaw; surrounding the vent its intensity is considerable; it reaches nearly half way up the sides, and is almost sharply divided from the grey of the upper surface; and it occupies the whole of the inner side of the upper part of the limbs and the entire feet, being, however, on the latter of a much paler tint, approaching to whiteness: in *Lag. Cuvieri* the under surface is only less grey than the upper, and the feet are almost purely grey, the hairs which cover them being partly dusky and partly whitish, and having no intermixture of yellow or fulvous. The colouring of the under surface, and especially of the feet, is consequently strongly distinctive between the two species of *Lagotis*; and that of the long bristles which form a high crest along the upper surface of the tail and project beyond its extremity, affords another equally well marked character: in *Lag. Cuvieri* the greater number of these rigid hairs are whitish, and with these are intermixed (somewhat in tufts) others which are black, those of the extremity being entirely black; in *Lag. pallipes* it is only at the commencement of the crest that there is any intermixture of whitish or black hairs; these are immediately replaced by others of a dull ferruginous or rusty tint, which are continued to the extremity of the tail and project beyond it in a tuft of a brighter and deeper rust colour than the adjoining ones. The under surface and sides of the tail are covered in both species by the same short, rigid, adpressed hairs, of a mixed grey colour, which is deeper beneath, and forms along the middle of the under surface an almost black line.

Such are the principal differences manifested by the second species of *Lagotis* on a comparison of it with the one which formed the type of the genus. Subjoined are a few of the more important admeasurements of each, derived from the skins.

	Lag. Cuvieri.		*Lag. pallipes.*	
	ft.	in.	ft.	in.
Length of the body and head	1	4	1	3
Length of the tail, exclusive of the hair		$11\frac{1}{2}$		9
Length of the ear		$2\frac{3}{4}$		$2\frac{1}{4}$
Length of the hinder foot		$3\frac{1}{4}$		3

In conclusion it is necessary for me to remark that nearly at the same time with the reading of my communication '*On the Chinchillidæ*,' Dr. Meyen read before the Imperial German Academy of Naturalists a paper on various animals collected by him in Peru and Chili, in which he described, under the name of *Lagidium*, the genus which I had previously designated as *Lagotis*[1]: his type, *Lagidium Peruanum*, appears to be identical with *Lagotis Cuvieri*. To this paper by Dr. Meyen, in which he enumerates a much greater number of species of *Chinchillidæ* than appear to me to have yet been satisfactorily ascertained, I have adverted in a communication printed in the fifth volume of the 'Zoological Journal'[2], in which I have again reviewed the synonymy of the family, with the view of endeavouring definitely to establish it.

PLATE XLII.

Lagotis pallipes.

[1] Dr. Meyen's Paper was communicated to the Imperial Academy in March, 1833: mine was communicated to the Zoological Society in May of the same year. But the genus *Lagotis* had been characterized by me, so far as its external characters could be ascertained from the living specimen, at a Meeting of the Committee of Science and Correspondence in June, 1832, and the name then given was affixed, throughout the life of the individual, to the cage in which the Society's animal was kept.

[2] p. 491.

XXXVIII. *Observations on the Genus* Cancer *of Dr. Leach* (Platycarcinus, *Latr.*,), *with Descriptions of three new Species. By* Thomas Bell, *Esq., F.R.S., L.S., G.S., & Z.S.*

Communicated June 9, 1835.

In the course of the gradual distribution into various genera of a group of animals previously arranged under a single generic term, it is not always a matter devoid of difficulty to decide by which of the newly distinguished groups that original appellation should be retained; and different rules have been laid down, and different principles resorted to, by various naturalists on this point, whilst others have been wholly careless on the subject. The consequence of this discrepancy has been the absence of all unity of design in the present heterogeneous nomenclature of the different divisions of the animal kingdom, according to the varying views adopted by the individuals by whom each portion has been separately studied and developed.

It is undoubtedly desirable where a particular species can, with tolerable certainty, be recognised as having received a distinct appellation from any of the early masters of natural science, to retain that name for the genus to which the species belongs, and still to consider it as designating the smaller group in which it is included, whatever may be the changes and subdivisions made in the larger group to which it was originally attached. This is still more imperative when the name has been so applied by any modern naturalist, whose character for learning and accuracy is such as to give weight to his opinion in matters of nomenclature. It appears to me that the name which I propose to retain for the genus which is the subject of this paper is thus strongly recommended for our adoption, as being very probably the one by which the type of that genus was known to the older writers, and which has recently been applied by one of our most distinguished carcinologists, to the genus restricted by himself to the only species of it then known to him. The generic name *Cancer* was applied by Dr. Leach to the species *Canc. Pagurus*, with the full understanding that it constituted the type of a form distinct from all others of the family. I have therefore chosen this opportunity to claim for it the same distinction, upon the ground that the group was so designated by my distinguished friend, before the term *Platycarcinus* was applied to it by Latreille in the French Museum, and consecrated by Dr. Milne Edwards in his recent admirable work on the natural history of *Crustacea*; and also because, by applying any other term to this genus, we are obliged to restrict the word *Cancer* to a small and comparatively unimportant group, not a single species of which was probably distinctly known to any naturalist of early times.

When the characters of the present genus were first defined, the only known species was the common *large eatable Crab* of our coasts, the *Cancer Pagurus*, Linn. To this the name *Platycarcinus* was given by Latreille; an infelicitous appellation certainly, as none of the species are characterized by any particular degree of flatness of the body, and some of them even possess a rather remarkable degree of elevation. Dr. Edwards, with great correctness and tact, united to the genus, thus restricted in its characters, a second species, the *Cancer irroratus* of Say; and to these I have the satisfaction of adding three entirely new and highly interesting species, collected by Mr. Cuming; an acquisition which, whilst it increases our opportunities of fixing and appreciating the characters of the genus, renders a complete revision of it necessary. It is, indeed, worthy of remark, that the specific character of *Canc. Pagurus* as given by Dr. Leach in his 'Malacostraca Podophthalma Britanniæ,' is applicable, with very little latitude, to all the species now known, as they agree, without exception, in the margin, on each side, having nine, or more properly ten divisions (the last being obsolete), in the front being trifid, and the carapax granulated.

The application of the name *Cancer* to the present genus renders it necessary to attach a new generic term to the group to which Dr. Edwards had appropriated it, and which he has characterized with his accustomed discrimination. It is very nearly allied to *Carpilius*, from which some of the species scarcely differ except in the form of the legs, which in *Carpilius* are round, and in the other group much flattened and fringed with hair. I propose for this genus the name *Platypodia*; and I conceive that in making these alterations in the nomenclature of this family, I am not intrenching on any of the acknowledged rules by which these matters are generally regulated, but rather, by so early an interference, contributing to their establishment.

The genus *Platypodia* on the one hand approximates to *Carpilius* by *Plat. rosea* and *Plat. interrupta*, and on the other to *Zozymus* by *Plat. lobata.*

Genus Cancer, *Leach.* (Platycarcinus, *Latr.*, *Edw.*)

Antennæ externæ articulo basilari maximo, anticè in dentem fortem producto, hiatum inter frontem et canthum internum oculi implente: portione mobili setaceâ, brevi, propiùs foveolæ antennæ internæ quam cantho interno oculi insertâ.

Antennæ internæ foveolis longitudinalibus, antrorsum porrectæ.

Pedipalpi externi caulis interni articulo secundo ad marginem antico-internum excavato.

Pedum par anticum subinæquale, paria reliqua ambulatoria.

Abdomen maris 5- fœminæ 7-articulatum.

Oculi pedunculo brevi.

Testa transversa, lata, ellipticè arcuata, marginibus antico-lateralibus decem-lobatis, lobo posteriore obsoleto; fronte trifido.

The shell in this genus is broad, elliptical, somewhat elevated, and with the regions rather distinctly marked. The surface in all the species hitherto known is more or less granulated. The front is trifid, the middle tooth being sometimes lost in very old specimens. The orbits have a rather strong tooth over the inner *canthus*; there are two parallel fissures above, and one beneath. The latero-anterior margin on each side extends as far backwards as the centre of the cardiac region, where it is lost in a sinuous granulated ridge which rises over the latero-posterior margin. It is divided into ten lobes, which are either quadrate, and therefore contiguous at the sides, as in most of the species; or lanceolate, as in *Canc. dentatus*: the last lobe is always very small, and often obsolete.

The external *antennæ* have the basilar joint broad, very long and thick, filling the hiatus between the inner *canthus* of the orbit and the front, and terminating forwards in a strong, angular, tooth-like projection, directed forwards and a little inwards, reaching beyond the frontal line. The terminal or moveable portion is slender, very short, and arises from the internal part of the basilar joint, nearer to the cell of the internal *antennæ* than to the orbit. The internal *antennæ*, instead of lying obliquely outwards or transversely, as in most other genera of this section, are directed forwards; a character by which *Cancer* may at once be distinguished from *Platypodia*, *Carpilius*, *Xantho*, &c. The second joint of the inner footstalk of the external pedipalps is excavated at the anterior part of the inner margin; in some species the notch is confined to the angle, in others it extends half way down the side of the joint. The first pair of feet is nearly equal; in some specimens of each species the difference in size being scarcely appreciable. They are generally very robust. The remaining feet have no spines, but are in most species more or less hairy. The *abdomen* of the male has five, that of the female seven, joints.

With the exception of our indigenous species, *Canc. Pagurus*, they are all, as far as their localities are yet known, exclusively natives of the coasts of the hotter parts of America.

1. Cancer longipes.

Tab. XLIII.

Canc. testâ leviter granulatâ, sparsim punctatâ; margine antico-laterali plicato, decem-lobato, lobis contiguis, ad marginem minutè denticulatis; manibus lævibus, extùs lineis quinque impresso-punctatis; pedibus longioribus; abdominis articulo ultimo æquilateraliter triangulari.

Hab. apud Valparaiso. (Cuming.)

♂ Muss. Soc. Zool., Bell.

The general colour and thin texture of the carapax, with the long slender form of the legs, remove this species at first sight far from those which a nearer inspection prove to be very nearly allied to it; particularly *Canc. Edwardsii*, to which many of its most important characters so closely approximate it, as to require some care in expressing its specific diagnostic phrase.

The carapax is very broad; the surface minutely granulated with scattered impressed points. The margin is divided into ten shallow contiguous lobes, the extreme edge of which has a number of small granular teeth, and which from the fourth to the ninth have one tooth more prominent than the rest. There is a peculiarity in this species which does not occur in any other of this genus, nor perhaps in the whole order; the furrows which separate the branchial from the genital and cardiac regions, and which in most are distant, in some degree resembling the letter H, in this species coalesce on the median line, forming a single deep hollow; and thus the outlines of the genital and cardiac regions are placed far apart, whilst the branchial regions closely approach each other. The front has three rounded lobes, of which the middle is the longest. The tooth over the inner *canthus* of the orbit is obtuse, and rather less prominent than the frontal lobes. The tooth-like process of the basilar joint of the external *antennæ* forms an obtuse angle. The legs are very long; the third joint of the second pair extending considerably, and even that of the first in some degree, beyond the edge of the carapax. They are wholly without spines; nor are they hairy in any of the specimens I have seen, with the exception of the last joint of the four posterior pairs. The first pair is thick and strong, and its surface smooth. A simple *carina* extends along the *carpus*, terminating in an angular projection; and a similar *carina* occupies the upper edge of the hand, on the outer surface of which are five longitudinal lines of impressed dots, but without any elevation. The sides of the four posterior pairs of legs are also marked with lines of impressed dots; and the last joint of each is furrowed at the sides, and has a longitudinal crest of hair on the upper, and two on the lower, edge. The last joint of the *abdomen* in the male forms an equilateral triangle.

Colour above light red, indistinctly dotted with yellow; beneath yellowish. Tips of the claws blackish.

Length 3½ inches, breadth 6.

The only specimens which I have seen of this species were brought by Mr. Cuming from Valparaiso, where they are taken by nets in deep water: the claws are considered a great delicacy, and the fishermen are in the habit of breaking them off, and then throwing the animals, still alive, again into the water.

The indigenous name is *Boco*.

2. Cancer Edwardsii.

Tab. XLIV.

Canc. testâ granulatâ; margine antico-laterali decem-lobato, lobis latis, contiguis, profundè dentatis; manibus suprà obsoletè tuberculoso-carinatis; maris abdominis articulo ultimo anticè producto.

Hab. apud Valparaiso. (Cuming.)

♂ Mus. Soc. Zool. ♂ ♀ Mus. Bell.

Carapax elevated, particularly at the gastric region; the surface almost uniformly granulated. The latero-anterior margin is divided into ten lobes, the sides of which are contiguous, and their margins deeply dentate, two of the teeth of each being larger than the others; the lobes become broader and shallower posteriorly, and the last is obsolete, passing into the granulated posterior ridge. The front has three teeth, the middle one being small, and in the old specimen from which this description is principally taken it is wholly lost. A strong tooth projects over the inner *canthus* of the orbit, and there is a smaller one beneath, immediately exterior to the basilar joint of the external *antennæ*, the strong process of which is rather obtuse and simple. The anterior pair of legs are very large and strong: they are not tuberculated as in *Canc. dentatus*, nor spiny as in *Canc. irroratus*; but there are slight indications of a double tuberculate *carina* on the upper edge of the hand, particularly in young individuals, and on its outer surface are five obsolete longitudinal lines. The four posterior pairs of feet are strong, nearly smooth, and terminated by strong, sharp, horny claws. There is no hair on any part of the body or legs in the specimens which I have seen. The last joint of the *abdomen* in the male is produced anteriorly; the fourth nearly quadrate, rather longer than broad.

Colour above reddish brown; beneath yellow mottled with reddish.

Length $5\frac{3}{4}$ inches, breadth $7\frac{1}{2}$.

The adult specimen was taken by Mr. Cuming at the depth of twenty-five fathoms, on rocky ground; the younger specimens were caught by seines on sandy beaches.

I have dedicated this magnificent species of a genus the characters of which were first fully developed by him, to Dr. Milne Edwards, the author of incomparably the most complete work on Carcinology that has ever appeared.

3. Cancer dentatus.

Tab. XLV.

Canc. testâ granulato-scabrâ, hispidâ; margine antico-laterali decem-dentato, dentibus lanceolatis, denticulatis; manibus tuberculoso-bicristatis, extùs lineis quinque longitudinalibus granulatis; pedibus pilosissimis.

Hab. apud Valparaiso. (Cuming, Miller.)

♂ Mus. Soc. Zool. ♂ ♀ Mus. Bell.

Carapax considerably elevated, and the regions rather strongly marked; the surface roughly granulated, hispid, with patches of small spiny tubercles, particularly towards the anterior part. The latero-anterior margin, instead of being but slightly divided into obsolete lobes, as in most of the other species, is deeply cut into sharp lanceolate teeth, the edges of which are furnished with numerous sharp denticulations. The posterior tooth, which reaches to the anterior part of the cardiac region, is smaller than the rest, and its posterior granulated margin passes off into the post-branchial ridge. The front has three strong acute teeth, of which the middle one is the most prominent: there is also a strong triangular tooth over the inner *canthus* of the orbit, a smaller one over the outer, between the two superior orbitar fissures, and a large one beneath the inner *canthus*, with a smaller one at its outer base. The tooth-like process of the basilar joint of the external *antennæ* is strong, prominent, acute, and denticulate at its margin, like those of the border of the carapax. The claws are very robust, and strongly marked. The *carpus* has several more or less complete lines of strong spiny tubercles, which terminate in two strong spines on the upper and anterior margin; the hand is furnished on its upper edge with two crests of similar tubercles, which are extended to the moveable finger; on the outer surface of the hand are five longitudinal equidistant raised lines, which are more or less tuberculate or granulate. The remaining feet are almost covered with long dark-coloured hair. The *abdomen* of the male has the last joint somewhat produced. That of the female is very large and protuberant.

Colour above rich reddish brown, somewhat mottled with yellowish, particularly in young specimens; beneath red mottled with yellow.

Length of the largest specimen which Mr. Cuming brought home 4 inches, breadth $5\frac{1}{2}$.

This very handsome species was taken by Mr. Cuming at Valparaiso in deep water about rocks. I have also received a young specimen from Mr. Miller, who assigns to it a similar *habitat*.

4. Cancer irroratus, *Say*[1].

Tab. XLVI.

Canc. testâ leviter granulatâ; margine antico-laterali decem-lobato, lobis contiguis, quadratis, ad marginem denticulatis; manibus compressis, dentato-bicristatis.

Hab. ad oras Floridarum (Say) et Americæ Australis (Cuming, Miller).

Carapax transversely oblong, regularly elevated; the surface minutely granulated; the regions but slightly distinct. Latero-anterior margin slightly divided into ten lobes, the anterior ones smaller and contiguous, the posterior broader and slightly diverging; the edges minutely denticulated, each having one or two teeth larger than the rest. Front tridentate, the teeth triangular; orbits oval, with a small tooth over the inner *canthus*, but none between the superior fissures, as in some other species. External *antennæ* with the basilar joint flat, its inner margin a little excavated, and its tooth obtuse. Pedipalps as in the other species. *Sternum* almost without hair, polished, numerously and minutely punctated. *Abdomen* very slightly fringed; the terminal joint a little produced, terminated by a few longish hairs. Anterior feet compressed, angular, the wrist with a sharp spine above, projecting over the base of the hand; the hands compressed, somewhat inflexed, crested, the crest denticulated, the external surface with five longitudinal elevated granular lines. The remaining legs slender, very long, compressed,

[1] Journ. Acad. Ent. Sci. Phil., vol. i. p. 59. t. 4. f. 2.

the antepenultimate and terminal joints longitudinally furrowed; the nail small and slender.

The colour of this pretty species is a light lively red above, with several curved lines of white spots over the branchial and hepatic regions, a white lengthened spot on each side of the genital region, and a white mark, like a V, over the intestinal. The anterior feet are of a darkish red above, the remaining legs dotted with purplish red. The under side is whitish.

The carapax of the female is less broad in proportion than that of the male, and as usual more elevated; but I do not observe, in the numerous specimens in my possession, that considerable difference which Say describes as being sufficient to occasion some hesitation whether they belong to the same species. The spots on the carapax are indeed much less distinct in the female, but they are sufficiently obvious in every specimen which I have seen of that sex.

Length $2\frac{1}{4}$ inches, breadth 4.

5. Cancer Pagurus, *Auct.*

Leach, Mal. Pod. Brit., Tab. X.

Canc. testâ granulatâ; margine antico-laterali decem-lobato, lobis quadratis, contiguis, integris; manibus lævibus.

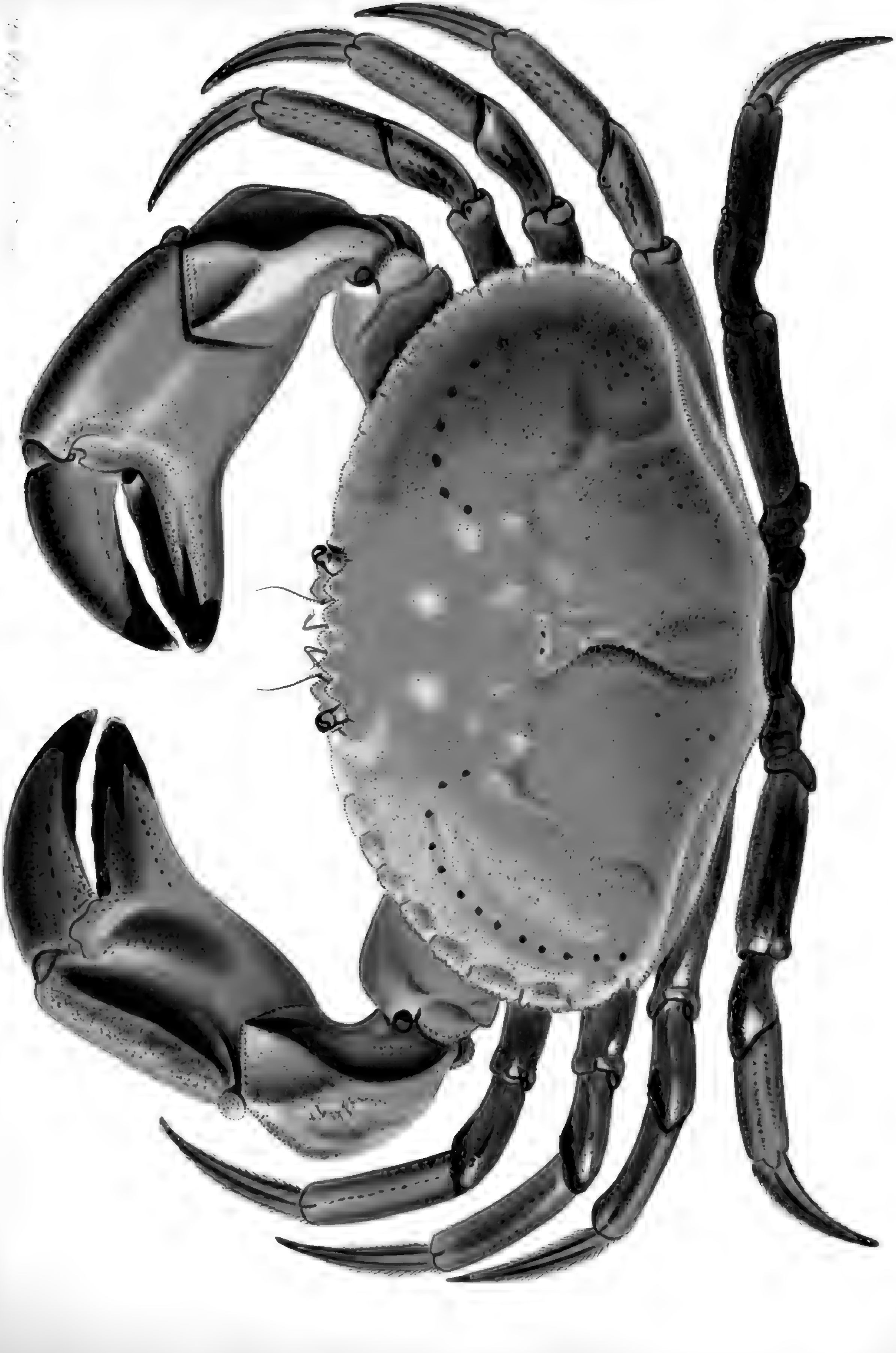
Hab. ad oras Magnæ Britanniæ et Europæ Occidentalis.

Carapax transversely oblong, flattened, but little higher in the middle than at the sides, somewhat rounded before and behind; the surface minutely granulated, smooth, with the regions but slightly marked. Latero-anterior margin slightly recurved, divided into ten quadrate lobes, the sides of which are contiguous, and the margins entire; the last lobe inconspicuous, and passing into the posterior marginal line, which terminates immediately anterior to the posterior transverse ridge. Front trifid, the teeth of nearly equal length and size. Orbits round, with a strong triangular tooth over the inner *canthus*, which does not project so far as the front; and a smaller one filling the space between the two superior fissures. External *antennæ* with the basilar joint much elongated, and terminating forwards in an obtuse tooth; the first joint of the moveable portion club-shaped, the second cylindrical, the remaining portion setaceous. Internal *antennæ* directed forwards, the anterior half doubled directly backwards in a state of rest. The basilar joint broad, cup-shaped, its outer edge projecting forwards; the second joint (the first of the moveable portion) cylindrical, the penultimate with a small, hooked, and recurved process at the *apex*. Pedipalps as in the rest of the genus. *Sternum* minutely punctated, and furnished with small patches or lines of short scanty hair. *Abdomen* in the male with the margin fringed with short hair; the last joint forming an equilateral triangle. Anterior feet large, robust, smooth, without spines or tubercles, minutely granulated, the hand rounded, without crest, the inner surface exhibiting only the rudiments of the five lines of *puncta*, so conspicuous in other species of the genus. The remaining feet furnished with numerous *fasciculi* of stiff hairs, the last joint in all furrowed, and terminated by a short strong nail.

Colour above reddish brown, the legs more red, the claws deep shining black; beneath whitish.

PLATE XLVII.

Fig. 1. *Abdomen* of *Cancer longipes*, ♂.
2. *Abdomen* of *Canc. Edwardsii*, ♂.
3. *Abdomen* of *Canc. Edwardsii*, ♀, very young.
4. *Abdomen* of *Canc. dentatus*, ♂.
5. *Abdomen* of *Canc. dentatus*, ♀.
6. *Abdomen* of *Canc. irroratus*, ♂.
7. *Abdomen* of *Canc. irroratus*, ♀.
8. Antennary region of *Canc. Pagurus*.
9. Pedipalp of the same.



O Westwood del.

