Contributions to the anatomy of anthropoid apes / by Frank E. Beddard.

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VII. *Contributions to the Anatomy of the Anthropoid Apes.*

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[Plates XX.–XXVIII.]

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I. Introductory.

During the last year the Society has lost two of the most valuable and interesting Anthropoid Apes from its collection—viz., the Bald-headed Chimpanzee "Sally" and the Lesser Orang "George." As neither of these forms has been investigated anatomically, except as regards the skeleton, I desire to offer to the Society some account of their structure as an addition to the existing knowledge of the Anthropoid Apes. Indeed, these are about the only two forms of the structure of the soft parts of which we have at present absolutely no knowledge. Unfortunately both animals were in certain respects in an unfavourable condition for dissection. The viscera of the Chimpanzee were very greatly diseased, while the enormous quantity of fat deposited round the abdominal viscera of the Orang rendered their condition if possible still more unfavourable for examination.

The Chimpanzee "Sally," as is well known, lived for a longer time in the Society's Gardens than has been recorded of any other Anthropoid Ape. She was purchased in October 1883, and died in August 1891, having thus been with us for eight years and some months. For notices of the character and intelligence of this animal, the reader is referred to papers by Mr. A. D. Bartlett[1] and Mr. Romanes[2]. Immediately after the death of the animal Mr. Smit made some careful drawings of the hands and feet and other external characters, which I now exhibit (Plates XX.–XXII.). A figure used in illustration of Mr. Bartlett's paper upon the Ape shows the general aspect and

[1] "On a Female Chimpanzee now living in the Society's Gardens," P. Z. S. 1885, pp. 673–675, pl. xli. The plate is reproduced in the present paper.

[2] "On the Mental Faculties of the Bald Chimpanzee (*Anthropopithecus calvus*)," P. Z. S. 1889, pp. 316–321.

coloration of "Sally" just after her arrival. The brain was carefully extracted and preserved in alcohol, and the muscles, after being soaked in alcohol, were kept in spirit vapour before being dissected. On opening the abdominal cavity the contained viscera were found to be extensively diseased, so much so that I have not attempted any description of them: so far as I could see, there were no differences from the Common Chimpanzee; I thought it would be worse than useless to give any accurate measurements and description. In the liver, for instance, there may be differences in the proportions of the lobes from the Chimpanzee; but, as the organ was greatly enlarged and had undergone fatty degeneration, it would obviously be misleading to give any measurements; its general form was, so far as I could judge, in no way different from that of the liver of the Chimpanzee as described by Prof. Flower in his published lectures upon the organs of digestion in the mammalian series[1]. Peritonitis was so extensive that the intestines were greatly matted together. The lungs also were diseased and were adherent to the pleural cavity. The bones of the vertebral column were diseased, being very friable. The muscles were somewhat wasted and there was no fat upon the body. The skin was preserved, and has been stuffed by Mr. Gerrard, Jun.; it has been purchased by the Hon. Walter Rothschild for the Tring Museum.

II. External Characters and Anatomy of Troglodytes calvus.

When the Ape first arrived at the Society's Gardens she was, as I infer from the teeth characters, about two years old; she was purchased from Mr. Cross, of Liverpool, in 1883. Two years after she had been in the Gardens, a notice of the principal external characters and of the habits by Mr. Bartlett appeared in the 'Proceedings'[2], illustrated by a coloured plate of the head and shoulders. The principal features to which Mr. Bartlett called attention as distinguishing this animal from *Troglodytes niger* were more evident at the time of her death. The face is quite black, as is also the hair covering the body. The hair on the top of the head only extends for a short distance in front of the level of the ears; on the sides of the face there is a scanty growth on the temporal region and on the cheeks; the chin is sparsely covered with short hairs, many of which are white, and there is also a still more sparse growth of short, chiefly white, hairs upon the upper lip. From the prominent supraciliary ridges spring the long scattered black hairs of the eyebrows, which do not meet in the middle line.

§ 1. *The Ear.*

The accompanying drawing (Plate XXVIII. fig. 3) shows the right ear of the natural size; the drawing was made immediately after the animal's death. It may be compared

[1] 'Medical Times and Gazette' for 1872.