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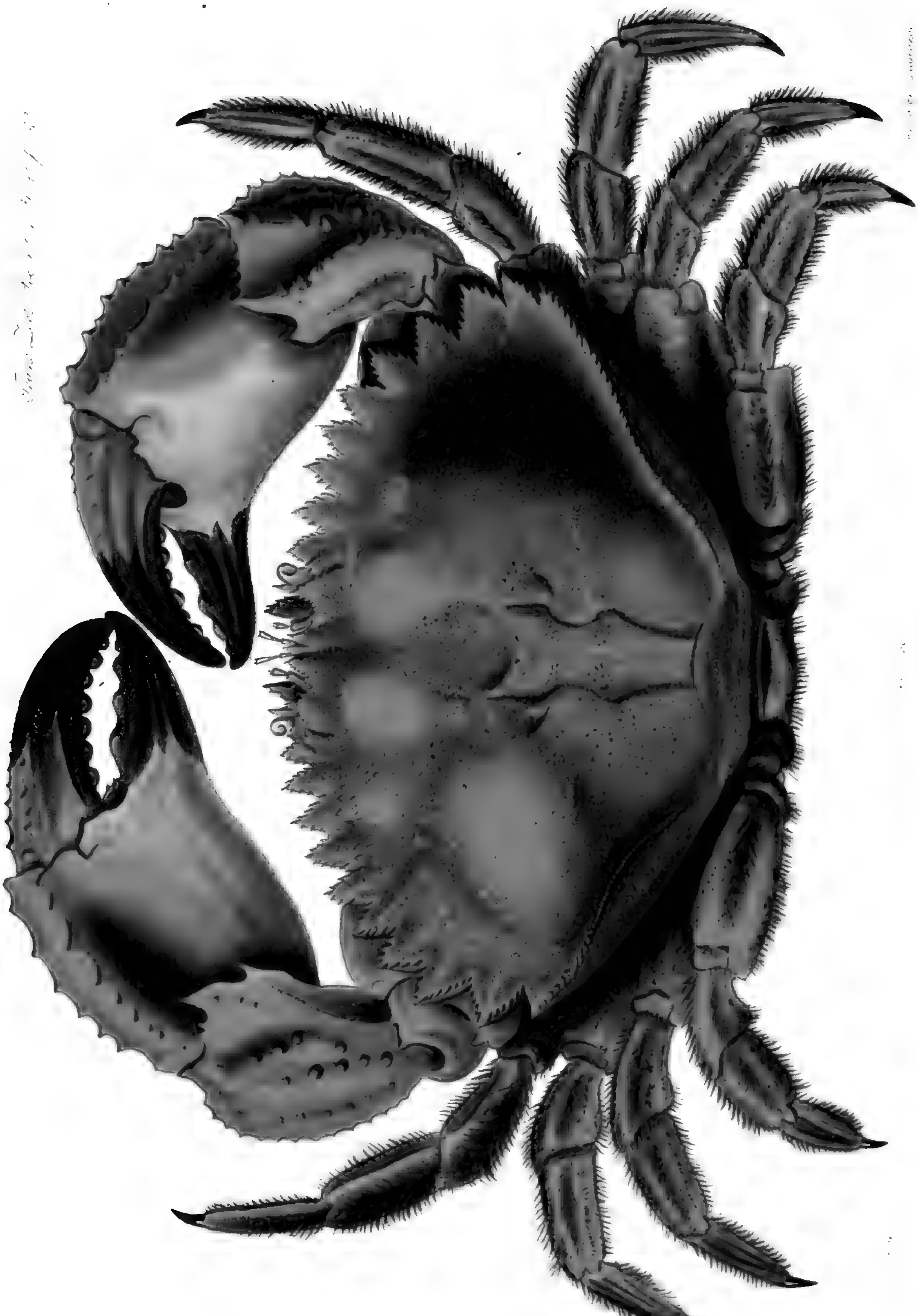
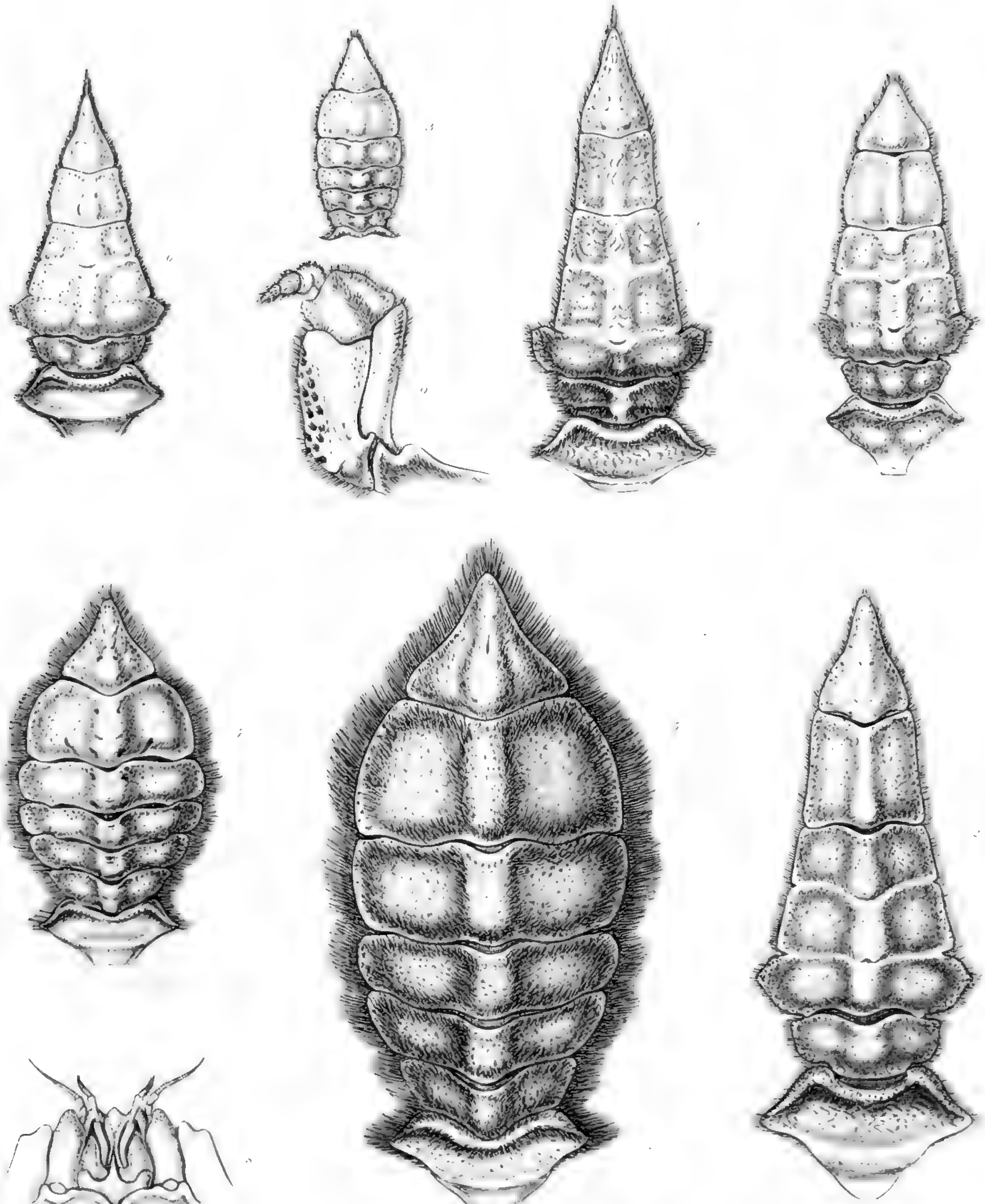
Printed by C. Hullmandel.

Cancer Edwardsii



Cancer irroratus



XXXIX. *On the Osteology of the* Chimpanzee *and* Orang Utan. *By* RICHARD OWEN, *Esq., F.R.S. & Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated March 10, 1835.

IN tracing the successive stages by which the lower animals approximate the structure of *Man*, the interest increases as we advance, and becomes most exciting when we arrive at the highest term of the brute creation. At this point every deviation from the human structure indicates with precision its real peculiarities, and we then possess the true means of appreciating those modifications by which a material organism is especially adapted to become the seat and instrument of a rational and responsible soul.

The *Orangs*, or great tailless *Apes* of Africa and Asia, have long been recognised as the *Mammalia* which make the closest approach to *Man*; and their organization has therefore been studied with more or less care and detail by many distinguished physiologists and comparative anatomists. Tyson[1], Camper[2], Blumenbach[3], Cuvier[4], and Lawrence[5], have been the chief contributors to this department of zoology, and by their labours most of the peculiarities of structure have been pointed out which relate to the semi-erect posture and climbing habits of the *Quadrumanous* order. The numerous analogies to the human structure which have at the same time been brought to light, have ever held a prominent place among the facts that have served as the basis of the theories of animal development: but as it has uniformly happened that the *Orangs* which have been described have been of immature age, many circumstances, as the facial angle, the forms and proportions of the teeth, and the shape and relative size of the *cranium* to the face, have had an undue importance assigned to them, and the transition from the *Monkey* to the *Man* has been assumed to be much more gradual than a more extended investigation will be found to sustain.

[1] Orang-outang, sive Homo sylvestris; or the Anatomy of a Pygmie, &c. 4to, Lond. 1699.

[2] Œuvres sur l'Histoire Naturelle, la Physiologie, et l'Anatomie Comparée, tom. iii. 8vo, Paris, 1803. Anat. de l'Orang Utang, tom. i.

[3] Beyträge zur Naturgeschichte. Göttingen, 1790—1811. Abbildungen Natur-historischer Gegenstände. Short System of Comparative Anatomy, translated from the German by W. Lawrence. 8vo, Lond. 1807. Manual of Natural History, translated by R. T. Gore. 8vo, Lond. 1825.

[4] Règne Animal, nouv. ed. 8vo, Paris, 1829. Leçons d'Anat. Comparée, *passim*. Dissertation on the Identity of the *Simia Satyrus* and *Pongo*, read before the Académie des Sciences Naturelles, but not published. (See F. Cuvier's Dents des Mammifères, 8vo, p. 10.)

[5] Lectures on Physiology, Zoology, and the Natural History of Man. 8vo, Lond. 1819.

Deductions in favour of the anthropomorphous character of the *Orangs* have also been derived from observation of the living habits of young *Orangs*; but these cannot be regarded as affording a type of the nature of the adults, since it is well known that the docility and gentle manners of the young *Ape* rapidly give way to an unteachable obstinacy and untameable ferocity in the adult; at least, of those species to which, as I shall afterwards show, the full-grown *Orangs* have the nearest resemblance in the form of the head.

In the present communication I propose to describe the osteological peculiarities of the *Chimpanzee* (*Simia Troglodytes*, Auct.) and the *Orang Utan* (*Simia Satyrus*, Auct.); to trace in each the changes which the skeleton undergoes in its progress towards the mature state; and while, with reference to the Asiatic *Orang*, proofs are thus eliminated of the identity of two supposed distinct species of the *Quadrumanous* order, to show the nature and extent of the osteological differences which divide the *Orangs* from the human species.

§ 1. *Of the Osteology of the adult* Chimpanzee.

It has been no less a matter of surprise than of regret, that while the natural history of the *Mammalia* which recede furthest from *Man*, and which inhabit the remotest regions, has been investigated with the most persevering and successful exertions, the species which are in immediate juxtaposition with him in the natural series should still remain almost as little understood as at the dawn of zoological science. We now, in fact, possess more accurate and detailed information respecting the economy and organization of the *paradoxical Platypus* of Australia than we do with regard to the *Chimpanzee*, the most interesting of all the brute creation, from its close affinity to the human type of structure, which has long been known to inhabit the forests of Africa, and where there is every reason to believe that it is far from being rare.

The coasts of the Gulf of Guinea and the regions of Congo and Angola have been frequented for ages by Europeans engaged in commercial enterprize, yet the adult *Chimpanzee* has never been secured or transmitted alive to Europe, nor have its habits in the wild state hitherto been accurately described by a competent or trustworthy observer. While the energies of Europeans were misemployed in an unholy traffic, but little sympathy could be expected with those pursuits which elevate and dignify the nature of man; and thus, while thousands of unoffending Negroes have been torn from the remote recesses of their native forests, and sacrificed at the shrine of Mammon, no museum in Europe has been enriched by a single prepared skin of the adult *Chimpanzee*; nor has the bony frame-work, or even a *cranium*, been deposited in any public collection to afford the means of accurately defining the limits of the brute creation.

In the Museum of Natural History at Paris[1] the osteology of the *Simia Troglodytes*

[1] Since writing the above I have been informed that the skull of an adult *Chimpanzee* has very recently been added to this collection.

is illustrated by specimens of the young animal only, and these at a period prior to the shedding of the deciduous teeth; the skeletons and *crania* of the *Chimpanzee* in the public museums of this metropolis exhibit its bony structure in the same immature state; and it is improbable that the enlightened naturalists of other European nations would suffer so great an osteological treasure as the skeleton or skull of the full-grown *Troglodyte* to remain hidden (as all undescribed specimens may be said to be,) in their museums.

This remarkable deficiency in the means of determining the changes which take place in the structure of the *Chimpanzee* during its passage to the adult state, was particularly felt and regretted by myself while engaged in investigating the anatomy of the *Orang Utan*, on the occasion of the death of the young animal of that species formerly in the possession of the Zoological Society. Having subsequently, however, been informed of the existence of the skeleton of an adult *Chimpanzee* in the private museum of a member of the Society, R. B. Walker, Esq., Surgeon, of Curzon Street, I applied to that gentleman, and was not only gratified with the sight of his valuable and unique specimen, but received liberal permission to describe it, and had every facility afforded to me for that purpose.

The animal was shot by a European at Sierra Leone, and the clavicle was broken by the fall. The skeleton was prepared by the ants, sent to England, and presented to Mr. Walker, but without any information as to the habits of the species. The bones are perfect in every respect, with the exception of the broken clavicle and are remarkably well articulated.

The general appearance and proportions of the skeleton of the adult *Chimpanzee* are unquestionably the most anthropoid that the *Quadrumanous* order presents, but the deviations from the human structure are numerous and important.

The skull is of a narrow elongated figure, slightly contracting towards the anterior part, which is, as it were, truncated, from the depth and direction of the *symphysis* of the lower jaw. Compared with the rest of the body it is of small size, owing to the arrested development of the cerebral portion. This part, or the *cranium* properly so called, is of a rounded ovate depressed figure, and is altogether posterior to and not above the face; which slopes forwards at an open angle, as in the *Baboons*. The exterior surface of the *cranium* is smooth and convex on the superior or coronal aspect, being devoid of the intermuscular frontal and sagittal crests which give so strong a carnivorous character to the skull of the mature *Orang*. The extent of the origins of the temporal muscles is, however, indicated by a bony boundary, continued from the outer part of the supra-orbital ridge, at first as a well-marked crest, but soon subsiding to a slightly elevated line, which extends backwards along the parietal bone about an inch from the sagittal suture, and is lost in the lambdoidal and supra-auditory ridges. The difference between the adult and young skulls in the extent of the surface of *cranium* affording origin to the temporal muscle is considerable, as might be expected from the increased power of mastication required for the due action of the large permanent teeth. The muscular impressions in the occipital region of the *cranium* are less strongly marked in the *Chimpanzee* than in the *Orang*, the occipital *foramen* is further from the posterior plane of the *cranium*, and its position is less oblique[1]. The lambdoidal ridge, the spine of the *occiput*, and the *crista* continued from the latter downwards towards the occipital *foramen*, although slightly developed in comparison to the *Orang*, are characters of the adult *cranium* of the *Chimpanzee* wihch are wanting in the young animal. There is a greater proportion of brain behind the *meatus auditorius externus* in the *Chimpanzee* than in the *Orang*, and this difference is greater in the adult than in the young skull, whence it results that in the former the supra-auditory ridge is at some distance anterior to the *additamentum suturæ lambdoidalis*, and consequently the skull in this respect more nearly approximates the human structure.

In the young *Chimpanzee*, the articular cavity for the condyle of the lower jaw is anterior to the bony circle of the *meatus auditorius*, and on a higher plane; but, as the zygomatic arch increases in strength with the increasing power of the maxillary apparatus, without any corresponding downward increase of the brain and *cranium*, the glenoid cavity is carried so near to the lower level of the bony *meatus*, that it no longer, as in the young animal and in *Man*, affords to the condyle of the jaw a support against backward dislocation. To remedy the effects of this change, a process, of which the rudiment is perceptible in the young *Chimpanzee*, co-extends in downward growth with the altered position of the articulation of the jaw, becomes interposed between the maxillary condyle and the *meatus*, and compensates for the loss of that protection which is afforded to the maxillary articulation by the downward development of the *cranium* posterior to the glenoid cavity in the human subject.

The lower part of the external boundary of the *meatus* is irregularly jagged in the *Chimpanzee*, for the better attachment of the cartilaginous portion of the auditory passage. The *zygoma* is proportionally weaker than in the *Orang*; the temporal portion joins the malar obliquely, and is slightly and irregularly wavy.

The most characteristic feature of the *Chimpanzee's* skull, both in the young and old state, is the large projecting supra-orbital ridges, which, being continued into one another across the *glabella*, form a sort of barrier between the *cranium* and face.

Behind the junction of the malar with the frontal bone there is a convex ridge leading obliquely downwards and inwards, and strengthening the bony *septum* which divides the orbit from the temporal *fossa*.

The cranial sutures, which are obliterated in the adults of the *Orang*, *syndactylous Ape*, and frequently in the adult *crania* of *Baboons* and other *Quadrumana*, are for the most part persistent in the *Chimpanzee*, and the coronal and sagittal sutures have the true denticulated structure. The sagittal suture is not continued along the frontal bone. The squamous suture is partially lost, but sufficient remains to show that the anterior

[1] Compare Plates LII. and LIV.

angle of the temporal joins the frontal and separates the parietal from the sphenoid bones, as in six out of seven skulls of the young *Chimpanzee* which I have examined.

The frontal bone extends to the middle of the coronal surface of the *cranium*; the parietals occupy the remainder of that aspect; the squamous portion of the occipital bone, which in the young *Chimpanzee* encroaches for a small extent upon the coronal surface, is in the adult wholly confined to the inial or posterior region of the skull: it is, however, of considerable extent, and more convex than in the *Orang*, and consequently more like that of the human subject[1]. The squamous portions of the temporal bone extend over a much less proportion of the sides of the *cranium* than in *Man*; and their superior margin, instead of forming a convex curve, is almost a straight line. The mastoid processes are represented on either side by a mere ridge of bone, and the styloid processes by small tubercles. The condyloid processes of the occipital bone are proportionally smaller than in the human subject. The *foramen magnum*, instead of being placed immediately behind the middle transverse line of the skull, as in *Man*, is situated in the middle of the posterior third of the *basis cranii*, and its plane is inclined upwards from the anterior margin at an angle of 5° from the plane of the basilar process. There are no posterior condyloid *foramina*, but the anterior condyloid *foramina*, the *foramina jugularia*, *stylomastoidea*, *carotica*, *spinosa*, and *ovalia*, are in nearly the same relative positions as in *Man*; the principal difference is in the greater distance between the *foramen caroticum* and the *foramen ovale*, in consequence of the greater antero-posterior extent of the petrous bone.

In consequence of the proximity of the *foramen magnum* to the posterior margin of the skull, a considerable extent intervenes between it and the posterior margin of the bony palate; this is occupied by the before-mentioned development of the petrous bones, and a corresponding extent of the basilar element of the occipital. The antero-posterior diameter of the bony palate in like manner greatly exceeds that of the corresponding part of the human skull. The zygomatic arches are opposite the middle third of the skull, as seen from below, while in the human *cranium* they are included in the anterior moiety. The form of the *basis cranii* differs generally from the *Bimanous* and manifests the *Quadrumanous* type, in its greater length, in its flatness, in the small extent of *cranium* behind the *foramen magnum*, in its contraction between the *zygomata*, and in the large size and especially the anterior development of the bony palate.

The front view of the skull of the *Chimpanzee* impresses the spectator still more strongly with its resemblance to that of the *Baboon* and the inferior tribes of *Quadrumana*. The superciliary ridges of bone almost hide the *cranium* from view; and the cranial mass, instead of forming a broad back-ground to the face, as in the young *Chimpanzee*, and as it does in a still greater degree in *Man*, is surpassed in breadth

[1] In two skulls of the young *Chimpanzee* I have observed an *os triquetrum* at the junction of the sagittal with the lambdoidal suture. Dr. Traill notices a similar circumstance in the young *Chimpanzee* dissected by him. (Wernerian Transactions, vol. iii. p. 10.)

by the lateral boundaries of the orbits and the zygomatic arches[1]. The orbits are situated higher in the *Chimpanzee* than in the *Orang*, and are larger in proportion to the entire skull, but their plane is more perpendicular, and they are wider apart. In neither the *Chimpanzee* nor the *Orang* are the orbits so deep in proportion as in the human subject. The supraorbital nerves and vessels leave a slight depression, and do not pass through a *foramen*. The lachrymal bones are entirely confined to the orbit, as in the higher *Quadrumana*.

A character by which the *Chimpanzee* approximates more closely than the *Orang* to the human subject is presented by the nasal bone, which projects in a slightly arched form beyond the inter-orbital plane, while a trace of its original separation into two lateral elements remains at the lower margin of the now consolidated and single bone: its upper expanded extremity was anchylosed with the frontal bone in the adult specimen here described.

The malar bones are largely developed, as in *Man* and the *Quadrumana* generally. Two or three small *foramina* are observable on the exterior of the orbital process; corresponding *foramina*, but of much larger size, are constantly met with in the *Orang*. The infraorbital canal is continued unclosed to within 2 lines of the rim of the orbit: it opens upon the face by a single *foramen*. In one young *Chimpanzee* I have observed a second small *foramen*. In the *Orang* there are usually three or more infraorbital *foramina*, as in many of the inferior *Simiæ*.

The ascending or nasal portion of the superior maxillary bone, which is of greater proportionate size than in the human subject, does not mount vertically to the orbits, as in *Man* and some of the lower *Quadrumana*, (those, for instance, of the genera *Cebus* and *Callithrix*), but slopes backwards as in the *Cynocephali* and in the *Carnivorous Mammalia*, but in a less degree. The contour of the upper jaw, from the nasal aperture to the incisor teeth, is almost straight, while in the *Orang* it is rendered concave by the greater development of the intermaxillary bones in the anterior direction. These bones are anchylosed to the maxillary bones in the adults of both the *Chimpanzee* and *Orang*. In *Simia Satyrus* the obliteration of the suture is incomplete until the full development of the huge *laniarii*, but in the *Chimpanzee* the *anchylosis* takes place at a much earlier period; although in the young animal, when the first dentition is completed, traces of the original separation of the intermaxillary bones from the maxillaries are still visible at the sides of the nasal aperture and on the palate external to the *foramina incisiva*. The situation of these *foramina* is always indicative of the original extent of the palatal process of the intermaxillary or incisive bones, and in no *Quadrumana* are they so close to the incisive teeth as in *Man*. One of the admeasurements in the subjoined Table shows the relative extent of the bony palate anterior to the *foramina incisiva* in the young and adult *Orang* and *Chimpanzee*, and proves that the latter species makes a nearer approach to *Man* in this particular. In the human subject, in the fœtus of which the existence of

[1] Compare figg. 1 & 2, Plate LVI.

separate intermaxillaries was first discovered by the immortal Göthe [1], scarcely a line's breadth intervenes between the incisive *foramina* and the *alveoli* of the anterior incisors.

The lower jaw, like the upper, is equally characterized by its strength and size in relation to the entire skull; the *symphysis*, or chin, recedes; but the depth of the jaw in front is less than in the *Orang*. The *alveoli*, however, advance more nearly to the level of the condyle than in the *Orang*, and the jaw consequently in this respect proportionally approximates the structure of the brute. The coronoid process rises a little higher than the condyle, but does not quite attain the level of the *zygoma*. The *ramus* of the jaw forms a more open angle with the body than in the *Orang*, and thus more nearly resembles the human structure. The mental *foramen* is single on either side.

The dental *formula* of the adult *Chimpanzee*, like that of the other *Catarrhine Simiæ*, is the same as in the human subject, viz. *Incisores* $\frac{4}{4}$, *Laniarii* $\frac{2}{2}$, *Bicuspides* $\frac{4}{4}$, *Molares* $\frac{6}{6}$. The teeth approximate in their proportionate size much more nearly than those of the *Orang* to the human teeth; but they manifest in their relative position the absence of that character which, with one anomalous exception[2], is peculiar, among *Mammalia*, to *Man*, viz. unbroken proximity. A well-marked interval separates the upper laniaries from the contiguous incisors, and the lower laniaries are removed by a smaller interval from the contiguous *bicuspides*: these intervals admit the *apices* of the large laniaries respectively of the opposite jaws when the mouth is closed. The absence of similar vacancies in the dental series of *Man* is owing to the shortness of the jaws, and to the equable development of the different teeth, and especially the laniaries, the points of which are opposed to one another. The formidable *cuspidati*, which supply the beast of prey with his weapons of destruction, and afford to the irrational ape his means of defence, are unnecessary in the master of the animal creation, who can contrive and vary at will more effective instruments for both purposes.

The fangs of the teeth in the *Chimpanzee* are proportionate to the size of their crowns; but the accompanying figures (Plates LI. and LII.) supersede the necessity of a particular description of these parts. Some modifications of the skull may, however, be noticed in reference to the powers of mastication.

As the strong nasal bones and contiguous processes of the maxillary and frontal bones, which constitute the wide inter-orbital space of the skulls of the *Carnivora*, are possessed in a comparatively feeble degree by the *Orangs*, the upper jaw is strengthened, and the weak ethmoid bone defended from the effects of the powerful forces that tend to push it upwards, by a thickening of the outer rim of the orbit, and by the enlargement of the malar bone, against which the malar process of the superior maxillary bone is firmly abutted, and is thus enabled to resist the pressure of the lower jaw. The entire *ramus* of the lower jaw, and the coronoid process more especially, are thickened and

[1] Zur Naturwissenschaft, &c. zur *Morphologie*, B. i. 8vo. 1817.

[2] In the fossil genus *Anoplotherium*, Cuv.

extended to increase the surface of attachment of the muscles of mastication ; the zygomatic arches are proportionally strengthened and widened to admit the passage of the temporal muscles ; and these cover by their extensive origin a considerably greater proportion of the *cranium* in the adult than in the young *Chimpanzee* : but in all these particulars the *Chimpanzee* recedes in a minor degree from the human construction than the *Orang*.

With respect to the *os hyoides*, I cannot agree with Tyson in the observation, " humano ferme simillimum existit" : the body, on the contrary, is expanded into a triangular form, and hollowed out behind for the reception of one of the *laryngeal sacculi* ; the *cornua minora* are also proportionally more developed.

The vertebral column of the *Chimpanzee* presents fewer deviations from that of the human subject than the *cranium*. The number of true *vertebræ* is the same ; but an additional pair of ribs takes one from the lumbar to be added to the dorsal or costal series. With respect to the cervical *vertebræ*, Audebert, in his description of the skeleton of the *Pongo* of Wurmb, particularly remarks, that in the length of the spinous processes that animal differed not only from every other *Ape*, but from every other *Mammal*. In the *Chimpanzee*, however, there exists a similar provision for an adequate origin of the muscles that are inserted into the *occiput*, and are designed to counterbalance the preponderating weight anterior to the centre of support. The spines of the cervical *vertebræ* are simple and elongated, not short and bifurcated as in the human subject : that of the third *vertebra* is the shortest, with the exception of the *atlas*, where, as is usually the case, the spine is wanting. The bodies of the lumbar *vertebræ* are proportionally smaller in the *Chimpanzee* than in *Man*, where they are enlarged to afford a basis of support to the column above in reference to his erect position, and where this region of the spine is proportionally of greater length. The recedence of the *Chimpanzee* from the *Bimanous* type of structure is manifested still more strongly by the narrowness and length of the *sacrum*, its smaller curvature, and its parallelism with the spine. A peculiarity in the *Chimpanzee* is observable in the position of the last lumbar *vertebra* with relation to the iliac bones ; these rise on either side of, and are partially joined to, that *vertebra*, so that it might almost be reckoned as belonging to the sacral series. In the adult specimen here described, the transverse processes of this *vertebra* are expanded, thickened, and joined to the *ilium* : in one skeleton of a young *Chimpanzee* I have observed the transverse processes of the fourth lumbar *vertebra* modified in the same manner.

The false *vertebræ* in the adult skeleton are seven in number, but the sixth is anchylosed with the *sacrum*, both by its body and transverse process, so as to give rise by that union to an additional pair of antero-posterior sacral *foramina* ; the sixth *vertebra* is not, however, perforated like the five preceding ones for the spinal chord. The seventh seems to be composed of two *vertebræ* joined together ; but this appearance may result from partial ossification of the sciatic ligaments : and this is the more probable, as in the skeletons of the young *Chimpanzee* preserved in the Hunterian Museum, after the four lumbar *vertebræ*, there remain only seven for the *sacrum* and *coccyx*. Of these *vertebræ* only the first two have their transverse processes fully developed; with reference to which it is interesting to remark, that in the adult *Chimpanzee* only the two superior sacral *vertebræ* are united to the iliac bones; and hence the trunk is less firmly connected with the pelvic arch, and consequently is more in need of additional support from the anterior extremities, than in *Man*.