[2] "On a Female Chimpanzee now living in the Society's Gardens," P. Z. S. 1885, p. 673.

with Hartmann's figure of the ear of the Common Chimpanzee[1] and with Gratiolet's and Alix's figures of the external ear of their supposed species *T. aubryi*. The ear is relatively quite as large as in these Chimpanzees, nor does it present any marked features which could distinguish it. This organ, however, varies in the Common Chimpanzee, even if we allow *T. aubryi* to be a distinct species. The margin of the ear of *T. calvus* agrees with that of *T. aubryi* in not being folded for the greater part of its length. Both the *tragus* and the *antitragus*, particularly the former, are very much marked, and they are divided by a very deep fossa. The margin of the ear is naked. Superiorly the helix is continuous with the antihelix, the fossa of the helix (at the letter H in the figure) becoming so shallow as to be practically non-existent. The fossa of the antihelix (F) is well marked, and there is no lobule.

§ 2. *The Hand.*

The accompanying drawing (Plate XXII. fig. 1) illustrates the lines upon the palmar surface of the hand, which were carefully drawn immediately after death. The figure itself does away with the need of any elaborate description; it may be compared with the drawing (Plate XXVII. fig. 1) of the palm of the hand of the Orang-Outang. I have also had the opportunity, through the death of a specimen at the Gardens on November 16th, of comparing the Bald-headed Chimpanzee with the Common Chimpanzee. The latter has been carefully described and illustrated by Alix[2]: his figure, however, evidently gives only the chief lines, those lettered *a*, *b*, *c*, in the accompanying drawing of the right hand of "Sally." There are no important differences that I can detect in the two Apes, except that in the Common Chimpanzee there are two longitudinal lines running from *a* to the roots of the fingers, such as occur in Man and in the Orang. The line *e*, which is not figured by M. Alix, seems to be of importance, as it occurs in both Chimpanzees. There is, no doubt, just as much variation in the lines on the hands of Apes as in the human hand. I do not, therefore, think it worth while at present to do much more than direct attention to the drawing. I have seen in the human hand the lines *a* and *b* running at right angles to the axis, as in the Chimpanzee, instead of somewhat obliquely, as in my own hand, for example.

§ 3. *The Foot.*

The accompanying drawing illustrates the plantar surface of the foot (Plate XXII. fig. 2). There are two principal cross lines, lettered *a* and *b*, which appear to correspond to those similarly lettered in the hand, and which by their direction show the prehensile nature of the foot; so do the strongly marked lines upon the hallux, which are hardly marked upon the pollex. The principal longitudinal line *e* is more marked than in the Orang.

[1] 'Der Gorilla,' pl. iv.

[2] "Des lignes papillaires du main et du pied," Ann. Sci. Nat. t. ix. 1868.

M. Du Chaillu's[1] description of the external characters of *T. calvus* agrees nearly absolutely with the above description of "Sally." I should, however, be inclined to dispute, on the hypothesis that "Sally" is an individual of that species, M. Du Chaillu's statement that the ears, though large, are smaller than in *T. niger*. Dr. Gray[2], it should be remarked, was disinclined to allow the species, and remarked later[3] that "the specimen received with the above name in the Museum was in too bad a state to determine with accuracy if it is distinct from *T. niger*. The baldness of the forehead appeared to be accidental." After this opinion, which certainly erred on the side of caution, it is curious to find a brief diagnosis of what is perhaps the "worst species" of Chimpanzee ever described, viz. *T. vellerosus*, immediately following. The N'tschego, according to Dr. Franquet, has a black face and small ears, thus contrasting with the Common Chimpanzee, which has a flesh-coloured face and very large ears. He says, as M. Du Chaillu has remarked, nothing about the baldness, which, if at all marked, would hardly have escaped his attention. We may therefore assume that there was no baldness; the smallness of the ears again distinguishes the animal described by Franquet and by Duvernoy. With regard to the black face, Du Chaillu says that *old* Chimpanzees of the common species are black in the face. The name also appears to have misled Dr. Franquet. According to Du Chaillu, "the natives of the Camma country call the *T. niger* 'Nschiego' and the *T. calvus* 'Nschiego M'bouve,' the latter meaning something like 'another tribe of the Nschiego.' The Mpongwé called the *T. niger* 'Nschiego,' or the 'N'chiego' of Dr. Franquet." Du Chaillu considered that the N'chiego of Franquet is simply *T. niger*, and, as I point out below, there is nothing in the osteology to contradict this opinion. I quite agree with Geoffroy St.-Hilaire when he writes[4]:—"Le Troglodytes tschego a été regardé avec raison par tous les zoologistes comme une espèce au moins très-douteuse." Geoffroy St.-Hilaire remarks also in this paper that a specimen of Franquet's species was on its way to the Paris Museum. In 1866[5] MM. Gratiolet and Alix described, in an elaborate and well-illustrated memoir, the external characters and anatomy of a species of Chimpanzee which they called *Troglodytes aubryi*. The anatomical account given in the paper is much fuller and more important than the section dealing with the external characters; for *post-mortem* changes had caused the almost complete loss of the hair and of the skin itself in the palmar and plantar regions. Nevertheless it is possible to institute comparison between that Chimpanzee and the animal which forms the subject of the present communication, which will be more valuable inasmuch as both individuals are females and of about the same size. This *Troglodytes aubryi*, which has been con-