The *pelvis* of the *Chimpanzee* differs from that of *Man* in all those particulars which characterize the *Quadrumana*, and which relate to the imperfection of their means of maintaining the erect position. The iliac bones are long, straight, and expanded outwardly above, but narrow in proportion to their length; the posterior surface is concave for the lodgement of the *glutæi* muscles; the anterior surface nearly flat, and stretching outwards almost parallel with the plane of the *sacrum*. The whole *pelvis* is placed more in a line with the spine than in *Man*: its superior aperture is elongated and narrow, so that the whole of the *sacrum* and *coccyx* is visible on a front view. The tuberosities of the *ischia* are broad, thick, and curved outwards. The pubic bones are broad and deep, but flattened from before backwards. With this general conformity with the *Quadrumanous* type, there is, however, a provision for a more extended attachment of the *glutæi* muscles, in a greater breadth of the *ilia* between the superior spinous processes, which also incline forwards more than is observable in the inferior *Simiæ*; and it may thence be inferred that the semi-erect position is more easily maintained in the *Chimpanzee*.

An important difference between the *Chimpanzee* and *Orang* is manifested in the relative size and strength of the lower extremities, in which respect the *Chimpanzee* claims a closer relationship to *Man*. Both animals, however, exhibit as permanent conditions, proportions of the inferior extremities which are transitory in the human subject: in the *Orang* they have the curtailed proportions which they present in the human fœtus of six months' gestation; in the *Chimpanzee* they retain the same relative size as in the yearling infant. It is, however, a remarkable and interesting fact, that the lower extremities instead of being shorter in proportion to the trunk in the young *Chimpanzee* are longer, their adult relations arising from the increased development of the trunk and anterior extremities, which are thus made fit for the vigorous acts of climbing; and in relation to which a corresponding increase of the inferior extremities would have been detrimental: so that the immature *Chimpanzee* tends to the great prototype of animal organization in two ways, viz. a disproportionate magnitude of brain and *cranium*, and an imperfect development of trunk and arms, which are both, however, circumstances peculiar to its nonage.

The *femur* of the *Chimpanzee* is slightly bent in the anterior direction, as in the human subject: the neck of the bone has the same comparative length, but stands out more obliquely to the shaft. The whole of the body of the bone is flatter or more compressed from before backwards. An error which has crept into the excellent and laborious work on Comparative Anatomy which the lamented death of the celebrated Meckel has left unfinished, requires here to be noticed, as it attributes a community of structure to the two species of *Orang* in a part which affords one of the best-marked differences. The head of the *femur*, which presents a smooth unbroken surface in the *Orang*, is marked with the pit for the attachment of the *ligamentum teres* as well in the adult as in the young *Chimpanzee*, in which I have ascertained the existence of that ligament in a dissection of a recent specimen. Meckel describes the absence of the *ligamentum teres* in the *Pongo* as well as in the *Orang*, and this is the case; but it is only another of the many coincidences of structure which prove the identity of the two animals. This peculiarity of the hip-joint appears to relate to the disproportionate shortness of the legs in *Simia Satyrus*; but the deterioration which they consequently suffer, as means of support, is compensated by the advantages which they gain as instruments of prehension, their extent and variety of motion being increased by the removal of a ligament that acts as an impediment to both in the animals which possess it.

The *tibia* in the *Chimpanzee* is proportionally thicker at the upper end, and the *fibula* considerably stronger at the lower end, than in *Man*: the interosseous space is wider, and the anterior convexity of both bones may be perceived to be slightly increased. The *patellæ* are proportionally smaller.

The relative size and position of the tarsal bones more nearly correspond to the same in the human subject than is found in any other *Quadrumanous* animal; but the deviations, though slight, are nevertheless indicative of the habit of turning the foot from the position necessary for supporting the body, to that which is best adapted for the readier application of the sole to the branches of trees for the purposes of climbing, viz. with the outer or fibular edge of the foot inclined to the ground; such a position being evidently most in accordance with the natural connexions of the bones of the *tarsus*. The *os calcis* is relatively feeble as compared with that of *Man*, being more compressed from side to side, and smaller in all its dimensions; but it projects backwards to a greater proportional degree than in the *Orang* or inferior *Simiæ*. From the inclination of the *tarsus* to rest on its outer edge, the *os naviculare* is further developed downwards, so as to project considerably below the bones of the same row without inconvenience from pressure on the sole. The internal cuneiform bone has a corresponding inclination, and thus the *hallux*, or great toe or hind thumb, is attached to the *tarsus* in a position best adapted for its being applied as an opposable instrument to the other toes. The whole foot of the *Chimpanzee* is relatively narrower and longer than in *Man*; and the digital *phalanges* are more inflected towards the sole. The admeasurements in the Table show the relative length of the hinder thumb, and other parts of the foot in the *Chimpanzee* and *Orang*.

The organization of the lower extremities evidently bespeaks a creature destined to reside in forests; and the modifications of the bony structure, which add to the facility of climbing and grasping, render the entire frame in a proportionate degree dependent on the upper extremities for support and progression. But while the *Chimpanzee* thus adheres to the *Quadrumanous* character, and especially in the curtailed proportions and detached opposable condition of the *hallux*, it must be admitted to approach the *Bimanous* type in the length and strength of the hinder thumb more closely than any of the lower *Quadrumana.*

The agile and powerful locomotive actions of the *Chimpanzee* require a proportionally ample development of the respiratory system, and the size and expansion of the *thorax* is accordingly a prominent character in its skeleton. The transverse exceeds the antero-posterior diameter of this cavity, but not to the same extent as in *Man.* The ribs are thirteen in number on each side, seven true and six false. The last two pairs are proportionally longer than in *Man*; and the end of the last rib is not pointed, but truncated for the attachment of a cartilage, which does not, however, join the cartilage of the rib above. The *sternum* is flattened from before backwards, but is not so broad as in the *Orang*: in the adult specimen not only does the *harmonia* between its body and the *manubrium* remain, but those of the four single pieces of which the body is itself composed are still visible.

The clavicle is long and strong, so that the shoulders are kept wide apart: it is not straight as in the *Orang*, but exhibits the same sigmoid curve as in *Man*, though in rather a less degree. The *scapula*, on the other hand, recedes further from the human type in the *Chimpanzee* than in the *Orang*, being narrower in proportion to its length, and having the spine running more in the direction of the axis of the trunk, and situated more towards the middle of the *scapula*, and more perpendicular to its plane. The *acromion* process is longer and narrower than in *Man.* The *humerus* very closely resembles that of the human subject, but is proportionally longer and stronger; and the peculiar twist is more marked, and occurs lower down the bone. The distal articulating surface is formed so as to allow of the same advantageous variety and freedom of motion to the bones of the fore arm as in *Man.*

As the segments of each limb recede from the trunk they become subject to more extensive and varied modifications. This is more especially exemplified in the lower extremities of the *Chimpanzee*; and the bones of the upper extremity follow the same law. The disproportionate length which the *humerus* already presents becomes greater in the bones of the fore arm; and those of the hand recede still further from the *Bimanous* type. Both the *radius* and *ulna* are more curved than in *Man*, and the interosseous space is, in consequence of the direction of their curves, much wider.

The carpal bones have the same number and relative position as in the human subject; but the *trapezium* and *trapezoides* are proportionally smaller, while the *os pisiforme* is of larger dimensions, being nearly equal to the *os magnum.*

The small size of the *trapezium* evidently relates to the shortness of the thumb, which it supports, and which does not quite equal the metacarpal bone of the first finger in length, and is as slender and weak as it is short. The little finger is also shorter, as compared with the other fingers, than in the human subject. The metacarpal bones are chiefly remarkable for their length; the *phalanges* both for their length and their anterior curvature. The hand is thus admirably formed for clasping the thick boughs of forest trees. The ridges on the sides of the anterior surface of the first and second *phalanges* are well developed to afford attachment to the *fasciæ*, which restrain the starting of the flexor tendons during the powerful actions of the muscles of the fore arm.

§ 2. *Osteology of the young* Chimpanzee.

In consequence of the early period at which the brain acquires its full size, the cranial portion of the skull of the young *Chimpanzee* greatly preponderates over the facial or maxillary part when the small deciduous teeth only are developed. At that period, therefore, it proportionally approximates towards the human form: the facial angle is more open; the occipital *foramen* is more central, and its plane more horizontal; the slender *zygomata*, as seen from below, are confined to the anterior moiety of the skull; and altogether the resemblance to the human *cranium* is startlingly close.

The difference, on the other hand, between the young and the old skulls is such, that a naturalist, unaware of the changes of form which the jaws undergo as they acquire their permanent set of teeth, might fail to recognise them as belonging to the same species, and might still entertain doubts as to the specific identity subsisting between the baboon-like skull of the adult and the anthropoid one of the young *Chimpanzee*, which he had previously been accustomed to consider as characteristic of the species. These doubts, which I entertained myself on the first inspection of the adult skeleton, were, however, in a great degree removed by perceiving the correspondence which prevailed in the two skeletons in the forms and proportions of the extremities, the number of *vertebræ* and ribs, the structure of the *sternum* and *scapula*, &c. But to derive further confirmation of their identity, I compared the crowns of the permanent teeth [1] which were lodged within the jaws of the young *Chimpanzee*, with those which had replaced the deciduous set in the adult skull. The resemblance in point of figure and size was exact, and showed that the Pygmy of Tyson must ultimately acquire teeth which would necessarily induce those changes of form in the jaws upon which the differences in question chiefly depended.

The germs of the permanent teeth are placed with singular irregularity within the jaws; the second incisor is situated directly behind the first; and the *apex* of the crown of the laniary is lodged deep in the jaws, below the first *bicuspis*. Both *bicuspides* are, however, lodged conveniently below the crowns of the deciduous *molares*. Their crowns were completely formed, and the first true molar had taken its place in the jaw in the specimen examined, but its fangs were open and incomplete. The crown of the second molar was completely formed, and corresponded to the dimensions of the second molar in the adult skull: the germ of the third molar was not yet apparent. The suc-

[1] See Plates LI. and LII., *a, b, c, d, e, f, g*.

cession therefore takes place precisely as in the human jaw; but the permanent teeth are proportionally larger in the *Chimpanzee*, especially the incisors and laniaries. Hence, as the brain does not continue to expand after the development of the deciduous teeth, the increase of the skull is confined to the enlargement of the jaws, the widening of the zygomatic arches, the strengthening of the orbital buttresses, and the production of those muscular ridges which are indicative, as well of the force and development of the muscles immediately engaged in mastication, as of those which are inserted into the posterior part of the head to sustain the preponderating mass which now lies anterior to the occipital condyles.

The amount of the changes, and the influences which have been concerned in their production, are shown in four views of the *cranium* of the young and old *Chimpanzee* subjoined to this paper (Plate LVI.); and the differences in other parts of the skeleton are given in the Table of admeasurements. The bones of the young *Chimpanzee*, when the first permanent *molaris* is acquired, exhibit all the peculiarities of incomplete development: the four elements of the occipital bone are separate; the body of the *atlas*, like the basilar piece of the *occiput*, is detached from the processes which complete the ring; the sacral *vertebræ* are separated from one another and from the *coccyx*; and the three portions of the *os innominatum* are at this time distinct. The coracoid bone is still joined by cartilage to the *scapula*; the *epiphyses* of the long bones are detached from the shafts, and are in part cartilaginous; and the carpal and tarsal bones are but partially ossified; the latter are especially imperfect as compared with those of the human subject at a corresponding period of dentition, and thus demonstrate the inferior importance of the lower extremities as means of support and progression in the *Chimpanzee.*

The depth of the lower jaw being proportionally less than in the adult, the cavity of the *thorax* proportionally smaller, and the *sternum* in consequence less elevated, the distance between the latter and the chin is proportionally greater. The other differences in the relative magnitudes of the different parts of the skeleton have already been alluded to in the description of that of the adult.

§ 3. *Osteology of the* Orang Utan.

The opportunity which the rare and interesting skeleton of the adult *Chimpanzee* in the possession of Mr. Walker has afforded of tracing the changes which the osseous structure of that species undergoes in its progress to the adult condition, induces me to review the question which I formerly brought under the notice of the Society[1] relating to the identity of the young *Simia Satyrus* with the great *Pongo* of Borneo, *Pongo Wurmbii*, Geoff., and to consider the osteological structure of the latter animal, here regarded as the adult *Orang*, with reference to its less powerful and more anthropoid congener, the *Chimpanzee.*

[1] Proceedings of the Committee of Science, part i. p. 9.

In the course of this comparison it will be shown that the number and value of the points of resemblance or of approximation to the *Bimanous* structure are in favour of the *Chimpanzee*; and that, as in many similar instances, there are some particulars of the organization of the *Orang* which indicate a closer affinity with the inferior forms of the group to which it belongs than to those *Quadrumana* which rank immediately below it.

Notwithstanding the many strongly marked characters which the *cranium* of the adult *Orang* exhibits in common with that of the *Mandrill*, as the contracted forehead, the flattened *occiput*, the formidable canine teeth, huge jaws, strong expanded zygomatic arches, and largely developed cranial ridges, yet in continuing the comparison we cannot fail to be struck with the general effect of a less ferocious expression in the skull of the *Orang*. This results from the more perpendicular slope of the facial contour, from the absence of the projecting superciliary ridges (beneath which even the sightless sockets of the *Mandrill* scowl upon the observer), from the greater expansion of the cerebral cavity, and lastly, from the non-development of the superior maxillary ridges, which appear in the *Mandrill* as a gratuitous supplement to the hideous *tout ensemble* of its head.

The *cranium* of the *Orang* is less flattened at the crown than that of the *Chimpanzee*. The size of the cavity of the skull exceeds in a very small degree that of the young animal at the period when it has acquired the first permanent *molares*, the subsequent enlargement of the *cranium* being chiefly owing to the thickening of its walls and to the development of the muscular ridges which circumscribe the origins of the temporal muscles. These ridges commence at the external angular process of the frontal bone, pass inwards, upwards, and backwards behind the superciliary ridge, from which they are separated by a deep groove, then, converging upon the *cranium*, they meet at the junction of the sagittal with the coronal suture, including a neat triangular portion of the frontal bone, along the middle of which there is a slight longitudinal convexity. The smoothness of this part of the *cranium* forms a contrast to the irregularly indented surface of the remainder, which is exclusively the seat of origin or attachment of powerful muscles.

The interparietal crest rises, as in the *Hyæna* and other *Carnivora*, above the general level of the skull, to the extent of from $\frac{1}{3}$ to $\frac{2}{3}$ of an inch; at the *vertex* it divides and passes posterior to the lambdoidal suture to the mastoid ridge. A third strong spine is continued from the point of divarication half way down the squamous portion of the *occiput*, and forms a strong posterior projection at its commencement. The situation of these ridges in reference to the sutures, is only determinable by comparing the faint commencement of their growth in the young *Orang's* skull. In two adult skulls, where the ridges were fully developed, the only traces of the cranial sutures which were visible were the upper part of the squamous, about 1 inch of the lower end of the coronal, and that small one by which the *ala* of the sphenoid joins the descending angle of the parietal, and separates the frontal from the temporal bone, as in *Man*. This is one of the few osteological differences in which the *Orang* has a closer approximation to the human structure than the *Chimpanzee*[1]. In a younger specimen of the adult *cranium* of the *Orang* I observed that the *additamentum suturæ lambdoidalis* was still visible on either side, but the remainder of the sutures, with the exception of those first mentioned, were obliterated.

The occipital *foramen* approaches, in its figure, position, and aspect, nearer to that of the lower *Mammalia*. Its plane forms, with a line drawn parallel to that of the basilar process, an angle varying in three adult *crania* from 15° to 20°. The occipital condyles are more closely approximated anteriorly than in the *Chimpanzee*. The anterior condyloid *foramina* are double on each side; they have the same relative position with the stylo-mastoid *foramina* as in the *Chimpanzee*; the carotid *foramina* are situated more posteriorly, and are relatively smaller; the petrous portion of the temporal is smaller, while the glenoid cavity forms a much larger proportion of the base of the skull. This articular cavity, if such it may be called, presents a remarkable contrast with the numerous points of resemblance to the *Carnivora* observable in other parts of the *cranium*: it is a quadrate and almost flattened surface, slightly concave in the transverse, and slightly convex in the antero-posterior directions, affording an interesting correspondence with the structure of the molar teeth, and being, together with these, indicative of the vegetable diet of the animal.

The styloid and styliform processes are wanting, as in the *Chimpanzee*. The mastoid process is represented by a protuberant ridge behind the auditory *foramen*; and its cellular structure is visible from the thinness of the external table of the skull at this part. The ant-auditory process, which protects the articulation of the lower jaw, is more developed than in the *Chimpanzee*; the margins of the auditory *foramina* are smoother.

On the bony palate the relative positions of the *foramina incisiva* correspond with the increased development of the laniary teeth in the *Orang*, as compared with the *Chimpanzee*, and consequently deviate in a proportional degree from their position in the human subject. They are situated upwards of an inch behind the incisor teeth, and two or three *foramina* remain on either side but more anterior, and indicate the original separation of the incisive bones. Small vascular *foramina* and grooves indicate, in the same manner, on the anterior part of the skull, the situation of the suture, or *harmonia*, which originally joined the incisive to the maxillary bones. The late period at which these sutures are obliterated forms an important differential character between the *Orang*

[1] This affinity is of less value from the fact of some of the inferior races of *Man* occasionally presenting the same arrangement of these sutures as the *Chimpanzee*. I have observed the junction of the temporal with the frontal bone in the *cranium* of a native of Australia, and in more than one negro. I have also observed the same disposition in one out of eight *crania* of the *Simia Satyrus*: this exception occurs in the skull of the adult, of which the entire skeleton is preserved in the Museum of the Royal College of Surgeons.

and *Chimpanzee*. In the latter animal this obliteration takes place at a very early period, some time at least before the temporary teeth are shed; whilst in the *Orang* the sutures remain until the permanent teeth are almost fully developed. In the human subject the inter-maxillary bones can be traced as distinct elements of the jaw only at the early periods of fœtal existence.

The *os nasi* of the *Orang* is a flattened elongated triangular bone, no part of which projects, as in the *Chimpanzee*, beyond the plane of the nasal processes of the superior maxillary bones; there are no traces of its being originally separated at the mesial line, while such are usually observable in the *Chimpanzee*. Dr. Traill, indeed, found two distinct nasal bones in the young animal of that species dissected by him[1]. In the *Orang* a strong spine or ridge extends from the posterior aspect of the *os nasi* down the middle line.

The whole outer boundary of the orbit has a more anterior aspect than in the *Chimpanzee*: it is relatively broader and stronger, but has the oblique posterior ridge less developed. The interorbital space is relatively narrower; and this difference between the *Orang* and *Chimpanzee* is naturally greater in the young state, before the upper maxillary bones have acquired their full development[2]. In this particular, again, the *Orang* recedes further from the human form.

The lachrymal bones are proportionally larger in the *Orang* than in *Man*; but, as

[1] Wernerian Transactions, vol. iii. p. 12.

[2] With respect to the difference in the proportions of the orbits in the young *Orang* and the *Pongo*, the same argument to prove a difference of species might be drawn from a comparison of the orbits of a child's skull of four years, and those of an adult human subject, which do not differ more than 2 lines, and in some instances not more than 1, in either the transverse or vertical diameter; and a similar proportional magnitude of the orbits prevails in the young of most *Mammalia*. The ingenious observation, however, made by Dr. Harwood (Linnean Transactions, vol. xv. p. 478.) on the difference in the breadth of the interorbital space, would be apparently borne out by contrasting some skulls of the young and adult *Orangs*, since it is not always the same in animals of the same age: but I apprehend that the difference between the young and adults in this respect may be accounted for by the increase of size which the nasal processes and every other part of the superior maxillary bones undergo after the development of the great *laniarii*, it being remembered that the cavities of the orbits do not increase in the same ratio. Having had the opportunity of comparing six *crania* of the young *Orang* with two of the *Pongo*, I find the interorbital space of 2½ lines to be the minimum in the former, and that of half the breadth of the orbit to be the maximum in the latter, among the individual varieties.

	Young Orang.		*Pongo.*	
	in.	lines.	in.	lines.
Breadth of the face taken at the fronto-malar sutures . . .	2	10	4	6
Breadth of the orbit	1	1	1	6
Interorbital space taken across the fronto-maxillary suture .		3		7½

To determine the degree of difference which existed in the planes of the orbits of the young *Orang* and *Pongo*, I drew a line from the anterior part of the auditory *foramen* through the part where the sagittal joins the coronal suture, and intersected it by another drawn from the lower part of the orbit across its plane. In this way a difference in the plane of the orbit is found to manifest itself in the skulls of specimens of the immature *Simia Satyrus* of different ages and of acknowledged identity of species, the angle becoming more open in the older specimens; whilst in the great *Pongo* the difference in the angle is not more than four degrees.

in the *Chimpanzee* and the higher *Quadrumana*, they are confined to the orbit. The *os malæ* is distinguished by several large *foramina* in its orbital process, which lead from its facial superficies into the orbit. The superior maxillary bone differs from that of the *Chimpanzee*, in being perforated by three infraorbitary *foramina* instead of one, as well as in the greater magnitude which it acquires in consequence of the large laniaries which are implanted in it[1]. From the great anterior development of these bones and of the intermaxillaries, the incisors project more obliquely forwards than in the *Chimpanzee*.

Now in all the peculiarities of the *Orang's* skull which are independent of the changes consequent upon the second dentition, we find an exact correspondence between the *Simia Satyrus*, or young animal, and the *Pongo*, or adult. Their *crania* equally exhibit the absence of the projecting supraciliary ridges, the presence of the double anterior condyloid *foramina*, the numerous infraorbitary *foramina*, and those in the malar bone, the same disposition of the cranial sutures, the same form of the *os nasi*, and the same difference from the *Chimpanzee* in the contraction of the interorbital space. The characters of the lower jaw, by which it differs from that of the *Chimpanzee*, viz. the greater height and breadth of the *rami* and the greater depth of the *symphysis*, are equally manifested in the young as in the old *Simia Satyrus*.

In following out the same observations with regard to the germs of the permanent teeth in the young *Orang*, the same satisfactory results are obtained in reference to their identity with those which are fully developed in the old animals, as were previously detailed in the account of the *Chimpanzee*[2].

In the young *Orang*, with three molars in use on either side of each jaw, it is easy to see that the last is of a different set from the two smaller ones that stand before it. Its grinding surface exhibits the *cuspides* entire and sharp, and all the radiating furrows as if freshly impressed upon it; while the same surface in the deciduous *molares* is smooth, the crown worn down, and part of the fangs are protruded from the socket. The small laniary stands off at a distance from the neighbouring molar, and a still greater interval

[1] Among the differences that have been pointed out in the *crania* of the young *Orang* and *Pongo*, in support of the theory of their specific difference, one has been insisted upon which relates to the size of the *antrum maxillare*. It would be difficult to decide this point without making the necessary sections to expose the cavity; but I may observe, that what appears to be a greater extension of the *antrum* backwards in the young *Orang*, is the bulbous projection produced by the still inclosed molar teeth, and which consequently is not to be observed after their complete development in the adult skull; and that in the *Pongo*, so far from the *antrum* being so diminutive that "it can be hardly said to exist at all" (Harwood, Ibid., p. 473.), it is really of a fair proportionate size. Its dimensions in a *cranium* of this animal, which measures from the *occiput* to the muzzle 10¼ inches, being in the antero-posterior diameter 2 inches and 5 lines, in the lateral diameter 1 inch and 6 lines, in height 2 inches.

[2] I have subsequently found that the large size of the germs of the permanent teeth in the young *Orang* were noticed by Professor Rudolphi, who inferred from them that the adult *Orang* must equal in size the *Pongo* of Wurmb; but as he was unable to compare them with the teeth of that animal, the proof of their identity was still to a certain extent incomplete. See Berlin Transactions for 1824, p. 131.

separates it in the upper jaw from the small deciduous incisors, which, together with the laniary tooth, are partially protruded from their sockets. The large *foramina* behind the incisor and laniary teeth afford a sure indication of the presence of the permanent series, which are still concealed within the jaws; and these are found, upon a removal of the *parietes* of the *alveoli*, lodged in the following order.

In the upper jaw the second or smaller incisor is the most advanced in its progress, its middle projecting point being just within the orifice leading to the cavity in which it is lodged. Its posterior surface is directed inwards, or mesiad, and is placed at right angles to the corresponding surface of the first or great incisor, immediately behind which it is situated, and from which it is separated by a thin *lamella* of bone. The entire crown and about half a line of the fang are formed. The great crown of the first incisor has almost a horizontal position, and occupies the whole breadth of the *os incisivum*.

Behind the second incisor comes, not the laniary, but the crown of the first *bicuspis*, separated from the incisor by a *lamina* of bone about a line in thickness. Then, deeper in the jaw and posterior to the first *bicuspis*, is the crown of the second *bicuspis*. In each of these about one third of a line of the fang is already formed. The first true molar has already taken its place in the dental series; but its recent formation is shown in the shortness of the fangs and the wide entry to their cavity, in which the pulp was contained. The crown only of the second true molar is formed, which is lodged deep in the jaw, with the grinding surface, as in the undeveloped teeth of the *Elephant*, directed backwards in the upper jaw, and forwards in the lower. This surface has, however, all the characteristic markings of the corresponding tooth in the old *Orang*. A large round *foramen* leads to the concealed cavity in which it is lodged. The socket of the third molar, or *dens sapientiæ*, is widely open, but contains as yet only a little shrivelled membrane with specks of calcareous matter, the remains of the pulpy, and commencement of the bony, rudiments of the future tooth.

In the lower jaw the crowns of the permanent teeth are situated in nearly the same relative position as in the upper. The second incisor is immediately behind and a little above the first. The conical extremity of the crown of the great laniary is lodged deep in the jaw, with the *apex* projecting into the interval between the second incisor and first *bicuspis*. The crowns of the *bicuspides*, which in the upper jaw have the grinding surface directed outwardly, in the lower jaw have the same surface turned in the opposite direction. The great crown of the second molar is equally advanced with that of the upper jaw; and in like manner, of the third molar, the cavity only and a small shrivelled rudiment remain.

It is impossible to contemplate the apparent confusion in which these huge successors of the temporary teeth are crowded in the jaws, without a feeling of surprise and admiration at the regular arrangement they present when their evolution is completed. It would seem as if the incisors must have taken up the same relative position as those of the *Hare*, viz. one behind the other, with the chance of being dislodged, together with the contiguous *bicuspis*, by the great laniary tooth, which threatens to undermine and sap their attachment to the jaw. But such is the orderly action impressed upon the agents of growth, that all obstacles are removed, and the necessary expansion of the jaws takes place in due succession in all the requisite directions, and perfect regularity in the ultimate position of the adult teeth is the result. It may, then, be reasonably asked, How does it happen that in *Man*, in whom the difference in the size of the deciduous and adult teeth is comparatively so inconsiderable, and where, therefore, the chances of disarrangement are so much fewer, malposition of the permanent teeth should be so frequent an occurrence, and an object of such common solicitude among parents? The answer obviously is, that in most cases it arises from a mischievous interference with the agents to which the necessary changes have been entrusted. The means by which the growth of the permanent teeth is kept in due restraint are too often prematurely removed by anticipating the natural period of shedding the temporary teeth. The act of extraction accelerates the growth of the concealed teeth, both by the removal of the check which nature had imposed upon it, and by the irritation induced in the surrounding parts; and their full development being consequently acquired before the jaws have been sufficiently enlarged, they occupy more or less of the relative position which they had when half formed within their bony cavities.

In the drawings of the *Pongo's* skull (Plates LIII. and LIV.), figures of the rudiments of the permanent teeth taken from the jaws of a young *Simia Satyrus* are added, so that a detailed account of their points of correspondence is here unnecessary. It will be obvious that the difference that exists depends on the proportions of the teeth which have been worn away in the adult skull.

The only instance which I have found recorded of a *Simia Satyrus* having been observed of that age when part of the anterior permanent teeth had been acquired, is in the account given by Dr. Jeffries of the dissection of an *Orang*, which measured 3 feet and 6 inches in height[1]. The permanent incisors had advanced to their proper place, and the middle ones of the upper jaw are stated to have measured $\frac{7}{8}$ths of an inch in length and $\frac{5}{8}$ths in breadth; now the same teeth in the *Pongo* precisely correspond in the latter dimensions, and their excess in regard to length obviously results from the completion of the fang.

The *os hyoides* has a broader body and shorter *cornua* than in the human subject, but the body is not hollowed out as in the *Chimpanzee*.

I have already alluded to the simple form and great length of the spines of the cervical *vertebræ* in the *Orang*. The conditions of their superior development are obviously the backward position of the occipital *foramen*, the disproportionate development of the face, and the general anterior inclination of the *vertebræ* themselves. The *atlas*

[1] See Webster and Treadwell's Boston Journal of Philosophy, vol. ii. p. 570; and Philosophical Magazine, vol. lxvii. p. 186, 1826.

of the *Orang* wants the knob at the back part of the ring which is observable in *Man*; it presents here merely a roughness of the surface. The spine of the *dentata* has a ridge along its upper part, and its extremity is slightly bifurcate; the spines of the other cervical *vertebræ* are simple; that of the fifth is the longest; those of the sixth and seventh have a slight inclination towards the head, indicating that the centre of motion in this region of the vertebral column is nearer the head than in *Man*. The transverse processes of the fifth and sixth, especially the latter, are longer, and inclined more forwards and downwards than in the *Chimpanzee* or in *Man*. The whole of the cervical region is proportionally shorter than in *Man*, and consequently better adapted to support the head.

The entire vertebral column has one general curve dorsad from the *atlas* to the commencement of the *sacrum*, where there is a slight curve in the contrary direction.

The number of the dorsal or costal *vertebræ* in the *Orang* is twelve, as in the human subject. This is one of the more important differences between the *Orang* and *Chimpanzee*: the number in the latter animal, as previously noticed, being thirteen.

The number of the lumbar *vertebræ* is four, as in the *Chimpanzee*. This, at least, is the case in the skeleton of the *Pongo* preserved in the Museum of Comparative Anatomy in the Garden of Plants at Paris, and in the trunk of the skeleton of the adult *Orang* in the collection of the Zoological Society; in which latter specimen, as the bones are connected by their natural ligaments, there is no room for supposing a *vertebra* to have been accidentally lost. This fact it is the more necessary to state, because the skeleton of the *Pongo* in the Museum of the College of Surgeons in London differs from those above mentioned in having an additional lumbar *vertebra*; and as the skeletons of the young *Orangs* have uniformly presented but four lumbar *vertebræ*, some stress has been laid on the additional *vertebra* of the above specimen of *Pongo*, as indicative of its specific difference from the young *Orang*[1]. The additional lumbar *vertebra* in the College specimen indicates, however, its abnormal character by its form and situation: it is lodged deeper in the interspace of the *ossa innominata* than the last lumbar *vertebra* of the adult *Orang* in the Museum of the Zoological Society; and the right transverse process is expanded like that of a sacral *vertebra*, and is joined to the *ilium* in a corresponding manner. The human subject occasionally presents a similar *lusus* of an additional lumbar *vertebra*; and in the skeleton of an Australian native, where the number of lumbar *vertebræ* is normal, I have also observed that the last has the left transverse process similarly expanded and joined to the *ilium*, as has been described in the *Orang*. The lumbar *vertebræ* have much shorter spines in the *Orang* than in the *Chimpanzee*.

The *sacrum* deviates from that of *Man* in the same particulars as in the *Chimpanzee*, but is longer, narrower, and straighter. In counting the *vertebræ* of this part, I have been guided, as in human anatomy, by the circumstance of their being perforated for

[1] See Dr. Harwood's paper, Linnean Transactions, vol. xv. p. 473.

the spinal canal, which is peculiar to five, leaving three not so perforated for the *coccyx*. Camper, who appears to have reckoned those *vertebræ* only as sacral which transfer the weight of the trunk upon the pelvic arch, allows only three sacral *vertebræ* to the *Orang*, and counts the rest as coccygeal, omitting, however, the last, and thus making only seven false *vertebræ*, which is one short of the true number in the *Orang*.

The coccygeal *vertebræ* are anchylosed together, but not with the *sacrum*, in the adult.

The *ilia* are rather more expanded than in the *Chimpanzee*, but are flatter. The *ischia* are less extended outwardly, so that the lower part of the *pelvis* is narrower, corresponding with the small size of the lower extremities. Both the *ischia* and *ossa pubis* resemble those of the *Chimpanzee* in their more elongated form, and the whole *pelvis* equally deviates from the *Bimanous* type in its position with regard to the trunk. The spine of the *os pubis* is well marked, but at a greater distance from the *symphysis* than in the human subject. The form of the superior aperture of the *pelvis* is an almost perfect oval, the antero-posterior diameter of which is to the transverse as 3 to 2. The axis of the brim forms with that of the outlet of the *pelvis* a much more open angle than in the human subject, whence it may be inferred that parturition is much easier in the *Orang*.

The chest has the same amplitude of development in the *Orang* as in the *Chimpanzee*; it equals in size that of the human subject, and the transverse diameter is greater than the antero-posterior. The ribs are narrower and less flattened in their form. The cartilages of the first and second pairs are proportionally longer. The twelfth or last rib is much longer, and has a long cartilage at its free extremity.

The *sternum* is short, but broader than in the *Chimpanzee*: it is composed below the *manubrium*, or first bone, of a double series of small bones, seven or eight in number: this structure is always obvious in the *Simia Satyrus*, or young animal; and in the skeleton of the *Pongo* preserved in the Museum of the College of Surgeons, the four upper bones are still separate, and traces of the *harmoniæ* which joined the four lower bones are very evident. While in Paris, I carefully examined the *sternum* of the great *Pongo* in the Museum of Comparative Anatomy at the Garden of Plants: the oblique transverse *harmoniæ* resulting from the alternating position of the original double series still remained, but the mesial *harmoniæ* were almost obliterated, so that the *sternum* would appear, to one who had not studied its composition in the young *Orang*, as if composed of a single series of broad oblique ossifications. In the young *Chimpanzee* the *sternum* is composed of a single series of bones, as in most other *Mammalia*; and the same structure is shown in the adult. In the human subject, although at the early period of ossification a single series of ossific centres appear, yet at a later stage the lower part of the *sternum* is frequently seen to be composed of a double series of bones.

The clavicles deviate from those of the *Chimpanzee* and of the human subject in being less curved: in the skeleton of the *Pongo* at the College of Surgeons they are almost straight. The *scapula* differs from that of the *Chimpanzee* in its greater breadth, and from that of *Man* in the inclination of its spine towards the superior *costa*; in the *acromion* being narrower and claviform, not an extended flattened process; and in the absence of the flattened and overhanging margin of the spine which we find in the human subject. The supra-spinal *fossa* is also larger and deeper in the *Orang*, the superior *costa* and spine of the *scapula* lying in nearly parallel lines; while the subspinal *fossa* is shorter from above downwards, and does not present any convexities, as in the human subject. The coracoid process has a greater inclination downwards, and the glenoid cavity is directed more upwards than in *Man*, but its form is the same. In the *Orang*, therefore, the *scapula*, as compared with that of the *Chimpanzee*, is shorter in proportion to its breadth, its spine is less perpendicular to its plane, and the upward curvature of the *acromion* is greater[1].

The principal feature of the organization of the *Orang*, and that in which it differs most from the *Chimpanzee*, is the relative length of the upper and lower extremities. The arms reach to the heel. The articular surface of the head of the *humerus* is larger in *Simia Satyrus* than in *Man*, its extent equalling a complete hemisphere. The twist of the shaft is not so remarkable, nor the groove at the posterior and outer part for the musculo-spiral nerve and artery. In some specimens the *humerus* is perforated between the condyles.

In the *radius* and *ulna* the principal differences are seen in the greater space existing between them, owing to the outward curve of the *radius*, and in the absence of the acute margin on its ulnar aspect: the corresponding spine in the *ulna* is also less marked than in the human subject. Dr. Jeffries observed " a large curved projection

[1] With respect to the *scapula* Dr. Harwood (Linnean Transactions, vol. xv. p. 472.) observes, that " The *scapulæ* of the *Pongo* have their spine strongly incurvated upwards, while in the *Simia Satyrus* it pursues almost a straight direction horizontally: the space also for the attachment of the *infrà spinatus* muscle is, relatively to the size of the bone, far more extended in the *Pongo*." On comparing the *scapulæ* of the young *Orang* with those of the *Pongo*, I confess myself unable to appreciate the differences here pointed out; but judging from the peculiar inclination of the spine and the *acromion* towards the superior *costa*, both in the young and the adult *Orang*, I should infer from this particular rather a specific identity than a difference. I therefore subjoin the following admeasurements, accurately taken from the same relative positions of the *scapulæ* of two specimens of *Simia Satyrus* of different ages, and of the adult *Orang* or *Pongo*.

	Younger immature Orang.		*Older immature Orang.*		*Pongo, or adult Orang.*	
	in.	lines.	in.	lines.	in.	lines.
From the extremity of the *acromion* to the root of the coracoid process		10	1	5	2	4
From the root of the *acromion* to the root of the coracoid process . .		7		11		14
From the root of the *acromion* to the inferior angle of the *scapula* . .	2	3	3	3	5	10
From the root of the spine to the inferior angle of the *scapula* . . .	2		2	8	4	5
From the root of the spine to the superior angle of the *scapula* . .		4		10		14

These admeasurements show that the progress of the spine from the base of the *scapula* to the root of the *acromion*, which is indicated by the second and fifth admeasurements of the younger immature *Orang*, has undergone a greater proportional change in the older immature specimen than in the adult *Orang*. The third and fourth admeasurements show that the increased size of the subspinal *fossa* is regularly progressive in each.

at the lower part, for the insertion of muscles" in the *ulna* of his specimen of *Simia Satyrus*. This process is less marked in younger specimens, but is very obvious in the skeleton of the *Pongo*. It serves for a more advantageous attachment to the *pronator quadratus*, which muscle has greater breadth than in *Man*. The length of the *radius* to the *ulna* is in *Man* as 11 to 12; in the *Orang* it is as 36 to 37.

The bones of the hand, like those of the fore arm and the *humerus*, recede from the human type in their elongated form; the bones of the thumb, however, are very slender and short, and do not reach to the end of the metacarpal bone of the fore finger. The bones of the *carpus* have their ossification completed later than in the human subject, and allow of a freer motion upon each other. The *os pisiforme* is divided into two, so that the number of carpal bones is nine. The proximal *phalanges* of the fingers are more curved than in *Man*, and the lateral ridges more strongly developed than in the *Chimpanzee*. The distal *phalanges* are more pointed, not expanding at their extremities to give support to an extended surface of delicate touch.

As the upper extremities exceed in length those of the *Chimpanzee*, so the lower extremities differ as much in the contrary respect, preserving throughout the existence of *Simia Satyrus* much less than the fully grown fœtal proportions of the human subject.

The *femur* has a straight shaft, but differs from the human chiefly in having no depression on the head for a *ligamentum teres*[1]. The neck is shorter and forms a more obtuse angle with the shaft of the bone, and there is not any *linea aspera* at the posterior

[1] In three recent specimens of *Simia Satyrus* I have found the *ligamentum teres* deficient in both the hip-joints. This singular circumstance in the organization of the *Orang Utan* is not noticed in the Manuals of Comparative Anatomy of Blumenbach or Cuvier, although it has been recorded by Camper in his Treatise on the *Orang*. (See Œuvres, tom. i. p. 132.) It appears also to have been overlooked in the dissection of the *Orang* detailed by Dr. Jeffries (Boston Journal of Philosophy, vol. ii. p. 570; Philosophical Magazine, vol. lxvii. p. 186.), unless, from the inference which he draws, the hip-joint of his specimen really presented this remarkable exception to the general structure. He says: "The articulation of the *femur* with the *acetabulum* is almost exactly like *Man's*; the neck of the bone forms about the same angle. In quadrupeds this forms a distinguishing characteristic, being in them nearly a right angle: the inspection of this joint is alone sufficient to satisfy the naturalist of at least the facility, if not the natural disposition, of the *Satyrus* to walk erect"! The skeleton is doubtless still preserved, and it would be worth while to make a re-examination of the head of the *femur* to ascertain the presence or otherwise of the depression for the *ligamentum teres*.

In all the other *Quadrumana* which I have examined the *ligamentum teres* is present, but in none of them are the legs so disproportionately short as in the *Orang*; the deficiency of the ligament doubtless, therefore, bears a relation to this circumstance, and a greater flexibility of the hip-joint, especially of rotation inward, is the result.

In the *Unau* (*Bradypus didactylus*, Linn.) and *Ai* (*Brad. tridactylus*, Linn.), with hinder limbs of similar proportions to those of the *Orang*, and habits still more strictly arboreal, a similar extent of motion is allowed to the leg by the absence of a restraining ligament in the hip-joint.

In the *Elephant* and *Megatherium* the deficiency of the *ligamentum teres* would seem to relate to the position of the *acetabulum* with reference to the head of the *femur*, the socket resting upon the ball, and not receiving it obliquely sideways, as in most other quadrupeds.

In the *Manis didactyla*, in the *Seal*, and in the *Walrus*, the *ligamentum teres* is wanting. Rudolphi and part; the inner condyle also is not produced beyond the external, and the axis of the *femur* is consequently the same with that of the *tibia*,—a circumstance which may also be observed in *Simia Troglodytes*. In both species the natural position of the *femur* is evidently a state of inflection upon the *pelvis*; the head must be partially displaced from the *acetabulum* in order to draw back the *femur* to a line parallel with that of the spine, as may be seen by comparing the figure of the *Chimpanzee* (Plate XLVIII.) with that of the *Orang* (Plate XLIX.). The angle which the *femur* forms with the trunk is more obtuse in the *Chimpanzee* than in the *Orang*, in which the arms are better organized as vicarious instruments of support.

The *tibia* and *fibula*, besides their shortness, are characterized in the *Orang* by the greater space existing between them, owing to the inward curve of the *tibia*, and by the rounder form of both bones. Both these deviations from the human form, especially the curvature of the *tibia*, are greater in the *Orang* than in the *Chimpanzee*. The

Meckel have noticed a similar simplicity in the structure of the hip-joint in the *Ornithorhynchus paradoxus*, and I have also found that the same structure obtains in the *Echidna Hystrix* and *Ech. setosa*.

There can be little doubt that the absence of the *ligamentum teres* is one cause of the greater vacillation observed in the *Orang Utan*, when it attempts progression on the hinder legs, than in other *Quadrumana*. In Dr. Abel's account of the capture of a very large Sumatran *Orang*, it is observed, "His motion on the ground was plainly not his natural mode of progression, for even when assisted by his hands or a stick, it was slow and vacillating; it was necessary to see him amongst trees in order to estimate his agility and strength." In Audebert's Histoire des Singes, p. 18, is a note on the progressive motion of the *Orangs*, which closely accords with the structure above mentioned; it is as follows: "Un naturaliste voyageur, M. Labillardière, qui a vu de ces animaux, m'a assuré que lorsqu'ils marchent *leurs jambes de derrière sont pliées* en sorte que ce sont les jambes de devants qui cheminent." And this account of the use he makes of his long arms in progression along the ground is confirmed by the observations of M. Fred. Cuvier, who has given some valuable observations on the habits of a living *Orang Utan* in the sixteenth volume of the 'Annales du Muséum'. He observes: "Cet *Orang-Outang* étoit entièrement conformé pour grimper et pour faire son habitation des arbres. En effet, autant il grimpoit avec facilité, autant il marchoit péniblement: lorsqu'il vouloit monter à un arbre il en empoignoit le tronc et les branches avec ses mains et avec ses pieds, et il ne se servoit que de ses bras, et point de ses cuisses comme nous le faisons dans ce cas. Il passoit facilement d'un arbre à un autre lorsque les branches de ces arbres se touchoient, de sorte que dans une forêt un peu épaisse il n'y auroit eu aucune raison pour que cet animal descendit jamais à terre, où il marchoit difficilement. En général tous ces mouvemens avoient de la lenteur; mais ils sembloient être pénibles lorsqu'il vouloit se transporter sur terre d'un lieu dans un autre: d'abord il appuyoit ses deux mains fermées sur le sol, se soulevoit sur ses long bras, et portoit son train de derrière en avant en faisant passer ses pieds entre ses bras et en les portant au delà des mains; ensuite appuyé sur son train de derrière il avançoit la partie superieure de son corps, s'appuyoit de nouveau sur ses poignets, se soulevoit et recommençoit à porter en avant son train de derrière comme nous l'avons dit d'abord."

In three living specimens of the immature *Orang* I have witnessed the same debility of the hinder extremities as instruments of support. If, however, the peculiar construction of the hip-joint add to the difficulty of progression in the erect posture, arising from a form of the *pelvis* and inferior extremities common to the *Orang* with other *Simiæ*, it doubtless facilitates his favourite mode of travelling among the branches of his native forests, by allowing a greater variety and extent of motion to the lower extremities, and by thus combining, as it were, the peculiar freedom of the shoulder-joint with the hand-like form of the foot.

patella is smaller in proportion than in *Man*, is of an oval shape, and has a single articular surface without any ridge.

The *tarsus* has the same number of bones; and they have nearly the same forms as in the *Chimpanzee*, but admit of freer motion on each other, and constitute a relatively smaller proportion of the entire foot. The *astragalus* has its articular surface more oblique, and the foot in consequence is more turned inwards; this bone is much flatter than in the human subject. The *os calcis* does not project so far backwards as in the *Chimpanzee*; it is small and compressed. Lawrence aptly remarks, that "this single bone is, therefore, an infallible characteristic of *Man*; and '*ex calce hominem*' would probably be a safer rule than '*ex pede Herculem*'."[1] The internal cuneiform bone recedes most from the human type in its greater production or development towards the plantar aspect, and in having the surface of articulation for the *hallux*, or great toe, below the range of the other articular surfaces. The metatarsal bones (that of the *hallux* excepted) are much longer, more concave towards the sole, and have greater interspaces than the human. The metatarsal bone of the second toe has its articulation with the *tarsus* on the same line as the rest: the metatarsal bone of the *hallux* extends very little beyond the middle of the preceding, and stands off from it at an acute angle.

The peculiarity of the structure of the hinder thumb, viz. its having but one bone, and consequently no nail, was first observed by Camper[2], who found it to be the case in seven out of eight *Orangs* which he had the opportunity of examining. In the *Orang Utan* decribed by M. Fred. Cuvier, however, it is expressly stated, "Tous les doigts des pieds avoient la même structure que ceux de la main et étoient très-libres dans leurs mouvemens; et tous, sans exception, avoient leurs ongles."[3] In the individual dissected at the Museum of the Zoological Society, (October 1830,) the great toes had very perfect but small black nails, and also two *phalanges* in addition to the metatarsal bone: the same number of *phalanges* exists in the natural skeleton of Lord Amherst's *Orang* preserved in the Museum of the College of Surgeons, so that these exceptions much diminish the importance of this circumstance as a generic or specific character[4].

The *phalanges* of the other toes are remarkably elongated; those of the first series are curved; the middle toe exceeds the rest in length; the concavity of the great toe is turned more towards the other toes than in the *Chimpanzee*: but the chief difference which obtains in the bony structure of the foot is in the relative length of the hind thumb. In the *Orang* it does not reach to the condyle of the adjoining metatarsal

[1] Lectures, p. 144. [2] Œuvres, tom. i. p. 54. [3] Annales du Muséum, tom. xvi. p. 48.

[4] Since, in addition to this, the intermaxillary sutures are obliterated at the development of the great *cuspidati*, the generic character proposed by Dr. Leach for the *Simia Satyrus* will be unexceptionable in only one particular.

"PITHECUS. Os intermaxillaire parfaitement distinct; point de ligament suspenseur de la cuisse; la derniere phalange du pouce du pied manque, et par consequent point d'ongle à ce pouce."—Journal de Physique, tom. lxxxix. p. 159.

bone, while in the *Chimpanzee* it extends to the second *phalanx* of the second toe: in this species, also, it has always two *phalanges* in addition to the metatarsal bone, is set more forwards on the internal cuneiform bone, and has its concavity looking more towards the sole of the foot: consequently the resemblance of the hinder hand to a true foot is greater in the *Chimpanzee* than in the *Orang*.

§ 4. *Summary Comparison of the* Chimpanzee *and* Orang Utan *with each other and with* Man.

The *Chimpanzee* differs osteologically from the *Orang*

1. In having the *cranium* flatter and broader in proportion to the face.

2. In having the supraciliary ridges more developed, and in the absence of the interparietal and sagittal crests.

3. In the junction of the temporal with the frontal bones.

4. In the greater proportional breadth of the interorbital space.

5. In the more central position and less oblique plane of the occipital *foramen*.

6. In having but one anterior condyloid *foramen* on each side, while the *Orang* has two.

7. In having generally but one suborbital *foramen* on each side, while the *Orang* has three or more.

8. In the persistence of the cranial sutures.

9. In the earlier obliteration of the maxillo-intermaxillary sutures.

10. In the smaller proportional size of the incisive and canine teeth, and consequent smaller development of the jaws, especially of the intermaxillary bones.

11. In the smaller proportional size of the cervical, and larger proportional size of the lumbar, *vertebræ*.

12. In the additional dorsal *vertebra* corresponding to the additional pair of ribs.

13. In the more simple composition of the *sternum*, which consists of a single and not double series of bones, as in the *Orang*.

14. In the greater sigmoid curve of the clavicle, which in the *Orang* is nearly straight.

15. In the less proportional breadth of the *scapula*, and the more lateral aspect of the glenoid cavity.

16. In the less proportional breadth and greater length of the *sacrum*.

17. In the less proportional breadth of the *ilium*, and greater expansion of the *ischium*.

18. In the comparative shortness of the upper extremities, more especially of the fore arm and hand.

19. In the non-division of the pisiform bone of the wrist.

20. In the greater proportional length of the *femur* and *tibia*, and the less proportional length of the foot.

21. In the presence of a *ligamentum teres*, and consequent depression in the head of the *femur*.

22. In the greater proportional size of the *tarsus* as compared with the *phalanges* of the toes.

23. In having constantly two *phalanges* in the *hallux*, or great toe, with a nail; while the ungueal *phalanx* and nail are often wanting in the *hallux* of the *Orang*, especially in that of the female.

The *Chimpanzee* approximates more nearly to the human structure in those deviations from the *Orang* which are numbered 4, 5, 6, 7, 8, 9, 10, 12, 13, 17, 18, 19, 20, 21, 22, 23.

The *Orang* has a nearer resemblance to *Man*

1. In the junction of the sphenoid with the parietal bones.

2. In having twelve pairs of ribs.

3. In the form of the *scapula*, especially its greater breadth.

From the preceding comparison, therefore, it results that the *Chimpanzee* ought to rank above the *Orang* in a descending series, and not below it as in the 'Règne Animal' of Cuvier.

Both the *Chimpanzee* and *Orang* differ from the human structure

1. In the *diastema*, or interval between the *cuspidati* and *incisores* in the upper jaw, and between the *cuspidati* and *bicuspides* in the lower jaw.

2. In the greater magnitude of the intermaxillary bones indicated in the adult by the distance of the *foramina incisiva* from the incisive teeth; both of which differences result from the greater proportional development and different forms of the *cuspidati* and *incisores*. These differences are of generic value.

3. In the more backward position and oblique plane of the occipital *foramen*.

4. In the smaller proportional size of the occipital *condyles*.

5. In the larger proportional size of the petrous bones.

6. In the greater proportional development of the jaws.

7. In the flatness of the nasal bone, which is rarely divided in the mesial line, while in *Man* the nasal bones are as rarely consolidated into one.

8. In the presence of the ant-auditory process of the temporal bone, and the absence of the mastoid and styloid processes.

9. In the absence of the process of the ethmoid, called the *crista galli*.

10. In the shortness and comparative weakness of the lumbar region of the spinal column, which is also composed of four instead of five *vertebræ*.

11. In the narrowness and proportional length of the *sacrum*.

12. In the flatness of the *ilia*, and the larger development and outward curvature of the *ischia*.

13. In the position of the *pelvis* in relation to the spine.

14. In the larger proportional development of the chest.

15. In the greater length of the upper extremities.

16. In the wider interval between the *ulna* and *radius*.

17. In the shortness and weakness of the thumb, and narrowness of the hand in relation to its length.
18. In the shortness of the lower extremities.
19. In the greater proportional length and narrowness of the foot.
20. In the small size of the *os calcis*.
21. In the shortness and opposable condition of the *hallux*.

These differences result from original formation, and are not liable to be weakened in any material degree, either, on the one hand, by a degradation of the human species, or, on the other hand, by the highest cultivation of which the anthropoid *Apes* are susceptible.