[1] Proc. Boston Nat. Hist. Soc. 1860.

[2] P. Z. S. 1861, p. 273.

[3] 'Catalogue of Monkeys, &c.' 1870, p. 7.

[4] Arch. d. Mus. t. x. p. 17, footnote.

[5] "Recherches sur l'Anatomie du *Troglodytes aubryi*, Chimpanzé d'une espèce nouvelle," Nouv. Arch. Mus. d'Hist. Nat. t. ii. (1866) 264 pp. 9 pls.

sidered[1] to belong to the same species as a Chimpanzee ("Mafuca") living in the Dresden Zoological Gardens in 1876, has a black face, a more pronounced prognathism, and a more massive form than the ordinary Chimpanzee; the hair is black with a red reflection. In all these characters, except the last, it agrees with the Chimpanzee dissected by myself. I did not observe any reddish tinge in the hair of "Sally;" indeed the entirely black hair of this animal is one of the most marked differences from the *Troglodytes niger*. As to the prognathism, I have gone into the matter more fully below in describing the skull. On p. 35 of their memoir, MM. Gratiolet and Alix describe in detail the pigmentation of the skin, which is not uniformly black. The external characters mentioned above, of which a necessarily incomplete account is given, hardly permit of a definite opinion as to the specific distinctions of *T. aubryi* or its identity with *T. calvus*. Later in this paper (p. 183) I point out that the skull-characters, at any rate, are not those of *T. calvus*. The Chimpanzee called "Mafuca" was examined after its death by Dr. A. B. Meyer[1] and by Dr. Bischoff[2]. The coloured sketch of the face shows no resemblances to *T. calvus*; the skin is yellowish brown, except on the nose and round the eyes, and there is no baldness on the top of the head.

§ 4. *The Skull.*

I have carefully compared the skull of "Sally" with a skull of a nearly adult male Chimpanzee which arrived at the Society's Gardens on the same day, and died 29th October, 1883. This individual was slightly larger and had all its permanent teeth; the canines, however, had evidently only just cut the gums. The teeth of "Sally" are in the following condition[3]:—In the upper jaw the permanent incisors and bicuspids are present; the first molar is the only one of the molar series which is in place. The canines are a long way from their definitive position; the point of the tooth is fully half an inch from the rim of the socket; the extremity of the root of the tooth is barely half an inch from the rim of the orbit. Those teeth, which are not covered by bone, look as if they had been artificially inserted into excavations of the maxilla, and are very prominent and affect the contour of the face. The milk-canines are the only representatives of the milk-teeth which have not been replaced. The condition of the teeth, were their possessor a human being, would suggest the age to be between ten and eleven years. The brain-caps of both apes belonging to the prosector's stores had been removed for the purpose of extracting the brain; this showed the greater density as well as the greater thickness in front of the bones of *T. calvus*.

In a preliminary account of *Troglodytes aubryi* communicated by M. Gratiolet to the

[1] "Notizen über die Anthropomorphen Affen des Dresdener Museum," Mitth. Mus. Dresd. Heft ii. p. 223 (1877).

[2] See a paper immediately following that of which the title has just been quoted.

[3] Many of them are diseased and defective, but I think that the above account is complete; I made certain that the bicuspids are the permanent teeth by cutting into the jaw.