With respect to the structure of the foot, it has been asserted by the supporters of the theory of progressive development and transmutation of species, that the position of the great toe, which converts the foot into a hand, is a modifiable character. M. Bory de St. Vincent[1], assuming that this is the only organic difference between the *Orang* and the human subject, endeavours to invalidate its importance as a zoological character by showing that a prehensile property of the foot is gained by *Man* himself under certain circumstances, and that therefore it ought not to disunite the members, as he terms them, of the same zoological family. In support of this view he proceeds to relate, that in certain districts, as the Landes of Aquitaine, the peasants, who obtain their livelihood by collecting the resin of the *Pinus maritima*, and who are termed *Resiniers*, acquire a power of opposing the great toe to the others, like a hinder thumb; but supposing the extent of motion of the great toe to be sufficiently increased by constant habits of climbing, or in connexion with a congenital defect of the upper extremities, yet it does not appear that the *os calcis* or the other bones of the foot have lost any of those proportions which so unerringly distinguish *Man* from the *Ape*. The author of the article Orang in the 'Dictionnaire Classique' seems even to doubt whether the hinder hand of the *Ape* may not be a mark of an organization superior to that of the *Bimanous* type. "C'est un chose digne de remarque, que pour rejeter les Orangs parmi les Singes, et ceux-ci parmi les brutes stupides, en conservant à nos pareils la dignité qu'ils s'arrogent au sein de l'immense nature, on ait argué d'un avantage incontestable que posséderaient sur nous les Singes et les Orangs. En effet, quatre mains ne vaudraient-elles pas mieux que deux comme élémens de perfectibilité?"[2] To give due force to this proposition the four hands of the *Ape* ought to be independent of any share in stationary support or progression; now it is scarcely necessary to observe, that the perfection of the hands of *Man* results in a great measure from the free use he is enabled to make of them in consequence of the organization of the lower members as exclusive instruments for sustaining and moving the body. It has, however, been suggested that the *hallux* of the *Orang* might acquire increased length and strength during the efforts of successive

[1] Art. Orang, Dict. Classique d'Hist. Nat., tom. xiii. p. 264.
[2] Ibid. p. 264.

generations to maintain the erect position; but if we look a little further into the anatomy of the *Orangs*, a difficulty presents itself unforeseen by Lamarck. The muscle called *flexor longus pollicis pedis* terminates, in the human subject, in a single tendon, and its force is concentrated on the great toe,—the principal point of resistance in raising the body upon the heel. In the *Orang*, however, the analogous muscle terminates in *three* tendons, which are inserted separately and exclusively in the three middle toes, obviously to enable these to grasp with greater force the boughs of trees, &c. It is surely asking too much to require us to believe that in the course of time, under any circumstances, these three tendons should become consolidated into one, and that one become implanted into a toe to which none of the three separate tendons were before attached. The myology of the *Orangs*, to which I may hereafter endeavour to direct more attention than it has yet received, affords many arguments equally unanswerable against the possibility of their transmutation into a higher race of beings.

Certain modifications in the form of the human *pelvis* have been observed to accompany the different forms of the *cranium* which characterize the different races of mankind; but there is nothing in the form of the *pelvis* of the Australian or Negro which tends to diminish the wide hiatus that separates the *Bimanous* from the *Quadrumanous* type of structure in regard to this part of the skeleton. Observation has not yet shown that the *pelvis* of the *Orang* in a state of captivity undergoes any change approximating it towards the peculiar form which the same part presents in the human subject: the idea that the iliac bones would become expanded and curved forwards, from the pressure of the superincumbent *viscera* consequent on habitual attempts at progression on the lower extremities, is merely speculative.

Those features of the *cranium* of the *Orangs*, which stamp the character of the irrational brute most strongly upon their frame, are, however, of a kind, and the result of a law originally impressed upon the species, which cannot be supposed to be modified under any circumstances, or during any lapse of time; for what external influence operating upon and around the animal can possibly modify in its offspring the forms, or alter the size, of the deeply-seated germs of the permanent teeth? They exist before the animal is born, and let him improve his thinking faculties as he may, they must, in obedience to an irresistible law, pass through the phases of their development, and induce those remarkable changes in the maxillary portion of the skull which give to the adult *Orangs* a more bestial form and expression of head than many of the inferior *Simiæ* present.

It is true that in the human subject the *cranium* varies in its relative proportions to the face in different tribes, according to the degree of civilization and cerebral development which they attain; and that in the more debased Æthiopian varieties and Papuans, the skull makes some approximation to the *Quadrumanous* proportions: but in these cases, as well as when the *cranium* is distorted by artificial means or by congenital malformation, it is always accompanied by a form of the jaws, and by a disposition and proportions of the teeth, which afford unfailing and impassable generic distinctions between *Man* and the *Ape*[1].

To place this proposition in the most unexceptionable light, I have selected the *cranium* of a human idiot, in whom nature may be said to have performed for us the experiment of arresting the development of the brain almost exactly at the size which it attains in the *Chimpanzee*, and where the intellectual faculties were scarcely more developed. Yet no anatomist would hesitate in at once referring this *cranium* to the human species.

A detailed comparison with the *cranium* of the *Chimpanzee* or *Orang* shows that all those characters are retained in the idiot's skull which constitute the differential features of the human structure.

The cranial cavity extends downwards below the level of the glenoid articulatory surfaces.

The nasal bones are two in number, and prominent.

The jaws and teeth exhibit the *Bimanous* characters as strongly as in the most elevated of the human race. The *cuspidati* do not project beyond the contiguous teeth, and consequently there are no interruptions in the dental series, as in the *Orangs*, where they are required to lodge the disproportionate crowns of the canine teeth.

With respect to the zoological relations subsisting between the *Chimpanzee* and *Orang*, the differences above mentioned warrant their being regarded as types of two distinct subgenera. The characters, however, proposed by M. Geoffroy St. Hilaire[2], being derived from immature specimens, require to be altered.

Subgenus Troglodytes.

Muzzle long, truncated anteriorly; strong supraciliary ridges, behind which the forehead recedes directly backwards; no cranial ridges.

Facial angle 35°, excluding the supraciliary ridges.

Auricles large.

Thirteen pairs of *ribs*; bones of the *sternum* in a single row.

Arms reaching below the knee-joint.

Feet wide; *hallux* extending to the second joint of the adjoining toe.

Canines large, overpassing each other, the *apices* lodged in intervals of the opposite teeth.

[1] Perhaps one of the best exemplifications of the degree of approximation which the *Quadrumana* make towards the human species, is the position assigned by naturalists to the adult *Orang* before its identity with the immature *Satyrus* was established. See 'Annales du Muséum,' tom. xix. p. 89; Latreille, 'Fam. Nat. du Règne Animal,' p. 44; and Fischer, 'Synopsis Mammalium,' p. 32, who, without entering into the particular differences, observes, "Sunt qui hanc speciem (Simia Wurmbii) pro Sim. Satyro adulta ducant. Permultæ tamen sententiæ isti repugnare videntur."

[2] Annales du Muséum, tom. xix. p. 87.

Intermaxillary bones anchylosed to the maxillaries during the first or deciduous dentition.

Ex. The *Chimpanzee*, *Black Orang*, or *Pygmy*. (*Troglodytes niger*, Geoff. *Simia Troglodytes*, Blum.) *Jocko*, a name for the young *Chimpanzee*.

Height of adult four feet.

Hab. Africa.

Subgenus Pithecus.

Muzzle large, elongated, somewhat rounded anteriorly; forehead sloping backwards; slight supraciliary ridges, but strong sagittal and lambdoidal crests.

Facial angle 30°.

Auricles small.

Twelve pairs of *ribs*; bones of the *sternum* in a double alternate row.

Arms reaching to the ankle-joint.

No *ligamentum teres* in the hip-joint.

Feet long and narrow; *hallux* not extending to the end of the metacarpal bone of the adjoining toe; often wanting the ungueal *phalanx* and nail.

Canines very large, their *apices* extending beyond the intervals of the opposite teeth.

Intermaxillarg bones anchylosed to the maxillaries during the second or permanent dentition.

Ex. The *Orang Utan*, or *Red Orang*. (*Pithecus Satyrus*, Geoff. *Simia Satyrus*, Linn.) *Pongo*, a name for the adult, originally applied to the *Chimpanzee*.

Height under five feet.

Hab. The islands of Borneo and Sumatra.

Table of Admeasurements.

	Adult Chimpanzee.			Young Chimpanzee.			Adult Orang[1], Fœm.			Young Orang.		
	ft.	in.	lin.	ft.	in.	lin.	ft.	in.	lin.	ft.	in.	lin.
Length of the body from the *vertex* to the base of the *os calcis*	3	10	0	2	0	0	4	1	6	2	7	1
Length of the head from the *vertex* to the base of the occipital condyle	0	3	6	0	2	10	0	3	7	0	3	5
Length of the spinal column	1	9	3	0	10	5	1	11	6	1	3	0
Length of the posterior part of the occipital ridge												
Length of the head from the *inion*, or posterior plane of the *occiput*, to the margin of the incisors	0	7	3	0	4	4	0	7	6	0	6	1
Length of the head from the *inion* to the fronto-nasal suture	0	5	3	0	3	4	0	4	7	0	4	4
Length of the head from the fronto-nasal suture to the margin of the incisors	0	4	4	0	2	4	0	4	4	0	3	3
Length of the greatest lateral diameter of the *cranium* at the post-auditory ridges	0	4	6	0	3	5	0	5	4	0	4	6
Length of the smallest lateral diameter of the *cranium* behind the orbits	0	2	8	0	2	4	0	2	6	0	2	6
Length of the *os frontis*	0	2	9	0	2	4	0	2	8	0	2	6
Length of the sagittal suture	0	2	6	0	2	5½	0	2	7	0	2	6
Distance between the temporal ridges	0	1	10	0	3	0	0	0	6	0	3	0
Diameter of the face at the *zygomata*	0	4	8	0	3	2	0	6	0	0	4	5
Length of the zygomatic *fossa*	0	1	9	0	1	3	0	2	6	0	2	0
Breadth of the zygomatic *fossa*	0	1	1½									
Diameter of the face taken from the outsides of the orbits	0	4	0	0	2	9	0	4	2	0	3	7
Interorbital space	0	0	7	0	0	4	0	0	5	0	0	3
Lateral diameter of the orbit	0	1	6	0	1	2	0	1	4	0	1	4
Perpendicular diameter of the orbit	0	1	3	0	1	1	0	1	6½	0	1	5
Transverse diameter of the nasal aperture	0	1	0	0	0	7½	0	1	1	0	1	0
Perpendicular diameter of the nasal aperture	0	1	1½	0	0	7	0	1	6	0	1	0
Distance between the infra-orbital *foramina*	0	2	1	0	1	6	0	1	8	0	1	8
Breadth of the alveolar portion of the *maxilla superior*	0	2	4	0	1	3	0	2	4	0	1	7
Distance from the inferior margin of the nasal bone to the inferior margin of the intermaxillary bones	0	2	6	0	1	7	0	2	7	0	1	9
Length of the bony palate	0	2	10	0	1	9	0	3	3	0	2	6
Distance from the anterior margin of the intermaxillary bones to the anterior palatal *foramen*	0	0	10	0	0	5	0	1	3	0	0	7
Breadth or antero-posterior extent of the palatal process of the palate bone	0	0	6	0	0	4	0	0	8	0	0	7½
Breadth of the crown of the first incisor	0	0	5	0	0	3	0	0	5	0	0	3½
Breadth of the crown of the second incisor												
Breadth of the four incisors	0	1	6	0	1	3½	0	1	6	0	1	3
Length of the grinding-surface of all the *molares*, the *bicuspides* included	0	1	9	0	1	1	0	2	0	0	1	4
Length of the crown of the canine tooth				0	0	3	0	1	2	0	0	4
Breadth of the enamelled crown of the canine tooth	0	0	5⅔	0	0	3	0	0	9	0	0	3½
Interspace between the canine and incisor teeth, upper jaw	0	0	3	0	0	1	0	0	3½	0	0	3
Distance from the anterior margin of the occipital *foramen* to the posterior margin of the bony palate	0	2	4½	0	1	5	0	2	9	0	2	1
Length of the lower jaw (from the condyle to the *symphysis*)	0	5	0	0	3	5	0	6	2	0	4	7
Length from the angle to the *symphysis*	0	3	3	0	2	7	0	5	6	0	3	10
Length from the angle to the condyle	0	2	5	0	1	3	0	3	10	0	2	5
Breadth between the angles	0	1	10	0	2	1	0	3	9	0	2	10
Breadth of the *ramus*	0	1	10	0	0	11	0	2	3	0	1	6
Breadth between the mental *foramina*	0	1	10	0	1	4	0	1	11	0	1	7
Breadth of the four incisors	0	1	4	0	1	3	0	1	5	0	1	0
Breadth of the canine tooth	0	0	4	0	0	3	0	0	8	0	0	3½
Length of the enamelled crown of the canine tooth	0	0	7	0	0	4	0	1	2	0	0	4
Length of the grinding surface of the *molares*	0	2	0	0	1	0	0	2	4	0	1	2

[1] The admeasurements in this column are taken, by permission of the Board of Curators, from the skeleton in the Museum of the Royal College of Surgeons, in which the absence of the cranial ridges, and some still separated *epiphyses*, would indicate the non-attainment of full growth.

	Adult Chimpanzee.			Young Chimpanzee.			Adult Orang, Fœm.			Young Orang.		
	ft.	in.	lin.	ft.	in.	lin.	ft.	in.	lin.	ft.	in.	lin.
Length of the *sternum* (not including the ensiform cartilage)	0	4	10	0	2	5	0	4	4½	0	2	8
Length of the *manubrium sterni*	0	1	5	0	0	8	0	1	5	0	0	9
Breadth of the *manubrium sterni*	0	2	0½	0	0	10	0	2	4	0	1	3
Breadth of the *sternum* opposite the fifth rib	0	0	9	0	0	3½	0	1	2	0	0	9
Length of the first rib	0	2	8	0	1	2	0	2	7	0	1	7
Length of the seventh rib	1	0	0	0	4	0	1	4	6	0	4	7
Length of the last rib (which is longer than in *Man*, and has a cartilage)	0	5	9	0	1	6	0	6	2	0	3	6
Length of the cervical portion of the vertebral column	0	3	4½	0	1	6	0	4	7	0	2	8
Length of the dorsal portion of the vertebral column	0	9	0	0	4	6	0	8	3	0	6	4
Length of the lumbar portion of the vertebral column	0	4	9	0	2	5	0	4	3	0	2	8
Length of the sacral portion. Length of the caudal	0	4	5	0	2	8	0	4	9	0	3	7
Breadth of the *sacrum*	0	2	6	0	1	3	0	3	4	0	2	2
Breadth of the *pelvis* from one antero-superior spine of *ilium* to the other	0	9	3	0	4	3	0	11	5	0	6	4
Breadth of the *ilium*	0	4	2	0	2	0	0	4	9	0	2	11
Breadth of the *ischium*				0	1	7	0	3	7	0	2	2
Length of the *os innominatum*	0	9	10	0	5	6	0	9	10	0	6	0
Antero-posterior diameter of the pelvic aperture	0	5	0	0	1	7	0	5	5	0	2	4
Transverse diameter of the pelvic aperture	0	3	5	0	1	2	0	4	0	0	2	0
Distance between the *acetabula*	0	4	0	0	1	10	0	5	5	0	3	4
Distance between the spines of the *ischia*	0	3	0	0	1	3	0	2	9	0	1	4
Length of the *symphysis pubis*	0	1	6	0	1	4	0	2	0	0	1	5
Length of the sacro-sciatic notch	0	3	3	0	1	7	0	2	7	0	1	7
Longest diameter of the *obturator foramen*	0	1	7	0	1	1	0	1	9	0	1	3
From the antero-superior spine of the *ilium* to the *acetabulum*	0	4	3	0	2	7	0	4	3	0	2	8
From the outside of one *tuber ischii* to that of the other	0	6	0	0	2	7	0	5	8	0	2	10
From the antero-superior spine of the *ilium* to the *symphysis pubis*	0	7	3	0	3	9	0	7	8	0	4	10
From the *acetabulum* to the upper end of the *symphysis pubis*	0	2	5	0	1	3	0	3	1	0	2	0
Superior, or Atlantal, Extremities.												
Length of the *clavicle*	0	4	7	0	2	0	0	6	9	0	4	2
Length of the *scapula* along the base				0	2	6	0	5	5	0	3	5
Breadth from the end of the *acromion* to the opposite part of the base				0	3	0	0	4	8	0	4	1
From the root of the spine to the superior angle				0	1	3	0	1	4	0	1	0
From the root of the spine to the inferior angle				0	1	5	0	4	3	0	2	6
Length of the atlantal extremity from the head of the *humerus*	2	5	0	1	5	0	3	1	3	2	1	2
Length of the *humerus*	0	10	9	0	6	5	1	1	4	0	8	10
Length of the *radius*	0	10	0	0	5	6	1	1	7	0	8	9
Length of the *ulna*	0	10	8	0	6	0	1	2	5	0	8	9
Length of the hand	0	8	4	0	5	7	0	10	5	0	7	3
Length of the fore finger	0	7	1	0	4	3	0	8	5	0	6	0
Length of the middle finger	0	7	6	0	4	9	0	9	3	0	6	5
Length of the ring finger	0	6	4	0	4	4	0	8	10	0	6	0
Length of the little finger	0	5	4	0	3	7	0	7	9	0	5	8
Length of the thumb	0	3	0	0	1	9	0	3	8	0	2	3
Breadth of the wrist	0	1	9	0	0	9	0	2	0	0	1	3
Breadth of the distal end of the *metacarpus*	0	2	0	0	1	2	0	2	5	0	1	9
Inferior, or Sacral, Extremities.												
Length of the sacral extremity (to the base of the *os calcis*)	1	9	0	1	0	0	1	9	3	1	2	6
Length of the *femur*	0	11	0	0	6	4	0	10	3	0	7	2
Length of the *tibia*	0	8	5	0	5	0	0	9	0	0	5	10
Length of the *fibula*	0	8	0	0	4	7	0	8	7	0	5	5
Length of the *patella*	0	0	10	0	0	4	0	0	10			
Breadth of the *patella*	0	0	9	0	0	3½	0	0	9			
Length of the foot	0	8	2	0	4	10	0	10	0	0	7	10
Breadth of the *tarsus*	0	1	6	0	1	1	0	2	3	0	1	6
Breadth of the distal end of the *metatarsus*				0	1	0	0	1	9	0	1	6
Length of the *hallux*	0	3	9	0	2	3	0	2	10	0	1	9
Length of the next toe	0	5	9	0	3	0	0	8	5	0	5	5
Length of the little toe	0	4	7	0	2	9	0	7	0	0	4	10

PLATE XLVIII.

Side view of the skeletons of the adult and young *Chimpanzee* (*Simia Troglodytes*, Blum.), the latter being of that age when the first permanent *molares* have been acquired, and before the shedding of any of the deciduous teeth.

PLATE XLIX.

Side view of the skeletons of the adult and young *Orang Utan* (*Simia Satyrus*, Linn.). The young skeleton is of a corresponding age with that of the *Chimpanzee* in the preceding Plate: like it, it exhibits the anthropoid character in the relative smallness of the face to the *cranium*, resulting from the state of dentition, but shows the correspondency with the adult skeleton in the number of ribs and in the relative proportions of the upper and lower extremities. With regard to the number of *vertebræ*, it must be observed, that the figure of the adult skeleton, being taken, by permission of the Board of Curators, from the specimen in the Museum of the Royal College of Surgeons, exhibits the abnormal number of five lumbar *vertebræ*, instead of four, which is the number existing in the trunk of the mature *Orang* preserved in the Museum of the Zoological Society and in the skeleton in the Museum of Comparative Anatomy in the Jardin des Plantes.

PLATE L.

Front view of the skeletons of the adult *Chimpanzee* and *Orang Utan*. The trunk of the latter is figured from the specimen belonging to the Zoological Society, and shows the normal number of lumbar *vertebræ*, which is the same as in the *Chimpanzee*. The proportions are given according to the size indicated by a *cranium* and *ulna* and *radius* in the Museum of the Royal College of Surgeons; from which it would appear that the height of the animal, fairly measured from the *vertex* to the sole of the foot, could not exceed five feet.

PLATE LI.

Side view of the *cranium* of the adult *Chimpanzee*, natural size. On the left hand are figured the germs of the permanent teeth, taken from the skull of a young *Chimpanzee* at the period when the first true molar, *f*, has appeared.

a. The first incisor.
b. The second incisor.
c. The *apex* of the crown of the laniary or *cuspidatus*.

d, *e*. The two *bicuspides*.

f. The first true molar, its fangs yet imperfect.

g. The second molar.

On the right hand, a front view is given of the first and second permanent incisors, as they appear partly worn down in the adult.

PLATE LII.

The base of the skull of the adult *Chimpanzee*, natural size. The rudiments of the permanent teeth, *a* to *g*, are figured in a position corresponding to those in the jaws of the adult. The formation of the last molar, or *dens sapientiæ*, *h*, had not commenced in the young *cranium* from which the rest of the permanent teeth were taken.

PLATE LIII.

Side view of the *cranium* of an adult *Orang Utan*. A front view of the first permanent incisor, *d*, and the rudiments of the permanent teeth, *a* to *g*, from the jaws of a young *Orang* are subjoined, proving its identity with the adult, or supposed *Pongo*.

This Plate is taken from a *cranium* in the possession of Mr. Cross, of the Surrey Zoological Gardens, who obligingly sent his specimen to me for the purpose of describing and figuring it. On comparing it with the skull of the *Pongo*, or adult *Orang*, in the Museum of the College of Surgeons, I noted the following differences:

The skull belonging to Mr. Cross is shorter in the antero-posterior diameter, and rises higher at the *vertex*. The supra-orbitary ridges are more prominent; the plane of the orbits is more vertical, and their lateral exceeds their perpendicular diameter. The profile line of the skull is concave between the *glabella* and incisor teeth, while in the specimen in the Museum of the College it is almost a straight line between the same parts. The *symphysis* of the jaw, from the interspace of the mesial incisors to the origin of the *genio-hyoidei* muscles, measures $2\frac{1}{2}$ inches in Mr. Cross's specimen, but equals $3\frac{1}{3}$ inches in the *Pongo* in the College Museum. There is also a remarkable difference in the position of the zygomatic suture: in the *Pongo* of the College Museum it commences at the distance of a quarter of an inch from the orbital process of the malar bone and extends obliquely backwards to within $1\frac{1}{2}$ inch of the origin of the zygomatic process of the temporal bone; in Mr. Cross's specimen, the same suture commences 8 lines from the orbital process of the malar bone and extends to within 10 lines of the origin of the temporal zygomatic suture, so that it is much nearer the middle of the *zygoma*.

With these differences, however, there exist the same form and proportions of the teeth, and the same peculiarities of the *foramina* and sutures which distinguish the *Orang* from the *Chimpanzee*. So that, although the difference in the shape and general contour of the two skulls is greater than is usually observable in those of other wild animals of the same species, yet I do not consider them sufficient to afford grounds for specific distinction. It is probable, however, that they may be indicative of varieties of the *Orang* inhabiting distinct localities; and it would be interesting with that view to compare the *crania* of ascertained specimens from Borneo and Sumatra, to which islands this very remarkable animal appears to be confined.

PLATE LIV.

Base of the skull of the adult *Orang Utan*: *a* to *g*, Rudiments of the permanent teeth taken from the jaws of an immature specimen.

PLATE LV.

Fig. 1. Side view of the skull of a young *Chimpanzee*.

Fig. 2. Side view of the skull of a young *Orang Utan*. These views are both of the natural size, and taken at corresponding periods of dentition, when the permanent teeth are advanced to the extent shown in the preceding figures.

PLATE LVI.

Comparative views of the skulls of the young and old *Chimpanzee* and *Orang Utan*, showing the changes of form they respectively undergo in attaining to maturity.

Figg. 1, 5. Young *Chimpanzee*.
2, 6. Adult *Chimpanzee*.
3, 7. Young *Orang Utan*.
4, 8. Adult *Orang Utan*.

A comparison of Fig. 1 with Fig. 2, and of Fig. 3 with Fig. 4, will show that those differences between the young and old skulls that are present in the *Simia Satyrus*, and which have been chiefly insisted upon as proofs of a specific difference between them, obtain equally in the *Simia Troglodytes*.

Dr. Harwood (*loc. cit.*, p. 474,) observes, "But the most distinguishing difference relates to the proportions of the orbits, and the space which separates them. They are of by far the greatest proportionate size in the *Satyrus*; for in the very young animals before alluded to they measure transversely 15 lines and a half, while in the skull of the largest *Pongo* ever brought to this country, they extend no more than 17 lines and a half. But the difference in the extent of the space between the orbits is of all the distinctions I have seen the most apparent; for in the *Satyrus*, where the transverse extent of the orbits is 15 lines and a half, and the vertical 17 and a half, the space between the orbits is only 2 lines and a half; and in the still younger *Satyrus* at the Royal Institution, where the transverse diameter is 13 lines and a half, this space measures only 2 lines, or less than one sixth; while in the *Pongo*, where the same diameter is 17 lines and a half, it is no less than 7 lines and a half, or nearly equal to *one half the breadth of the orbit.*"

The cause of the proportional differences in the size of the orbits, and extent of the inter-orbital space, is explained in the text, p. 358. And the Figures in this plate show that they operate equally in the *Simia Troglodytes* as in the *Simia Satyrus*, and that the proportionally greater breadth of the inter-orbital space which distinguishes the young *Chimpanzee* from the young *Orang* is equally characteristic of the adults of the two species.

A comparison of Fig. 5 with Fig. 6, and of Fig. 7 with Fig. 8, will show that in each species a gradual change takes place in the plane of the occipital *foramen*: this is occasioned by the downward and lateral growth of the upper jaw, and is accompanied with a corresponding enlargement of the glenoid cavities, and of the whole base of the skull, which, as the cerebral portion remains stationary in its development, throws the occipital *foramen* more backwards. This change is of course proportionally greater in the *Simia Satyrus* than in the *Simia Troglodytes*, corresponding to the greater difference which subsists between the young and adult states of their jaws and dentition; but the relation that is preserved equally proves the identity of the young with the adult *Orang*, as between the young and the adult *Chimpanzee*.

PLATE LVII.

Side view of the skull of a human idiot, natural size.

PLATE LVIII.

Base of the same skull, natural size.

This figure and the preceding were taken, by the liberal permission of Edward Stanley, Esq., F.R.S., from the specimen in his Museum of Human and Pathological Anatomy at St. Bartholomew's Hospital.

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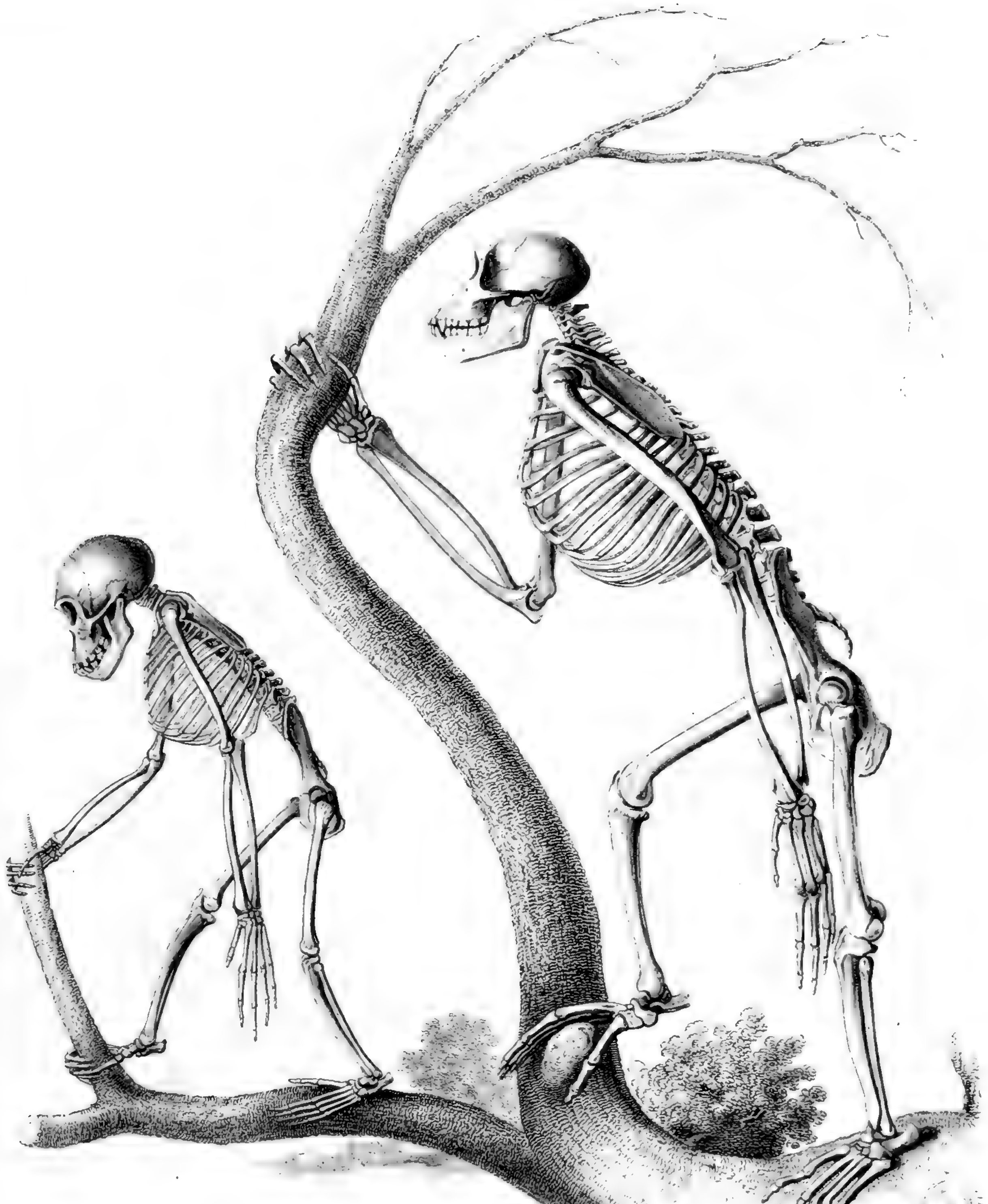
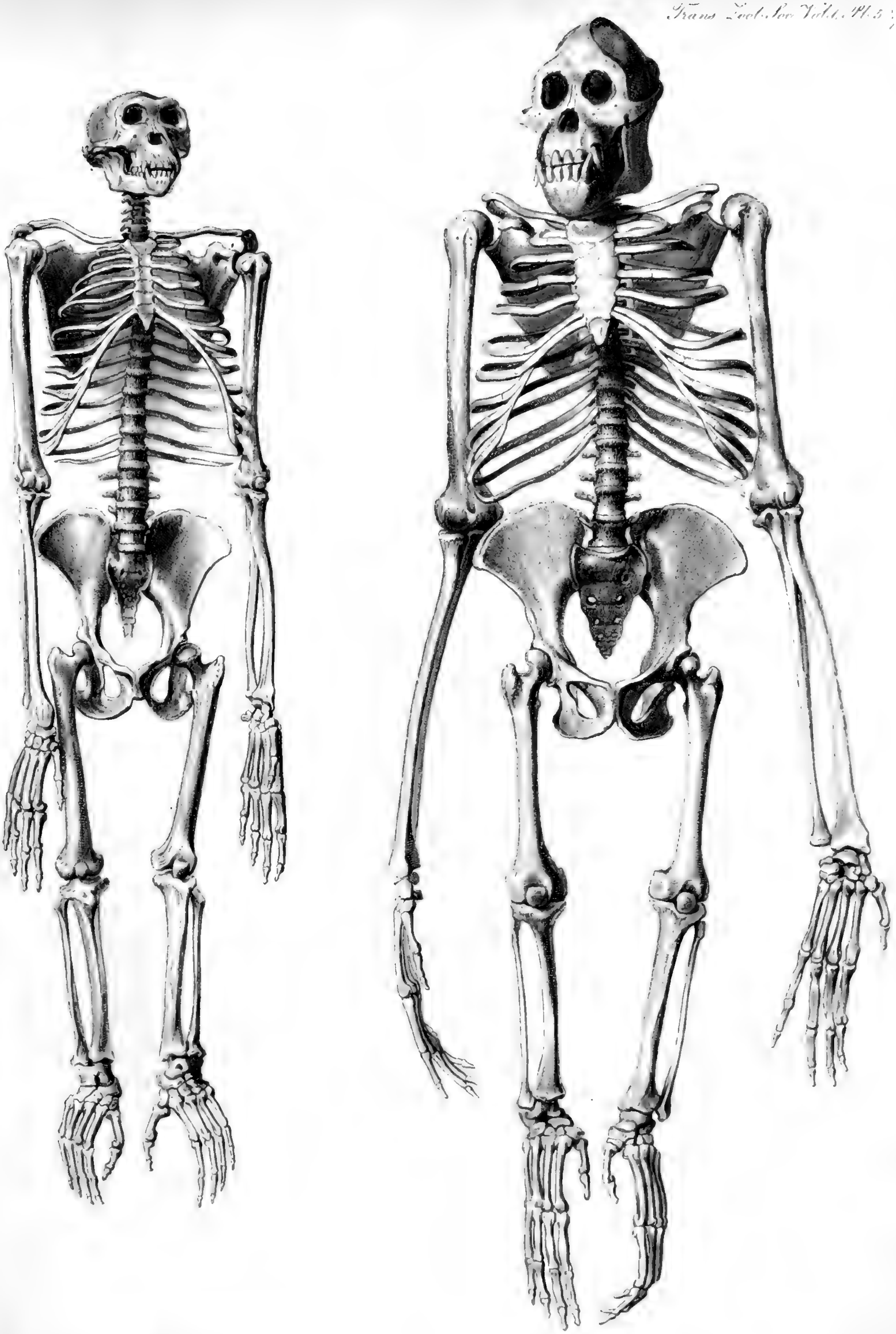


Simia Troglodytes.

Owen del.

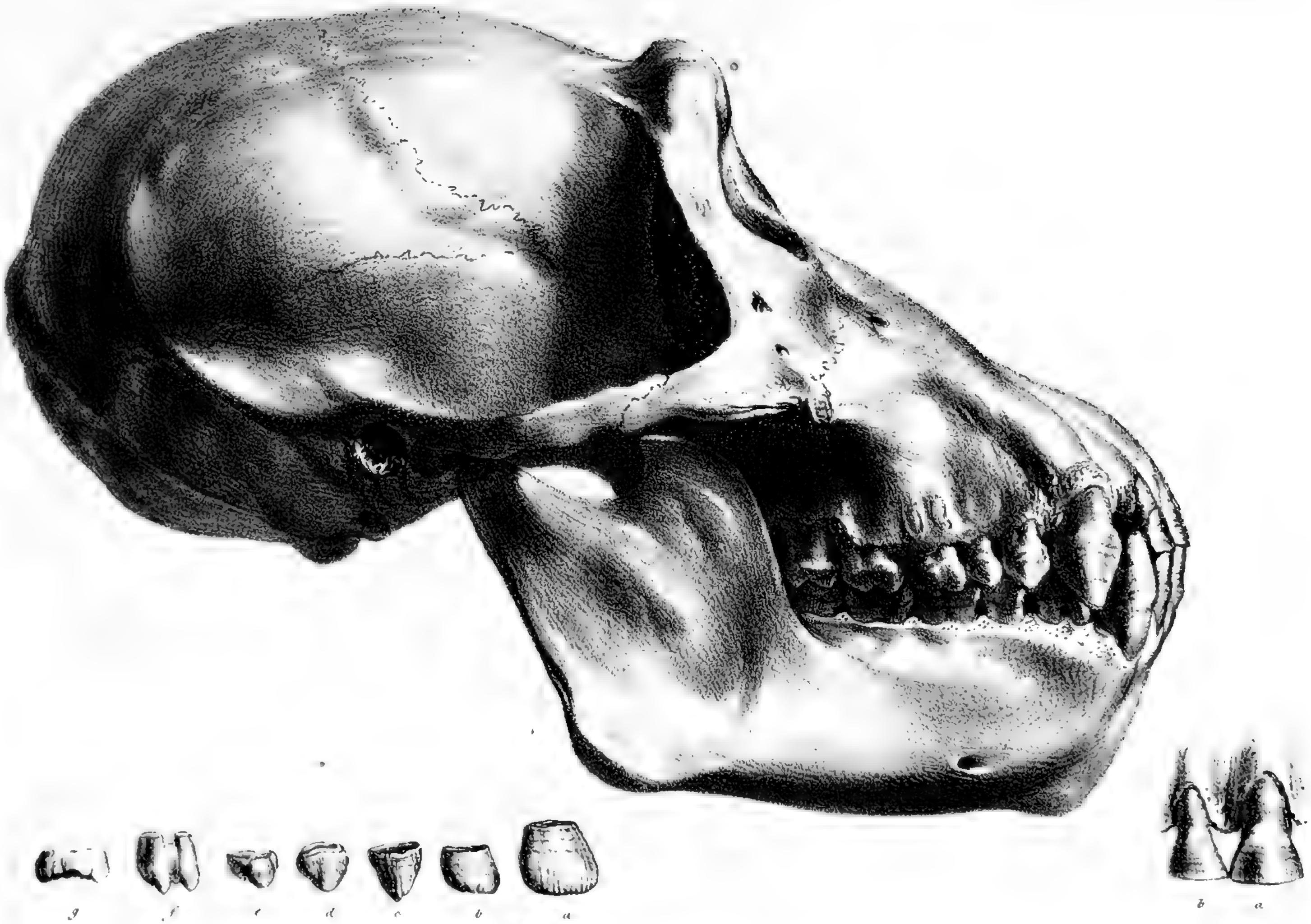
Simia Satyrus.

Owen. del. J. Erxleben sc.



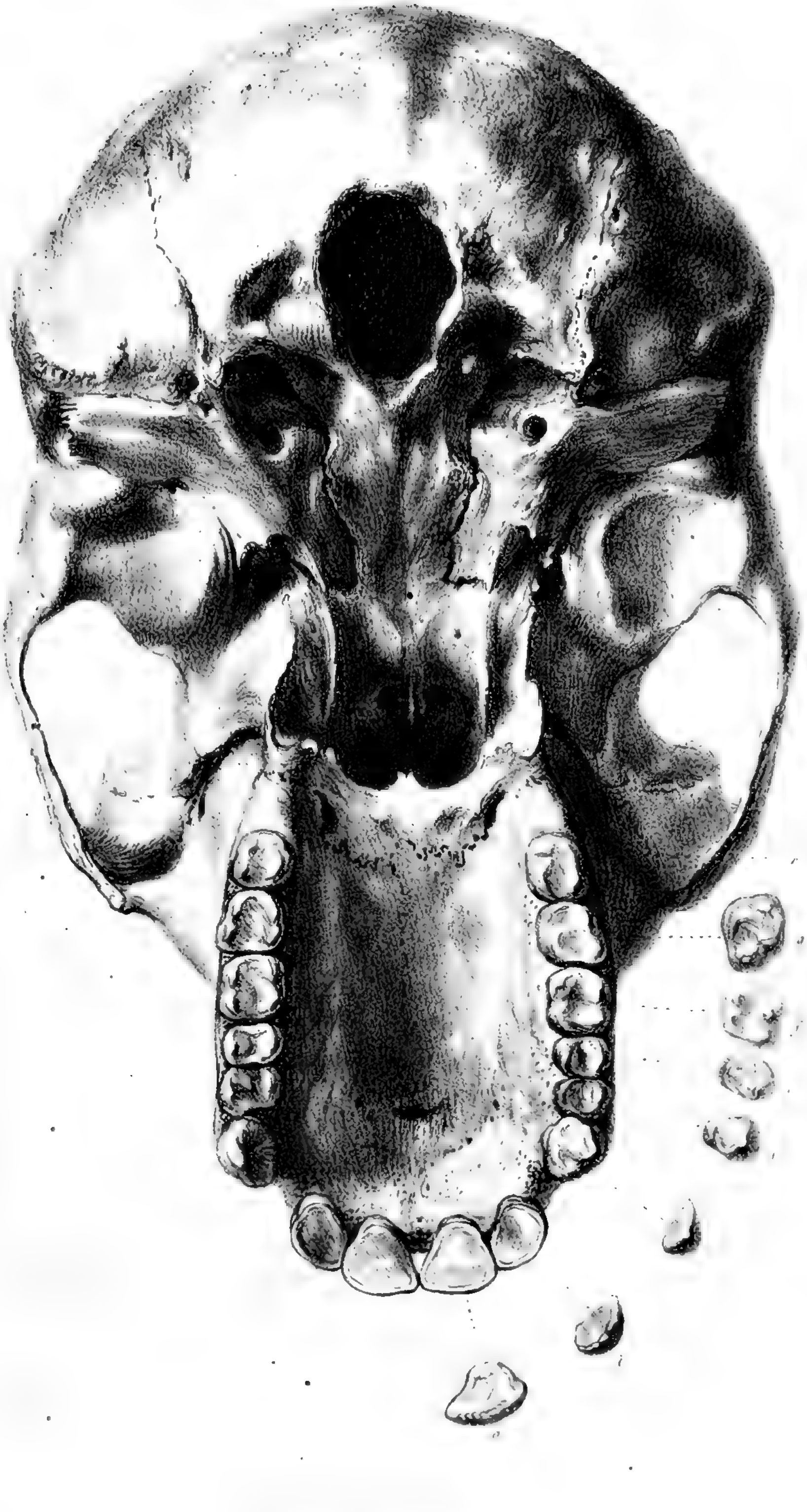
Simia. Troglodytes.   Simia. Satyrus.

Owen. del.



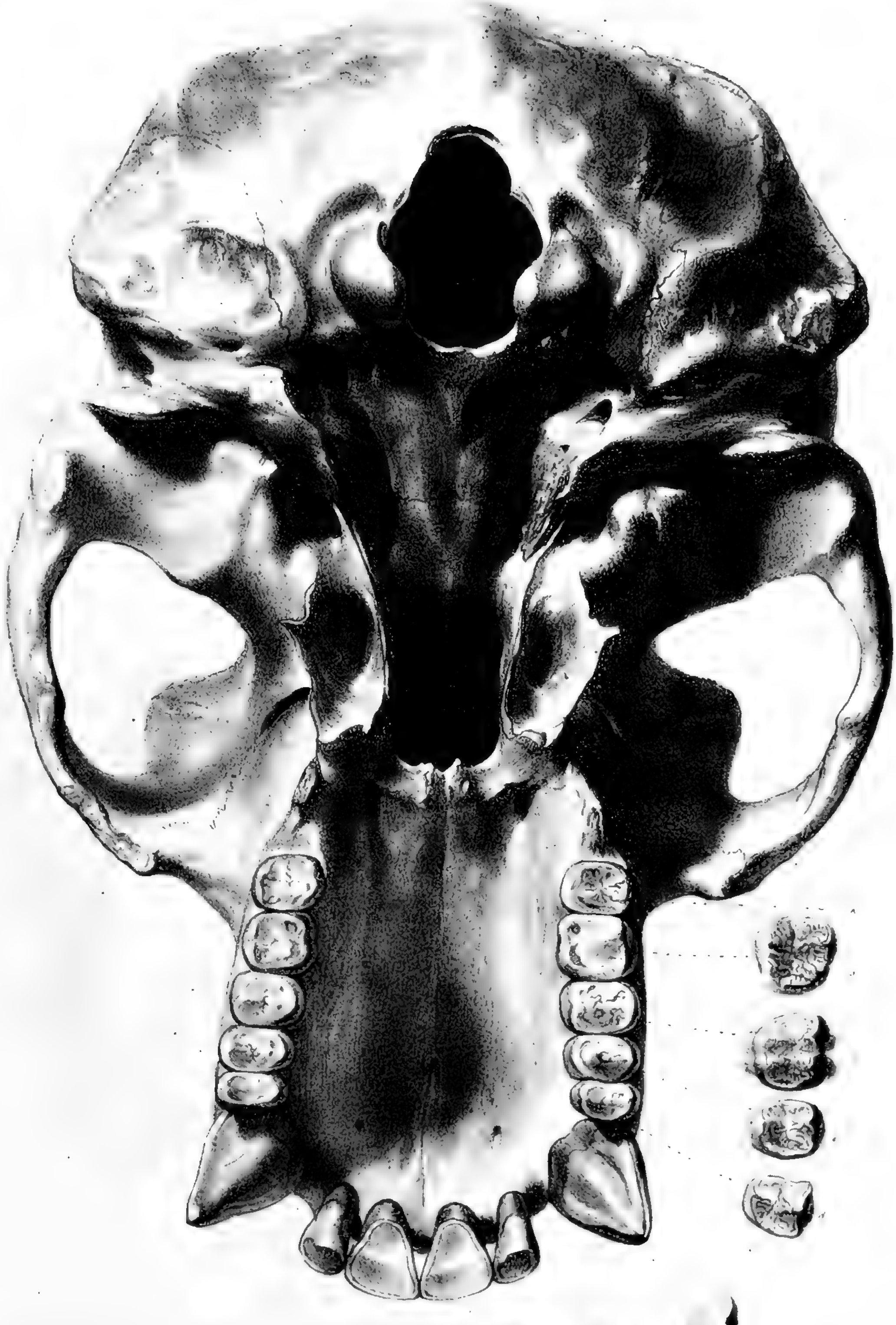
...m Troglodytes.

Lithographed from Nature by G. Scharf. Printed by Hullmandel



Lithographed from Nature by G. Scharf

Simia Satyrus.



Simia Satyrus

Lithographed from Nature by G. Scharf

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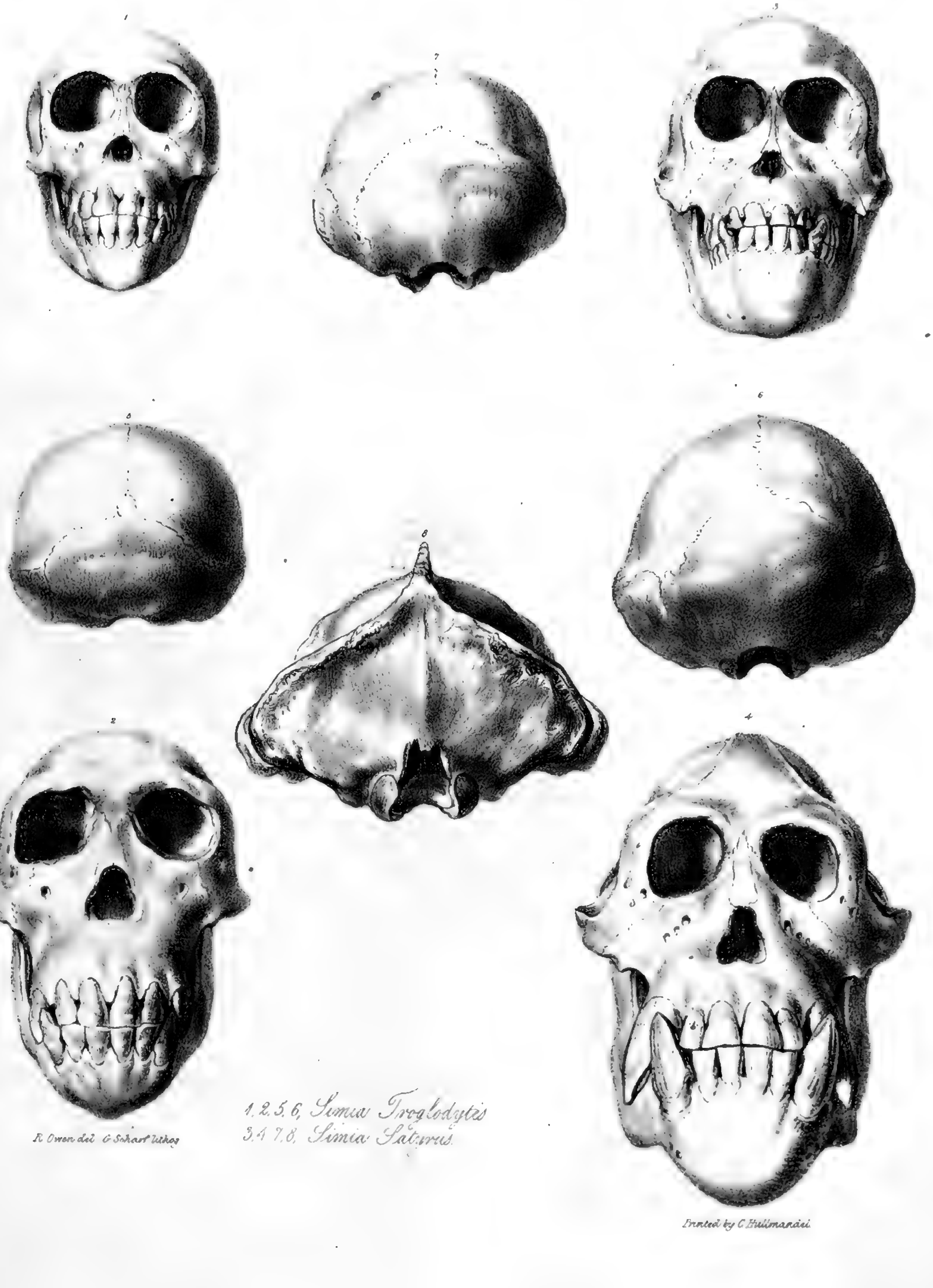
1 Simia Troglodytes 2 Simia Satyrus

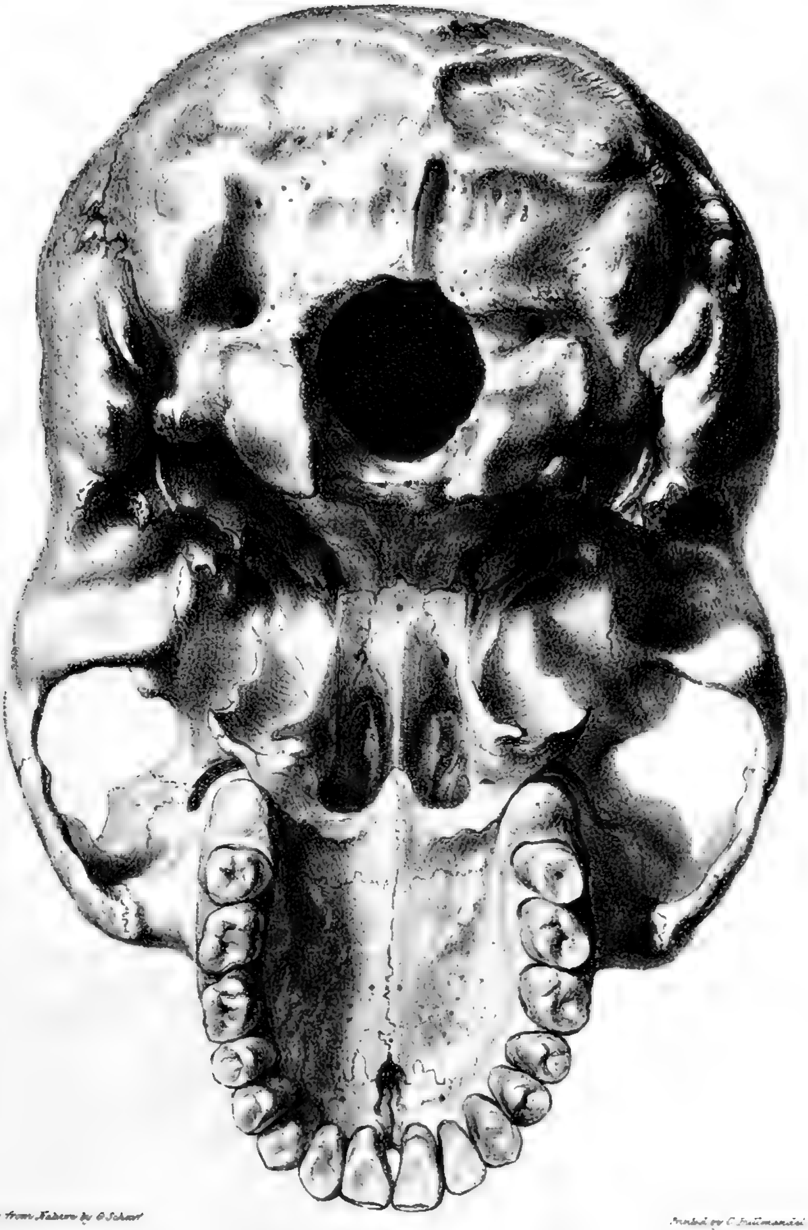


R. Owen del. G. Scharf lithog.

1, 2, 5, 6, *Simia Troglodytes*
3, 4, 7, 8, *Simia Satyrus.*

Printed by C. Hullmandel.

Side View of the Skull of a human Idiot



Lithographed from Nature by G. Scharf

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Base of the Skull of a human Idiot

XL. *On the Anatomy of* Distoma clavatum, *Rud. By* Richard Owen, *Esq., F.R.S. & Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated May 26, 1835.

In former papers[1] I gave descriptions of two *Entozoa*, or internal animal parasites, of widely different degrees of organization: the one manifesting simply a homogeneous granular pulp, enveloped in a transparent thin elastic tegument; the other having distinctly developed nervous ganglions and filaments, a muscular tunic, a digestive canal contained in an abdominal cavity, ovaries, oviduct, and fecundating glands. I now propose to offer a few observations on an *Entozoon* of an intermediate grade of structure, in which a cellular *parenchyma* still occupies the body, where no distinct nervous filament can be traced, but in which a complicated system of nutritious and generative canals, with external organs for adhesion and locomotion, are developed.