French Academy of Sciences [1], the author distinguishes this species by the presence of an additional cusp upon the last molar of the lower jaw. In the complete paper, on p. 73, the following statement is made about the 5th molar of the lower jaw :—" Elle a cinq tubercules, comme les deux dents qui la précèdent. Ce caractère sépare le *Troglodytes aubryi* du *T. niger* et du *T. tschego*, et le rapproche au *Gorilla gina*." I quote the passage in full in order to leave no room for any doubt of a misunderstanding on my part in case my own statements are questioned. In the lower jaw of *Troglodytes niger* belonging to the individual mentioned above the *last molar of the lower jaw*, though smaller than either M. 1 or M. 2, *has an identical pattern*. I have not been able to compare the corresponding molar of *T. calvus*.

A comparison of these two skulls shows a good many points of difference ; but the series of skulls in the Natural History Museum, comprising animals of various ages and of both sexes, makes it a matter of considerable difficulty to draw up very definite specific distinctions. The examination of a larger series would probably increase these difficulties. On the whole it appeared to me that the prognathism of the face is more marked in *T. calvus* ; the face in profile shows a very much more concave outline, the interorbital region being vertical or even (in " Sally's " skull) slightly directed backwards, while in *T. niger* the line passing from the top of the skull to the extremity of the upper jaw is almost flat or slightly concave ; in an adult skull from Sierra Leone the concavity of the profile outline was fully as marked as in *T. calvus*. In none of the specimens in the Natural History Museum was it possible to examine the interior of the skull.

The inside of the skull of " Sally " showed a few points of difference in the two animals. In *T. calvus* the cribriform plate has a distinct crista galli ; this ridge is wanting in *T. niger*. The transverse groove for the optic chiasma is decidedly deeper in *T. calvus* than in *T. niger* ; the foramen lacerum anterius is also more extensive, the outwardly directed part being wider as well as larger in *T. calvus*. The orbits as seen from the inside of the skull were rather different in the two Chimpanzees. In the Common Chimpanzee a strong transverse ridge marks the highest part of the convexity formed by these lines. In *T. calvus* there is no marked ridge, the surfaces sloping gradually, and the concavity for the lodgment of the anterior part of the temporal lobes of the brain being in consequence less deep. On the other hand, in the skull of *T. calvus* the petrous bone was produced into a much sharper edge, and the excavations for the occipital lobes of the brain were in consequence decidedly deeper. The vomer of *T. niger* is bifurcate behind, the diverging plates being attached to the pterygoids. In *T. calvus* the hinder part of the vomer is covered by the pterygoids, the two little plates of bone which cover over the vomer being distinct from the rest of the pterygoid. The relative length of the basi-occipital and basi-sphenoid is different in the two

[1] This is reprinted at the end of the elaborated Memoir already referred to.

species: in *T. niger* the junction of these two bones is situated about a quarter of an inch behind the anterior end of the petrosal; in *T. calvus* the line of division is farther forwards, nearly on a line with the anterior extremity of the petrosals: this produces also a difference in the shape of the basisphenoid; it is a triangular bone in *T. calvus*; in *T. niger* it ends in a point anteriorly in the same way, but it has parallel margins from behind the points where the pterygoids lose their connection with it.

If the existence of the crista galli and the grooving for the optic chiasma prove to be really differential characters, they are particularly interesting from the fact that they occur in the Gorilla. The *nasal bone* in the skull of "Sally" was distinctly ridged in the middle line; this character, however, was not found in the two skulls of *T. calvus* in the Natural History Museum nor in any of the skulls of *T. niger*. This character is also of some little interest, as it occurs in the Gorilla, and is indeed mentioned by Owen as one of the points of distinction between these Anthropoids. In *T. calvus* the spheno-maxillary fissure is very wide and continuous with the groove lodging the orbital branch of the trigeminus. In *T. niger* this groove is not always open behind: in the male Chimpanzee skull belonging to the Society the groove in question is connected posteriorly into a tube by the complete closing in of the walls; and in other specimens of *T. niger* I found a partial indication of such a closing in. In the male Chimpanzee just referred to, the spheno-maxillary fissure is remarkably narrow, instead of presenting the appearance of a deep wide gash. And this apparent difference between the two species is very clearly marked in the two skulls belonging to the Society; but it will probably require revising when a large number of skulls are available.

No doubt it would be possible to institute a more detailed comparison between the two species; but the above notes contain, I believe, the principal points of difference, and I would submit that, taken collectively, they fully justify the separation of the two Chimpanzees. It is now necessary to inquire how far *T. calvus* agrees with any other "species" of Chimpanzee.