My attention was first called to the species of *Distoma* about to be described by the following circumstance. In the series of the Hunterian collection of comparative anatomy relating to the digestive functions, there is a preparation[2] of an *Acrite Invertebrate* animal, of a round elongated form, showing at one extremity a sac opening externally by a minute orifice; and at the opposite end a larger orifice surrounded by a suctorious disc, behind which, and at a little distance from each other, are two other orifices, the posterior being of large size, and evidently an organ of adhesion. From the manuscript catalogue it appeared that Mr. Hunter had regarded the sac as the stomach.

I was for some time uncertain to what class of animals this singular specimen could belong, but was inclined to refer it to the *Trematode*, or fluke-worms, on account of the suctorious orifices at the smaller end; although the digestive cavity, which the specimen had apparently been prepared to exhibit, was a feature in its organization which appeared to remove it equally from that and any other order of the *Sterelmintha.* Subsequently, however, on looking over the 'Spicilegia Zoologica' of Pallas, I found, in the tenth *fasciculus*, a figure and description of a *Worm* termed *Fasciola ventricosa,* which closely resembled the animal in question. The general form and situation of the different orifices were the same, but the orifice corresponding to that which led to the cavity regarded by Mr. Hunter as the stomach, Pallas calls the *anus.*

The account given of the cellular *parenchyma* of the body, of its dark-coloured contents, and yellow *ovula,* agreed very closely with the appearances in the Hunterian specimen, but nothing could be deduced from the description as to the existence of any cavity communicating with the *anus,* corresponding to that which the Hunterian specimen presented; and the figures given by Pallas illustrate the external form only. The size of the specimen described in the 'Spicilegia' is nearly 2 inches in length, and $\frac{4}{5}$ of an

[1] Page 315 and page 325.

[2] No. 116.

inch in breadth, exceeding that in the Hunterian collection by about one third; so that Pallas calls it the giant of its kind, "ad aliud quam Fasciolarum genus referre non potui, in quo quasi gigas erit."

The *Distoma ventricosum* of the 'Synopsis Entozoorum' of Rudolphi, is a minute species distinct from the *Fasciola ventricosa* of Pallas, whose account appears to have escaped the Lyncean eye of the learned founder of Entozoology. Pallas's species is nevertheless characterized by Rudolphi, but under the designation of *Distoma clavatum*: and in the more detailed description contained in the 'Historia Entozoorum,' reference is made to Mr. Menzies' paper in the 'Linnean Transactions[1],' where the species described under the name of *Fasciola clavata* is evidently the same with the *Fasciola ventricosa* of Pallas. Mr. Menzies both describes and figures the posterior aperture; and this testimony to the accuracy of Pallas is perhaps of more weight, as the author supposes that he is describing a new animal. Rudolphi, however, both in the 'Historia Entozoorum' and in the 'Synopsis Entozoorum,' doubts the accuracy of this statement, and gives no account of the internal structure of the species.

It was therefore with much satisfaction that I found, on looking over the admirable collection of *Invertebrate Animals* made by the late Rev. Lansdown Guilding, and recently sent to this country, a fine specimen of the *Fasciola ventricosa seu clavata*, of equal size with that figured by Pallas, and well preserved in spirit of wine.

The circumstances under which it was originally obtained were not mentioned in the manuscript catalogue of Mr. Guilding. Pallas, with reference to the habitat of the species, merely states that his specimen was sent from Amboyna[2]. Mr. Menzies observes that he often found the *Fasciola clavata* in the maws of the *Bonito*, between the tropics in the Pacific Ocean. Rudolphi also assigns the stomach of *Scomber Pelamys* as the habitat of the *Distoma clavatum*, on the authority of Garsinus and Tilesius[3].

Mr. Guilding's specimen of this large species of *Distoma* measures 2 inches 2 lines in length, and $2\frac{1}{2}$ inches in circumference at the thickest part. It closely resembles in form the figure given by Pallas. Mr. Menzies, who observed the animal in its living state, represents it of a longer and more attenuated form. The outer integument is thin, crisp, and semitransparent, transversely and minutely wrinkled, and evidently fibrous in the same direction: it adheres but slightly, at least after maceration in spirit, to the succeeding layer. This tunic is evidently muscular, and composed of longitudinal fibres, and adheres pretty closely to the membrane immediately inclosing the cellular *parenchyma* of the body; still, by proceeding carefully, they can be separated. The longitudinal fibrous tunic is beautifully ornamented with tortuous vessels, containing a dark-coloured fluid.

The anterior orifice, which is the commencement of the true alimentary canal, is surrounded by a muscular sphincter, forming a suctorious disc or cup, of a firm and

[1] Vol. i. p. 187. Plate XVII. fig. 2.

[2] "Ex Amboyna missum fuit singulare hoc Molluscum."

[3] It is always advisable to examine the stomach and intestines of the *Bonito, Albicore,* and other tropical *Fishes,* which are frequently infested with singular *Entozoa.*

almost cartilaginous texture at the bottom, which is perforated by a minute orifice, through which the fluids absorbed from the animal infested by the *Distoma* pass into the digestive tubes; these are two in number, and are continued, slightly enlarging and diverging from one another, to the cells at the posterior part of the body.

About 2 lines' distance from the mouth, on the concave side of the neck or narrow part of the body, there is a small transverse slit, concealed by the wrinkles of the integument, forming the outlet of the generative organs. The large cavity behind this slit is simply for adhesion, and does not communicate with the interior of the body: it is provided with a strong muscular concave disc, the margin of which is papillose; and external to the *papillæ* it is surrounded by a circular fold of the integument. The body continues to enlarge behind the *acetabulum*, and terminates in an obtuse clavate extremity. On closely inspecting this part a minute central orifice was clearly perceived, which conducted to a narrow cavity formed between two layers of a villous membrane, extending vertically across the terminal dilated part of the animal. No communication could be detected, upon the most minute inspection, between this cavity and the rest of the body.

Besides the cellular *parenchyma*, of which the body is chiefly composed, the three systems of canals, digestive, vascular, and generative, which the *Trematoda* usually possess, are present in their ordinary forms and positions; the cells at the smaller end of the body were occupied, in this specimen, by a yellow fluid, containing numerous *ovula* of the same colour, many of which had thence passed into the tortuous oviduct. Towards the posterior part of the body the cells enlarge in size, and are principally transverse in their direction.

The clavate end of the body is occupied by two large lateral cavities in addition to the mesial one above mentioned. The side cavities were filled with a dark brown fluid, containing minute opake particles of the same colour, similar in appearance to partly digested blood. The internal surface of these cavities is of a black colour, and covered with minute folds and wavy wrinkles. The dark-coloured canals which meander over the lateral *parietes* of the body take their origin from these large cavities, which also communicate with the smaller canals anterior to them, and from them they receive the nutriment, which is carried backwards by the two alimentary canals from the mouth; so that they hold an intermediate position between the alimentary and the sanguiferous canals. Analogous reservoirs have been observed in *Amphistoma conicum*, in which they have been denominated by Laurer *cisterna chyli*; and similar cavities are also termed chyle receptacles (*Chylusbehälter*) by Nordmann[1] in the minute *Trematode* parasites which he has detected in the eyes of *Fishes*. In the *Distoma clavatum*, however, these receptacles have no communication with the mesial cavity or the posterior aperture. Nordmann observed that a white fluid was ejected by successive spasmodic actions from the posterior aperture of *Diplostomum volvens*, which corresponds to the one above described in *Di-*

[1] "Am hintern Ende dieses birnförmigen Organs befindet sich eine deutliche, trichterförmige Öffnung, die durch einen Sphincter geschlossen werden kann. Man könnte es vielleicht am besten mit dem Namen eines Chylusbehälters bezeichnen."—Micrograph. Beiträge, p. 38, Hft. 1.

stoma clavatum. The surface of the cavity in *Distoma clavatum*, of which the small posterior orifice is the outlet, singularly contrasts with that of the receptacles on either side; being of a yellowish white colour, and smooth. The office of this posterior sac being most probably excretory, it may be regarded as exhibiting a rudimentary condition of the respiratory system.

This large species of *Distoma* exhibits, according to Mr. Menzies, well-marked locomotive powers. "In moving," he observes, "it fastens itself alternately by the ventral aperture and its mouth, raising its slender neck between them into an arched form, like a leech, and in this manner drags its body along with a slow motion. It is of a whitish colour, somewhat pellucid, discharging at its mouth a black-coloured fluid, which can easily be perceived through its body[1]." The superaddition of an excretive organ is in just accordance with the muscular energies above observed; and the analogy to the *Leech* is further shown in the form of the cells, which at the posterior part of the body communicate with and form part of the digestive apparatus; especially of the last two cavities, which very much resemble the last pair of gastric *cæca* occupying a similar position in the *Leech*.

PLATE XLI.

Figg. 17 to 20. Distoma clavatum.

Fig. 17. Ventral surface of *Distoma clavatum*.

a. Anterior pore, where the true mouth is situated.

b. Posterior depression, suctorial disc, or holder.

c. The genital orifice.

d. The orifice of the posterior sac.

18. *Distoma clavatum*, dissected from the dorsal aspect.

e. The cuticular wrinkled integument.

f. The muscular integument.

g. The anal sac, laid open: a bristle is placed through the orifice.

h. *h*. Cavities external to the anal sac, with a black minutely wrinkled surface.

i. Masses of *ova*.

k. The oviduct.

l. The *testis*.

m. Vessels.

19. Posterior view, showing the muscular discs surrounding the oral, a', and prehensile, b', *fossæ*, and the termination of the genital tube, c'.

m. The vascular circle surrounding the oral disc.

20. The oviduct, *k*, and testis, *l*.

[1] Loc. cit., p. 188.

XLI. *Description of a new species of Tape-worm,* Tænia lamelligera, *Owen.* *By* RICHARD OWEN, *Esq., F.R.S. & Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated June 9, 1835.

THIS species has hitherto been found only in the small intestines of the *Flamingo, Phœnicopterus ruber*, Linn., and is of a larger size than the *Tæniæ* of *Birds* usually are, being 7 inches in length, 5 lines in width, and 1 line in thickness. Two specimens were found by Lieut.-Colonel Sykes, F.R.S., in a *Flamingo* dissected by him, situated in the *duodenum*, so as almost completely to block up that intestine. The following description is taken from these specimens. The segments are extremely short and numerous; they gradually increase in breadth and thickness for about 3 inches from the head; as they approach the opposite end of the body they slightly diminish in breadth, and while they increase a little in length, retain the same thickness.

Along the middle of both the plane surfaces of the body the segments are separated by shallow indentations only, but at the sides the posterior margins of the segments project abruptly from the surface, and form a series of semicircular ridges, commencing about a line's distance from the margin on one side, and extending round to the same distance on the opposite side.

On both margins of each segment, immediately anterior to these ridges, there is a small pyramidal eminence, perforated at the *apex*, through which perforation a small cylindrical process or *cirrus* can be protruded.

A longitudinal line is slightly impressed along the middle of both surfaces of the body; it is most distinct on the anterior half. A few segments at the posterior extremity of the body were partially separated from the rest, and seemed about to be detached. In these alone were *ova* perceptible, which were aggregated near the base of the *cirrus*, but not confined in an ovary of any definite form: the sides of the canal which they were about to traverse were evidently glandular, and the *ova* are probably fecundated as they pass through. The *cirrus* would seem to be an exciting organ.

The segments at the anterior part of the body are so short that they resemble mere transverse *rugæ*; at the posterior end of the body they did not exceed half a line in length.

The dilated margins of the segments and the projecting *cirri* occasion in this *Tænia* a superficial resemblance to the *Nereis lamelligera* of Pallas, and peculiarly distinguish it from any species hitherto described. It may be characterized as follows.

TÆNIA LAMELLIGERA.

Tæn. incrassata, capite subgloboso; rostello cylindrico obtuso; collo nullo; articulis brevissimis, marginibus lateralibus dilatatis, rotundatis, utrinque parùm extantibus; superficie utrâque lineâ longitudinali leviter impressâ; lemniscis lateralibus oppositis.

Longitudo corporis, 7 unc.; latitudo, 5 lin; crassities, 1 lin.

Hab. in *Phœnicopteri rubri* intestinis tenuibus.

PLATE XLI.

Figg. 21 to 23. TÆNIA LAMELLIGERA.

Fig. 21. *Tænia lamelligera*, natural size.

22. Four segments of the same magnified.

23. A longitudinal section of three posterior segments, showing the *ova* collected near the base of the *lemniscus*.

XLII. *Remarks on the* Entozoa, *and on the structural Differences existing among them: including Suggestions for their Distribution into other Classes. By* RICHARD OWEN, *Esq., F.R.S. & Z.S., Assistant Conservator of the Museum of the Royal College of Surgeons in London.*

Communicated May 26, 1835.

IN investigating the nature of the small human *Entozoon* which I have called *Trichina*, considerable difficulty, extrinsic, or superadded to the subject itself, was experienced, from the habit of considering all such internal parasites as belonging to, or constituting, a distinct class of animals. It is true that it was easy to determine in *Trichina* the absence of *tracheæ*, of *branchiæ*, and of every other kind of respiratory organs, as well as of any true circulating organs, and that not even a vestige of a nervous chord existed in this worm-like animal. But its reference to the *Entozoa* was not therefore less a matter of doubt; for other negative characters presented themselves in relation to the digestive system, and to the mechanism for adhesion or suction, which no less prevented its association with already known *Entozoa*, than the first-mentioned deficiencies separated it, in common with the *Entozoa*, from *Worms* of a higher type of organization.

The greater part of Cuvier's definition of the class *Entozoa* is devoted to the account of their localities, and the remedies used against them, and to a consideration of their mode of production; while the character itself of the class is altogether a negative one. "On n'aperçoit aux vers intestinaux ni trachées, ni branchies, ni aucun autre organe de la respiration, et ils doivent éprouver les influences de l'oxygène par l'intermédiaire des animaux qu'ils habitent. Ils n'offrent aucune trace d'une vraie circulation, et l'on n'y voit que des vestiges de nerfs assez obscurs, pour que plusieurs naturalistes en aient mis l'existence en doute." Cuvier then adds: "Lorsque ces caractères se trouvent réunis dans un animal, avec une forme semblable à celle de cette classe, nous l'y rangeons, quoiqu'il n'habite pas dans l'intérieur d'une autre espèce[1]."

In consistency with this proposition, the *Vibriones* of Müller ought to have ranked in the 'Règne Animal' with the *Entozoa*; and it would be difficult to determine what modification of external form should exclude a species defective in respiratory or circulating organs from that class which, even in Cuvier's system, includes animals of almost every variety of shape. Fortunately, however, the presence of external vibratile *cilia*, which are in some degree subservient to respiration, affords a good character for distinguishing the simpler *Infusoria* from the *Entozoa*, although with this limitation those species of non-ciliated *Vibriones*[2], which do not occasion currents when placed in a coloured fluid, would still rank with the *Intestinal Worms*.

[1] Règne Anim., nouv. ed., tom. iii. p. 246.

[2] *Amblyura Serpentulus*, Ehr.; *Anguillula Aceti*, Auct.; and *Ang. Glutinis*, Auct. or the common *Vinegar-eel* and *Paste-eel*.

The difficulty of assigning a distinctive character to the *Entozoa*, which Rudolphi imagined he had overcome in the 'Historia Entozoorum' by denying them a nervous system, and so distinguishing them from the *Annulate Worms*, he justly allows in his subsequent work, the 'Synopsis Entozoorum'[1], to have returned in its full force, and proposes therefore to separate the *Nematoidea* from the other orders of *Entozoa*, and to join them with the *Annulata* (*Annelides*, Cuvier), in which class of *Worms* he thinks they should form a distinct family. The remaining *Entozoa* (the *Vers Intestinaux Parenchymateux* of Cuvier) Rudolphi leaves among the *Radiata* or *Zoophyta*, a division of animals which he justly terms 'regnum chaoticum.'

With respect to the affinity of the *Nematoidea* to the *Red-blooded Worms*, the important differences which the presence in the latter class of distinct respiratory organs and of vessels circulating red blood present, obviously forbid the junction proposed by Rudolphi, at least in any attempt at a natural arrangement. While the absence of ganglions on the nervous chords, which supply the body in the *Nematoidea* with the motive and sensitive endowments, bespeaks a difference of still greater importance.

As the *Nematoidea*, or *Vers Intestinaux Cavitaires*, differ from the *Vers Parenchymateux* in the presence of a distinct nervous system, as widely on the one hand as they do from the *Annelida* in the form of that system on the other, I have been induced to join them with those other classes of the *Radiata* of Cuvier which, while they are distinguished from the rest of that Division of the Animal Kingdom by the undoubted presence of nerves, agree with the *Nematoidea* in manifesting those organs in the form of simple, unganglиated, disconnected cords.

In attempting therefore a more natural arrangement of the *Entozoa*, I have been led to propose a division of the *Radiata* of the 'Règne Animal' into two groups, founded principally on the two conditions which the nervous system presents, the molecular and the filiform. The necessity of such a dismemberment appears to have been felt by every naturalist who has considered the natural affinities of the classes which are included in the lowest division of Cuvier's system. His *Radiata*, indeed, embrace animals which differ widely from one another, not only in the condition of the nervous but of many other important systems of their organization; and, as the division now stands, an anatomist is unable to predicate a community of structure in either the locomotive, excretive, digestive, sensitive, or generative systems of the various classes which it embraces.

The learned entomologist Mr. W. S. MacLeay has proposed, in the sketch of the natural affinities which he has given in the second volume of the 'Horæ Entomologicæ', to limit the term *Radiata* to the *Echinodermata* and *Acalepha* of Cuvier, which alone, as he justly observes, strictly present the radiated form of the body, and to form a distinct division of the animal kingdom, to include the *Infusoria*, Cuv., *Polypi*, Cuv., and *Parenchymatous Entozoa* under the term *Acrita*, while the *Intestinaux Cavitaires* are transferred to the *Annulose* or *Articulate* division of the animal kingdom; they are not, in-

[1] p. 572.

deed, merged into the class *Annelida*, as Rudolphi proposes, but are made a distinct class in conjunction with the *Epizoaria* of Lamarck, which Mr. MacLeay imagines may be entitled to a place between the *Anoplura* of Dr. Leach and the *Chilognatha*.

The simple filamentous disposition of the nervous system, however, which opposes Rudolphi's views of the place which the *Nematoidea* ought to hold, equally forbids their allocation as an annectant of any of the classes of the *Annulose* or *Homogangliate* division of the animal kingdom.

The *Acrita* of MacLeay are thus defined.

"Animalia gelatinosa polymorpha, interaneis nullis, medullâque indistinctâ.

"Os interdum indistinctum, sed nutritio absorptione externâ vel internâ semper sistit. Anus nullus.

"Reproductio fissipara vel gemmipara, gemmis modo externis modo internis, interdum acervatis.

"Pleraque ex individuis semper cohærentibus animalia composita sistunt."

This definition, able, comprehensive, and accurate as it undoubtedly was, agreeably to the state of anatomical and zoological knowledge at the time when it was penned, fails now to convey a just idea of the prevailing and characteristic organical conditions of the *Acrita*. Fourteen years of subsequent research, crowned by discoveries of which the most brilliant relate to the structure and economy of the lowest classes of the animal kingdom, have wrought their wonted effect on what was intended at a previous period to be the most general expression of the existing knowledge of the organization of a natural group.

The discoveries of Professor Ehrenberg with reference to the digestive system of the *Monads* not only obviate the necessity of ascribing a mode of nutrition by external absorption to any, even the lowest of the animal kingdom; but, while they prove the existence of a complicated internal digestive cavity in the *Agastria* of M. De Blainville, show also that in many of the genera of this simple class the alimentary cavity is provided with a distinct anal outlet. The larger fæcal pores of the *Spongiæ* may be also considered in the same relation to the digestive system.

With respect to generation, the organs of which function afford in their varieties the least certain indications of the relative perfection of the species, it may be observed that in the *Tæniæ* the race is propagated neither by spontaneous fission nor gemmation, but by true *ova*, frequently formed by, and contained in, distinct ovaries, of which one is appropriated to each joint. The *ova* in these receptacles are commonly advanced in proportion as the joints recede from the head; and although the ovaries have distinct outlets either at the middle part or margin of the segments, yet these are commonly detached as the *ova* in the ovary are matured, in a manner analogous to the bursting of the external ovisacs of the *Lernææ* and *Monoculi*. In another order of *Parenchymatous Worms*, the *Trematoda*, distinct fecundating glands are superadded to the productive or female apparatus, and some physiologists suppose, with Cuvier, that generation is effected by reciprocal intromission. Again, distinct sexes are attributed to the *Echinorhynchi*, the highest organized of the *Parenchymatous Intestinal Worms.*

Thus the generative system fails to afford a character applicable to the whole of the *Acrita* of Mr. MacLeay; and we are equally unable to predicate of them a simple digestive sac without an anal outlet. In general it may be observed, that it is only with respect to the nervous system that we can attribute a community of structure to a primary division of the animal kingdom.

Now the classes which present the diffused condition of the nervous globules, are the *Polygastrica*, *Spongiæ*, *Polypi*, and *Acalephæ*; to which must be added the *Vers Intestinaux Parenchymateux* of Cuvier, or *Vers Mollasses* of Lamarck, and of which I would propose to form a class of *Acrita* under the term *Sterelmintha*[1].

But as all the classes of the *Acrite* division exhibit the lowest stages of animal organization, and are analogous to the earliest conditions of the higher classes, during which the changes of the *ovum* or embryo succeed each other with the greatest rapidity, so we find that the species in each class successively present modifications of their peculiar types, which come into close approximation, not with the *Acrite* classes immediately succeeding them, but with some one or other of the classes of higher groups in the animal kingdom, of the typical form of which the *Acrite* classes represent, as it were, the germs. Owing, therefore, to this tendency to ascend in the *Acrita*, it becomes proportionally more difficult to assign a general organic character to that than to any of the higher divisions. Even with respect to the nervous system we find, as we are led step by step from the *Hydra* to the *Actinia* in the class *Polypi*, that the nervous globules begin to manifest the filamentous arrangement about the oral orifice of the last-named genus; that in passing through the *Sterelmintha* from the *Hydatid* to the *Echinorhynchus*, we come also to perceive traces of longitudinal nervous chords in that highly organized *Entozoon*; and that in the *Acalephæ*, examples of the aggregate form of the nervous system have been described. But even supposing these exceptions to be well founded, and the filaments to be really nervous which have been so considered[2], yet the proportion of each class in which the molecular diffused condition of the nervous

[1] Στερεος, *solidus*, ἑλμινς, a term applied by the ancients to intestinal worms, which were distinguished into ἑλμινθες στρογγυλαι, or *Intestinalia teretia*, and ἑλμινθες πλατειαι, or *Intestinalia lata*. My compound is further sanctioned by a term invented by Zeder for the *Entozoa* generally, viz. *Splanchnelmintha*, which term is, however, with that of *Entozoa*, equally subject to the objection of being applied to animals of different classes according to structure.

[2] Professor Ehrenberg has recently ascribed to the *Medusa aurita* distinct visual organs, in the form of minute red points, situated on the surface of the eight brown-coloured masses set round the circumference of the disc. These masses consist each of a yellowish, oval or cylindrical, little body, which is attached to a small and delicate pedicle. This short pedicle arises from a vesicle, in which there is placed a glandular body, unattached, presenting a yellow colour when viewed with transmitted light, and a white colour when under reflected light. It is on the dorsal aspect of the yellow head which surmounts the pedicle that the well-defined red spot is seen which Professor Ehrenberg considers as an eye. He compares the eyes of *Medusæ* to those of *Rotifera* and *Entomostraca*. The glandular body situated at the base of the pedicle, he regards as one optic ganglion, which

system obtains is so great, that it may still be regarded, with little inconvenience, as the chief character of the *Acrita*.

I have already observed that the absence of an egestive outlet to the alimentary canal cannot be assigned to the *Acrita* as a character of that division; but there is a condition of the digestive system in relation to the *parietes* or substance of the body, which is as generally applicable to the *Acrita* as the molecular distribution of the nervous substance; in this division the intestine is not separated from the skin by an abdominal cavity, but, whatever be its form, is essentially a simple excavation of the *parenchyma*. Now the few genera which recede from this character are precisely those in which the existence of nervous filaments is perhaps least ambiguous, as, for example, in *Actinia* and *Beroë*. It is fortunate for the systematic naturalist that these genera form so small an exception to the rule in regard to the conditions of the nervous and digestive systems in the *Acrita*, since the filamentary disposition of the nervous substance, in coexistence with a distinct abdominal cavity and muscular *parietes* of the alimentary canal, constitute the distinctive character of the remaining *Radiated* classes from which the *Acrita* are separated.

In all the *Acrite* classes, then, we find that there is an internal digestive cavity, one of the chief characteristics of the animal kingdom. In the *Sterelmintha*, as in the majority of the *Acrita*, there is but a single communication with the exterior of the body, with the apparent exception in the genus *Cœnurus*, in which, as in the composite *Zoophytes*, nutrition is effected by numerous mouths, but without an *anus*.

The vascular system, where traces of it are met with in the *Acrita*, corresponds with the digestive system, being equally devoid of proper *parietes*, and consisting of reticulate canals excavated in the parenchymatous substance of the body, generally superficial, and in which a *cyclosis* of the nutrient fluids is observed analogous to that of plants; but there is no true circulation. This condition is met with as low down in the scale as the *Polygastrica*, where Professor Ehrenberg has determined the existence of a superficial network of hyaline canals. In those genera of the *Sterelmintha* which manifest traces of a sanguiferous system, the fluids undulate in canals of a similar structure, form, and position, as in the *Trematoda*, especially the *Planariæ*, and in *Echinorhynchi*, in some of the species of which latter the cutaneous vascular network is extremely rich[1].

In the *Medusæ*, among the *Acalephæ*, the condition of the vascular system is equally simple with that of the lowest *Acrita*, as is exemplified in the marginal vascular reticu-

is connected with two filaments that decussate one another at about the middle of their course. These he describes as forming part of a nervous circle placed, throughout the greater part of its course, immediately along the bases of the row of tentacles that surround the disc, so as to form, as it were, the outer wall of the circular vessel, or appendage to the digestive cavity which runs round the margin of the disc. Ehrenberg further describes another nervous circle, composed of four ganglion-like masses, disposed around the mouth, each being in connexion with a corresponding group of tentacles.—Müller's Archiv., 1834, p. 662.

[1] *Echinorhynchus vasculosus*, Rud., Syn., p. 581.

lation in the disc of *Rhizostoma*, &c.; a structure which, when compared to the distinctly developed vessels manifested in the *Echinodermata*, presents a strong argument for retaining the *Acalephæ* in the more simple division of Cuvier's *Radiata*.