Prof. Hartmann[1] does not consider that any case has yet been made out for dividing up the Chimpanzees, though admitting "that there are not inconsiderable, and perhaps even specific, varieties from the ordinary type." He is inclined to allow provisionally three varieties, viz. the typical form of *T. niger*, Giglioli's variety (which may be the same as MM. Gratiolet and Alix's *T. aubryi*), and thirdly Duvernoy's *T. tschego*, probably the same as the Chimpanzee "Mafuca" already referred to. What claims has *T. aubryi* to be regarded as a distinct species? Of the external characters our knowledge is far too incomplete to allow of an attempt to answer this question. With regard to the skeleton, I do not find that the skull offers any character that one can seize upon as being of specific value. The skull of *T. aubryi* is figured in four

[1] "Anthropoid Apes." Int. Sci. Series.

aspects [1], which enables one to get a very good idea of its principal characters, even without reference to the careful description in the accompanying letterpress. Judging from the figures, it seems to me that *T. aubryi* does not differ so much from *T. niger* as does *T. calvus*. In the text MM. Gratiolet and Alix do not call attention to any points of difference between their species and the Common Chimpanzee, except as regards the teeth. I have pointed out, on pp. 182, 183, the main cranial characters of *Troglodytes calvus* which seem to distinguish it from *Troglodytes niger*: none of these characters are shown in the illustrations of the cranium of *Troglodytes aubryi*; in the regular slope of the face (shown in the lateral view, *l. c.* fig. 4) and in the regular and narrow palate the skull of this ape precisely resembles that of the typical *Troglodytes niger*.

Another "species" of Chimpanzee was described nearly forty years ago by Duvernoy [2] in a paper dealing with the Anthropoids in general. This Chimpanzee was called *T. tschego*, and the whole skeleton is described and for the greater part illustrated. With regard to the skull, which measures in extreme length 20 cm., and is therefore larger than that of "Sally," I cannot make out either from the description or from the plate (plate vi.) any marked differences from *T. niger*. This species having been identified by some with *T. calvus*, I naturally paid attention to the differences indicated by Duvernoy in order to see how far the characters agreed with those of the animal described in the present communication. One of the characters upon which Duvernoy lays some stress is the fusion of the temporal crests in *T. tschego* and the separation of those crests in *T. niger*. This supposed difference is indicated in the plate accompanying Duvernoy's memoir. With regard to this matter, one cannot dissent from the opinion of Geoffroy St.-Hilaire [3], who writes: "Les caractères ostéologiques que donne, à l'appui, M. Duvernoy, sont-ils véritablement spécifiques? Ne peuvent-ils s'expliquer par de simples différences de sexe et d'âge?" The skull of *T. tschego* showing the convergence and junction of the said crests is larger (and, having the complete dentition, therefore older) than the skull of "Sally," in which these crests do not meet. Hartmann mentions the single crest in the adult Chimpanzee without suggesting that this is a specific distinction. He speaks also of the muzzle being enlarged in front, the greater width of the palate in front, and states that the alveolar border of incisors and canines forms "un arc assez bombé." I do not think that anyone will be disposed to lay great value upon these characters, and at all events they do not indicate any particular resemblance to the skull of *T. calvus*. The plate does seem to show a rather thicker supraorbital ridge; but this is not probably by itself a difference of great importance.

[1] *Loc. cit.* pl. ii. figs. 1–4.

[2] "Des caractères anatomiques des grands Singes pseudo-anthropomorphes," Arch. d. Mus. t. viii.

[3] "Description des Mammifères nouveaux ou imparfaitement connus," &c., Arch. d. Mus. t. x.

§ 5. *Muscular System.*

As *Troglodytes calvus* is undoubtedly a distinct species, I have thought it worth while to give such notes upon the muscles as I am able from my dissections of the limbs. The other muscles I have not touched at all. There is no account of the myology of this Chimpanzee, unless it be identical with *T. aubryi*; but this identification, as I have already pointed out, is hardly possible.

§ 6. *The Muscular Anatomy of the Fore Limb.*

(1) *Pectoralis major.*—This muscle has a clavicular origin as in Man; it is large and powerful and undivided at its insertion, which is two and a half inches in length; anteriorly a tendinous slip reaches the head of the humerus. The muscle where it is inserted is tendinous on the under surface, but fleshy above; posteriorly it is inserted in common with a part of the *deltoid*, this part of the muscle being fleshy on both faces.