If it be true, as has been stated, that the *Medusæ* produce not *ova*, but locomotive ciliated gemmules, we have an additional reason for placing the *Acalephæ* among the *Acrita*, in which division of the animal kingdom only is the plant-like generation by gemmation external or internal, or by spontaneous fission, observed. This character is not, however, generally applicable to the *Acrita*; for the *Sterelmintha* propagate by *ova*, and have appropriate organs, distinct from those of the digestive system. These organs are either cryptandrous, or productive only, as in *Cystica* and *Cestoidea*; or a fecundating gland is superadded to the ovary, as in *Trematoda*; or the sexes are separate, as in the *Acanthocephala*; so as already to typify almost all the modes of generation by which the higher classes of animals are perpetuated.

We thus perceive in the *Acrite* subkingdom that, with the exception of the generative and digestive organs, all the other systems are more or less blended together, and the corporeal *parenchyma* seems to possess many functions in common. Where a distinct organ is eliminated, it is often repeated almost indefinitely in the same individual. In the *Polypi* we frequently find the nutritious canals supplied with a thousand mouths; and the *Polygastrica* derive their name from an analogous multiplication of the digestive organ itself. Among the *Sterelmintha* the generative system becomes the subject of this repetition, each joint of the *Tæniæ* being the seat of a separate ovary, though all are nourished by continuations of the same simple tubes. Again, the calcareous and siliceous *Sponges*, which, in eliminating the first sketch of an internal skeleton, seem to lose the few characteristics of animal life which they before possessed, are limited to the repetition of the same *spiculum*.

The formative energies being thus expended on a few simple operations, and not concentrated on the perfect development of any single system, it is not surprising that we should find in the *Acrita* the greatest diversity of external figure; all the leading types of animal organization seem to have their origin in this division; and it has been well observed, that "Nature, so far from forgetting order, has, at the commencement of her work in these imperfect animals, given us, as it were, a sketch of the different forms which she intended afterwards to adopt for the whole animal kingdom[1]." Thus in the soft mucous sluggish *Sterelmintha*, we have the outline of the *Mollusca*[2]; in the fleshy living mass which surrounds the earthy and hollow axis of the *Polypi natantes*, she has sketched a vertebrated animal; and in the crustaceous covering of the living mass, and the structure more or less articulated of the *Polypi vaginati*, we trace the form of the *Annulosa*.

[1] Horæ Entomologicæ, vol. i. part ii. p. 223.

[2] These, however, are more immediately continuous with the composite *Polypes* by means of the genera *Botryllus*, *Eschara*, and *Cellaria*; while the *Trematoda* evidently lead to the *Haustellate Annelida*, as the *Leech*, &c.

Having been thus led, in considering the place which *Trichina* ought to occupy in the natural system, to review the arrangements of the *Entozoa* generally, to trace their affinities to the other classes of *Radiata*, and thus to take into consideration the grounds for retaining or otherwise that division of the Animal Kingdom, I now proceed to consider the *Entozoa* which are separated from the *Sterelmintha*, and examine them in relation to the classes of the *Radiata* which remain after the dismemberment of the *Acrita*.

The *Vers Cavitaires* of Cuvier, which include the *Nematoidea* of Rudolphi and the *Vers Rigidules* of Lamarck, together with the genus *Nemertes*, and the genus *Linguatula* (*Pentastoma*, Rud.) previously described, I propose to separate into two classes; the one including, with the *Nematoidea*, the genera *Linguatula* and *Sipunculus*, under the term *Cœlelmintha*[1]; the other formed by the *Vers Rigidules* under the term *Epizoa*, which the researches of Dr. Nordmann have recently shown to exhibit a much higher type in their free moving condition than many of them afterwards exhibit when they have become fixed to the animals which they infest.

Both these classes have a condition of the nervous system in common with the *Echinodermata* and *Rotifera* of Professor Ehrenberg, which may be termed the filamentous, since, in all these animals, simple unganglìated nervous filaments can be traced, extending from a point near the commencement of the alimentary canal, in number and direction corresponding with the form of the body. This condition of the nervous system is accompanied by a distinct development of the muscular system, and especially of a muscular tunic of the alimentary canal, which now floats in an abdominal cavity, and, with the exception of one family of *Echinodermata*, has a distinct *anus*. There is no longer in this division any instance of fissiparous or gemmiparous reproduction. In the *Echinodermata*, which are allied to the *Polypi vaginati* by the fixed pedicellate *Encrinites*, the nutritious fluid circulates in distinct arteries and veins; and in the *Holothuriæ*, express respiratory organs are superadded. From the *Echinodermata* which present this lengthened worm-like form, together with the softening down of the external crust, the *Sipunculi* make an easy and natural transition to the *Cœlelmintha*, to which class, from the absence of respiratory organs and tubular feet, from the obscure traces of a vascular system, and the disposition of the nervous filaments, they appear to me to have closer affinities than the *Echinodermata*.

The *Cœlelmintha*, thus constituted, present the same varieties in the condition of the generative system as the *Sterelmintha*. We find the simple female apparatus without male organs, or the cryptandrous type, in the *Sipunculi*; the superadded male glands, but without reciprocal fecundation, in the *Linguatula*; and the separate sexes in the *Nematoidea*.

If we distribute the internal parasites of the human body according to the preceding attempt at a natural arrangement of the *Entozoa*, they will be found to belong to at least three distinct classes of animals.

[1] *κοιλος, cavus, ἑλμινς, lumbricus.*

ENTOZOA HOMINIS.

Subregnum ACRITA.

Classis [INFUSORIA, *Cuv.*]

1.	*Cercaria Seminis*[1]. Cui locus	Semen virile.
2.	*Trichina spiralis.*	Musculi voluntarii.

Classis STERELMINTHA.

3.	*Echinococcus Hominis.*	Hepar.
4.	*Cysticercus Cellulosæ.*	Musculi, cerebrum.
5.	——— *visceralis.*	Viscera generatim.
6.	*Tænia Solium.*	Intestina tenuia.
7.	*Bothriocephalus latus.*	Intestina tenuia.
8.	*Polystoma Venarum.*	Venæ.
9.	——— *Pinguicola.*	Ovaria.
10.	*Distoma hepaticum.*	Vesica fellea.

Subregnum NEMATONEURA[2].

Classis CŒLELMINTHA.

11.	*Ascaris vermicularis.*	Intestinum rectum.
12.	——— *Lumbricoides.*	Intestina tenuia.
13.	*Strongylus Gigas.*	Ren.
14.	*Spiroptera Hominis.*	Vesica urinaria.
15.	*Trichocephalus dispar.*	Cæcum, intestina crassa.
16.	*Filaria bronchialis.*	Glandulæ bronchiales.
17.	——— *Medinensis.*	Substantia cellulosa.
18.	——— *Oculi.*	Oculus.

[1] As the form of the digestive cavity has not been ascertained in this or the succeeding genus, they cannot be referred to the *Polygastrica* of Ehrenberg.

[2] From *νημα*, *filum*, and *νευρον*, *nervus*; a term expressive of the condition of the nervous system which separates the *Cœlelmintha* and *Epizoa* from the *Articulata*, and associates them with the *Echinodermata* and *Rotifera*.

XLIII. *Additional Observations on* Alepisaurus ferox. *By the Rev.* R. T. Lowe, *M.A., Corr. Memb. Z.S.*

Communicated June 23, 1835.

Early in the month of April last, a third specimen of *Alepisaurus ferox* was caught by a fisherman off the village of Camera de Lobos, a little to the west of Funchal, on the south coast of Madera. Having beforehand offered a reward for one, sufficient to ensure its preservation from injury or mutilation, I obtained possession of this individual, a few hours only after its capture, in a state of great perfection. I am thus enabled to offer to the Society, along with this more perfect specimen itself, some important additions to my own former brief remarks upon this highly interesting genus, and my friend Mr. Bennett's more detailed description of its external characters. These additions relate chiefly to parts, which were either so mutilated in both the former specimens as to preclude altogether any attempt at delineation or description, or so fragile as probably to leave a wide field open for revision and correction to subsequent observers.

The body is thickest from the end of the first dorsal fin to the caudal, towards the root of which it is rounded, and somewhat thicker than deep. Proceeding forwards, it becomes gradually deeper, but not thicker, to the edge of the *operculum*; its deepest part being close behind the pectoral fins. The head is also much compressed and elongated, measuring, from the tip of the lower jaw to the hinder edge of the *operculum*, between one ninth and one tenth of the total length of the fish from the tip of the lower jaw to the extreme point of the upper lobe of the tail[1]: its depth at the posterior end of the *cranium* is less than one half its length, not measuring the branchiostegous membrane; and a little more, including the same. The general depth of the head and fore part of the body diminishes very gradually from the pectoral fins, or first ray of the dorsal fin, forwards; and the general thickness of the head, which is greatest close behind the eyes, and exactly equals the greatest thickness of the body at the root of the tail, is rather more than one third of its length. The tip of the upper jaw is strongly retuse or emarginate. The whole head is unarmed, smooth, and with a very gelatinous appearance. "The appearance of a double row of lengthened tubercles," produced by a series of small chain-like bones beneath the skin, was not noticed in the present specimen when recent; neither was it in the former until after immersion in alcohol. I believe this character does not become visible before the collapse or contraction of the integuments and muscles consequent to such immersion. An angular raised bony ridge, accompanied by a series of pores, extends beneath and round the hinder half of the orbit. A row of pores also runs along the side of the lower jaw, close beneath the lower edge of the dentary bone.

[1] This decrement of proportion from the former measurement of one seventh is owing to the perfect condition of the tail in the present specimen.

The nostrils are placed half way between the centre of the pupil and tip of the upper jaw, a little above a line drawn horizontally from the one of these points to the other. The anterior nostril is a round orifice, the posterior a curved lunate opening close behind it. In the former figure they were overlooked, or quite erroneously represented as a single orifice near the tip of the muzzle.

In the upper jaw the intermaxillary bones are finely and closely serrated throughout, as in the former two specimens; the anterior teeth being rather larger than the hinder: and in front, at the tip of the muzzle, there is a pair pointing forwards and curving a little downwards, one on each side, above the line of the rest, and, as it were, upon the lip itself. The palatine bones in front are furnished with a group of three very large recurved lancet-shaped teeth, placed in a triangle, of which the *apex* is directed forwards: proceeding backwards there succeeds a vacancy; then follows on each side a single lancet-shaped tooth, not much more than half the size of those of the group in front; and behind this a row of seven much smaller, close-set teeth, gradually increasing in size backwards, but the hindmost not above half the length of the single one immediately preceding them. All these are fixed immoveably; but upon a close examination were discovered, lying loose, flat, and buried amongst the skin of the palate, with their points directed backwards, three more long lancet-shaped teeth, one in the middle of the group of three in front, a second in the interval between these and the next large palatal tooth, and the third between the last-mentioned tooth and the row of seven behind it. Whether they were originally like the others, fixed, and are merely loose from injury or fracture, or are properly moveable and free, I can scarcely venture to decide. At first sight, and from the way in which they lie amongst the loose gelatinous integuments of the palate, with no appearance of a regular attachment by the base, their condition seems the effect of accident. Yet it would be difficult to explain perhaps, on the supposition of their having been broken off by violence, either the regularity of their particular direction, or the perfect condition of the other teeth.

The lower jaw is in this specimen rather longer than the upper. It is obtuse at the point, and has a pair of rather long subconical teeth in front at the tip, one on each side, with a smaller one between them; and below these on the tip of the jaw, quite outside the mouth, and upon or half way down the tip in front, or as it were upon the middle of the lower lip, there is a single smaller conical tooth, pointing forwards but curved upwards. Behind the pair of teeth first mentioned, there extends along each side a row of five much smaller, and becoming gradually more compressed; then come three rather larger, and still more compressed; and then two lancet-shaped ones, considerably larger, particularly the last of the two, which is double the length of the first, and equals the single palatal one behind the interval—into which, when the mouth is closed, it locks—above mentioned in the upper jaw. A short interruption in the row, or a vacant interval, succeeds, followed by a close-set series of eleven short but broad, triangular, much compressed teeth, reaching nearly to the corners of the gape, which in the present, as well as in both the former specimens, has a kind of internal web or skin, joining one jaw to the other, which extends some little distance forwards towards the teeth from the external angle of the mouth, or termination of the commissure. The teeth in the lower jaw do not extend backwards beyond a point corresponding nearly with that in which the palatal teeth terminate in the upper jaw: between one fourth and one fifth of the whole length of each jaw, from the external termination of the commissure, is thus unarmed posteriorly.

The tongue is small, very narrow, convex in the middle, smooth and black.

The branchiostegous membrane, in this third individual, has seven rays on each side.

The pectoral fins are longer than the head, or between one eighth and one ninth of the entire length. The ventral fins are not quite half the length of the pectoral fins, and more of a triangular form; while the pectoral fins are contracted at the base, without any posterior angle, and thus are truly lanceolate. The first ray of both the pectoral and ventral fins is rough, like the first ray of the first dorsal fin.

The dorsal fin was so perfect in the present specimen, that the following account of it may be depended on, so far as regards the individual. It differs considerably in outline from the formerly published figure, being less arched, or more straight and parallel with the line of the back; not highest in the middle, but towards the hinder end, and having the fourth ray in front produced beyond those immediately adjoining; the intermediate portion being nearly horizontal, or very gradually rising backwards. Its form is thus something like that of the dorsal fin in *Histiophorus Indicus*, Cuv. & Val., as represented in the 'Histoire Naturelle des Poissons'[1], only the anterior part in this *Alepisaurus* is much lower. It consists of forty-four unbranched or simple inarticulated rays, whose points are certainly not produced beyond the membrane. The first ray is on a line with the first ray of the pectoral fins, and rough with oblique transverse grooves in front: it is 4 inches long, which is something more than the greatest depth of the fish in any part. The two next rays are longer, each an inch, than the preceding, and smooth or even, like all the following. The fourth ray is more than twice the length of the first ($9\frac{1}{4}$ inches), but not produced beyond the membrane. The fifth ray is 2 inches shorter than the fourth, or just the length of the pectoral fins; and the ten or twelve[2] next are nearly the same length as the fifth, or gradually a very little longer, proceeding backwards. The following rays become more rapidly elongated to the twenty-fourth, which, with the twenty-third, is about the same length as the fourth ray. This twenty-fourth ray is at about two thirds of the length of the whole dorsal fin from its origin. The twenty-fifth and twenty-sixth rays are but little shorter than the twenty-third or twenty-fourth. The last eighteen rays decrease rapidly in length, and slope more backwards than those before them: the last of all, or forty-fourth, is one quarter of the length of the first ray, or one inch long, and joined by a small web to the body at its base. The anterior rays are rather remote; the posterior, particularly the last twenty, gradually closer and more crowded. All the rays are extremely

[1] t. 229.

[2] The eighth ray in this specimen is irregularly bent or crooked in the middle; evidently the result of some former injury.

fragile, not pungent, but flexible like whalebone, curving backwards, rounded, and tapering to fine, excessively slender points, like horse-hair, webbed quite up to their tips: the web is peculiarly delicate, of extreme tenuity, and inconceivably fragile; coloured dark iridescent steely blue, with a pale azure line extending partly up each ray, as in former specimens; but in this the whole outline is faintly edged with white, of which, from their less perfect condition, the traces only were visible in both the former individuals.

The second dorsal fin is just as in the two former specimens. Its hinder edge is broad and flattened towards the base, as in the dorsal fins of certain *Sharks*. Its height and breadth at top are each about an inch and a half.

The most striking and important addition is the correct form of the caudal fin. This organ in both the former specimens was too much mutilated to warrant any attempt at delineation or description. In the present it is deeply forked, and composed, as in the former specimens, of nineteen principal rays, of which ten form the upper and nine the lower lobe. Besides these nineteen, there are eight shorter rays, of unequal length, at the base of both forks, above and beneath. The great peculiarity which this third specimen has brought to light, is the production of the upper lobe into a long, gracefully-arched, linear, or rather tape-like, broad, flattened filament, composed of the one long outer unbranched ray, and of three with part of the fourth of the next inner branched rays. The first or outermost of the ten rays forming the upper lobe is simple, and extends considerably beyond the extreme tip of the lower lobe, but does not reach half the length of the produced part of the upper, of which it forms a portion. The next three rays are branched, and their threads or branches form entirely, along with the former simple ray, the produced or tape-like filament, which is an inch broad at its base, slightly narrowing towards the rather obtuse tip to about one third of an inch. There are seven threads or branches of these rays, running nearly parallel and reaching to the tip. The six next rays are much branched, and gradually shorter; the uppermost thread or branch of the first of them, i. e. of the fifth ray of the upper lobe, is a little produced, and forms a part of the base of the lengthened filament.

The lower lobe of the caudal fin is simple, oblong-oval, acute at the tip. Its lowest ray is also its longest, and unbranched. The four next are nearly the same length, and branched. The four innermost are gradually shorter, and also branched.

The upper lobe is between one third and one fourth of the whole length. The lower lobe is one tenth of the whole length.

The middle rays of the caudal fin are faintly barred, but much branched: the outer rays are very strongly barred, but gradually less branched from the middle outwards.

The caudal fin is set on in the peculiar manner general among the *Scombridæ*. It surrounds the termination of the body on three sides, leaving a rectangular central space longer than deep. This peculiarity is chiefly owing to the large number (eight) and strength of the supernumerary shorter rays, both above and beneath, which extend some distance forwards along the dorsal and the ventral lines.

The anal fin is one fifteenth of the entire length, and its greatest height, which is in front, one twentieth. It is considerably thickened at the base, and not seated in a groove. The first three rays are simple, but not pungent, and with difficulty distinguishable; the remaining eleven branched. Of these eleven, the first two are only bifid, and of nearly equal length with the third simple ray, which is the longest; the three next are trifid, but rapidly decrease in length; the last six are, again, only bifid, of nearly equal length, the last four being about the height of the first simple ray, and each more remote than the preceding. The first simple ray is not rough.

The following is the fin formula for the present specimen:

$$\text{1st D. 44. 2nd D. adipose. A. } 3+11. \text{ P. } 1+13. \text{ V. } 1+9. \text{ C. } \left\{ \begin{matrix} \text{Up. } 8+\overline{1+9} \\ \text{Un. } 8+\overline{1+8} \end{matrix} \right\}. \text{ B. M. 7.}$$

Total length, to the tip of the produced upper lobe of the caudal fin extended, 62 inches.

Greatest depth, being close behind the pectoral fins, $3\frac{7}{8}$ inches.

Greatest thickness, being at the root of the tail or just behind the eyes, $1\frac{3}{4}$ inch.

Weight little more than 4 lbs.

The lateral line resembles a gelatinous band or ridge, slightly elevated the whole length of the body, but most remarkably so, and forming quite a keel, from about the middle of the anal fin to the setting on of the caudal. After the fish has been some time out of the water, or immersed in spirits, this gelatinous keel falls, and loses nearly all its prominency. It is marked by a faint black stripe or line, accompanied by a series of pores, set at irregular intervals along each side. Throughout its whole length it is nearer the dorsal than the ventral line. The two little accessory oblique ridges on each side the termination of the lateral line, at the root of the caudal fin, present in the true *Mackarels* (*Scomber vulgaris* and *Colias*), as well as in the *Thunnies*, are here wanting.

The base of the first dorsal fin is seated in a deep groove, with jelly-like transparent margins. This groove continues backwards, from the termination of the first, nearly to the second dorsal fin, becoming gradually more shallow and obsolete.

The anterior branched rays of the pectoral and ventral fins, and the outer rays of both lobes of the caudal fin, have the bars or joints remarkably raised and prominent, resembling knobs, or like the knuckles of the fingers.

The extreme lightness of this fish, in proportion to its size, is equally remarkable with its peculiar flaccidity. The head seems ready to separate from the body with the smallest force.

This third specimen was much more brilliantly coloured than either of the former, though in a precisely similar manner. On each side, at the origin of the caudal fin, was a large metallic iridescent patch of extreme splendour; and the same hues prevailed, in almost equal brightness, along the base of the anal fin. The *iris* was coppery and golden, the pupil black.

In my former reference of this new genus to *Les Tænioides* of Cuvier, I was merely guided by its evident affinity to *Lepidopus* and *Trichiurus*. These two genera are now by Cuvier and Valenciennes, in the eighth volume of their 'Histoire', removed from the *Tænioides*, with which they were associated formerly by Cuvier in his second or last edition of the 'Règne Animal', and placed as an appendix at the end of the *Scombridæ*. Without, however, being aware of this, I had come to the conclusion some time since, that the proper station for *Alepisaurus* must be amongst the *Scombridæ*, in the neighbourhood of *Gempylus* and *Thyrsites*; and the alteration of Cuvier's views regarding the place of *Lepidopus* and *Trichiurus*, since discovered, affords at once a satisfactory confirmation of such a conclusion, and justifies my original idea of its close affinity with *Lepidopus*.

The four genera *Thyrsites*, *Gempylus*, *Lepidopus*, and *Trichiurus* may be considered as forming, with *Alepisaurus*, a small subordinate but highly interesting group, connecting the *Scombridæ* with the now expurgated *Tænioidæ*. The second adipose dorsal fin in *Alepisaurus* may be perhaps a modification only of the characteristic spurious finlets of its family. It even recalls to mind the separate hinder portion of the dorsal fin in *Histiophorus*, Cuv., or in an adult *Xiphias*. The general habit of the fish; its peculiar liability to be infested with intestinal worms, evinced in all the specimens observed; the powerful forked caudal fin, with the peculiar mode of its setting on, or of its penetration by the tail, owing to the large number of short accessory rays; and above all the gelatinous keeled lateral line, are all truly *Scombridal* characters. It may be added, that the complete development of the ventral fins gives it a higher claim than *Lepidopus* possesses to a place amongst *Scombridæ*[1].

The engraving is reduced from a most carefully executed drawing in outline of the fish while perfectly fresh, the size of life, kindly undertaken by my talented and accomplished friend Miss Young, checked by repeated and scrupulously accurate measurements of my own.

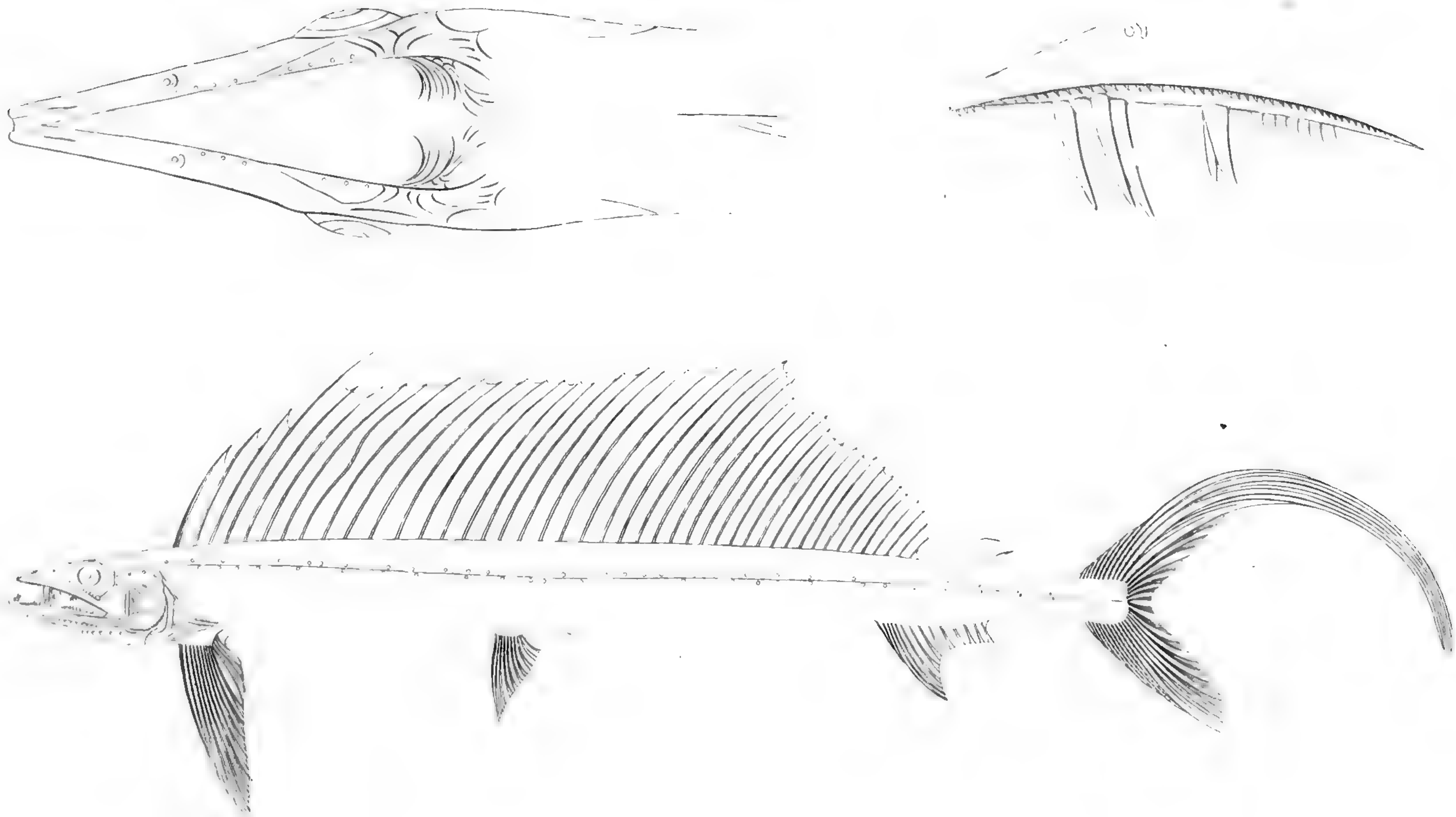
PLATE LIX.

Fig. 1. The entire fish.

2. The head as seen from above.

3. Side view of the upper jaw, with the lip or intermaxillary raised to show the palatal teeth. The teeth represented in dotted outline are those which lay loose among the integuments of the palate: they are figured in the position they respectively occupied when raised a little by the point of a knife.

[1] Since writing the above, I have received a letter from my able and zealous coadjutor Miss Young, dated Madera, June 22, 1835, giving some account of a fourth larger but much broken specimen, also caught off Camera de Lobos, which she has had an opportunity of examining since I left the island. The examination was most satisfactory, tending altogether to confirm the foregoing supplementary account. She writes: "The teeth were exactly on the same plan, but varying a little in number from the former (the third) specimen. The first dorsal fin had forty-two rays; its shape the same as in the last specimen, high in front, and straight to near the end. The ventral fins were unequal (perhaps from injury), the right having 1 + 9, the left only 1 + 8 rays. The caudal fin was much broken. The branchiostegous membrane had seven rays on both sides. The gelatinous keel on the lateral line was very high and distinct. The colours were not so bright as in the third specimen, though the present was quite fresh. In other respects it agreed with the former specimens."



Alepisaurus ferox.

DIRECTIONS FOR PLACING THE PLATES.

* In some copies misnumbered 14.

END OF THE FIRST VOLUME.

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