(2) *Pectoralis minor.*—The stout tendon of insertion of this muscle is upon the coracoid process, just above the origin of the conjoined *biceps* and *coraco-brachialis*.

(3) *Subclavius* is largely ensheathed by the coraco-clavicular ligament; its fleshy insertion is on to the proximal half of the clavicle.

(4) *Coraco-brachialis.*—The *coraco-brachialis* arises, in common with the coracoidal head of the *biceps*, from the coracoid process; the two muscles become separate at a distance of three inches from their origin; its insertion measures two inches in length; near to its insertion some of the fibres of the *triceps* and of the *brachialis anticus* arise from it.

(5) *Biceps* is composed of two very distinct portions, of which the scapular half is rather, but not very markedly, the thicker; the two parts of the muscle fuse together about three and a half inches in front of their common insertion; the two halves of the muscle are fleshy where they join. The tendon of insertion measures about two inches up to its beginning on the "coracoid" side of the muscle. It is inserted on to the radius, the diameter at the insertion being three-fifths of an inch.

(6) *Latissimus dorsi.*—This muscle gradually narrows towards its insertion, but gets slightly thicker just before it gives off the *dorso-epitrochlear*; it has a diameter of $\frac{9}{10}$ inch. The *dorso-epitrochlear* slip is very large and fleshy; it ends in a tendon two and a half inches in length, inserted on to the flexor condyle. The insertion of the *latissimus dorsi* measures one inch in length; it is completely free from the *teres*, and there is no division of the muscle into two parts such as occurs in the Orang. The tendon of the muscle commences earlier on its ventral side; an inch and a half is the length of the completely tendinous part.

(7) *Trapezius.*—The insertion of this muscle is on to the external half of the clavicle and on to the greater part of the scapular spine.

(8, 9) The insertion of the two *rhomboidei* is a common insertion. I have found it impossible to distinguish one from the other; the insertion extends along three quarters of the base of the scapula, commencing more than an inch and a half on the dorsal side of the point where the spine reaches the posterior margin.

(10) I could find no *rhomboideus occipitalis*.

(11) *Levator anguli scapulæ*.—This muscle is unusually well developed and consists of two distinct parts, which are perfectly separate from each other at their insertion. The anterior of them is inserted along a line measuring one inch and a quarter, commencing exactly at the angle of the scapula. The muscle becomes suddenly wider just at the insertion; at a distance of one inch from the actual insertion it only measures half an inch in diameter. This insertion is entirely of fleshy fibres. The second half of the *levator* is inserted by an almost entirely tendinous attachment to the next three quarters of an inch of the posterior border; it is mostly covered by the *rhomboideus* [1].

(12) The *Omohyoid* is of considerable size; its insertion nearly fills up the concavity on the inferior border; the insertion is slightly tendinous on the lower surface.

(13) *Serratus magnus*.—The attachment of this muscle is precisely as in the Orang.

(14) *Deltoid*.—The muscle is very large. It arises from the outer half of the clavicle, from a considerable portion of the scapular spine, and from the septa between itself and the *infraspinatus*, *teres minor*, scapular head of *triceps*, and *teres major*; also from the posterior portion of the scapula just in front of the origin of the *teres major*. The insertion is chiefly on to a rough triangular area upon the humerus; it is also connected with the humeral heads of the *triceps*, and, as already mentioned, with the insertion of the *pectoralis major*.

(15) *Teres major*.—This large and fleshy muscle arises along a line measuring two inches and three quarters. Its origin is chiefly from the scapular border, commencing immediately behind the insertion of the *serratus magnus* and from the septum between itself and the *teres minor*, *deltoid*, and *subscapularis*. The line of insertion on to the humerus measures one inch and three quarters; it commences just in front of the insertion of the *coraco-brachialis*. The insertion is largely muscular, but that this is so is not obvious on account of it being concealed by a sheet of tendon covering the muscle on each side; the anterior half-inch or so of the insertion is entirely fleshy, the last half-inch or so is nearly wholly tendinous.

(16) *Teres minor*.—The *teres minor* arises partly from the lower border of the scapula and also from the septa between itself and the following muscles, viz., *deltoid*, *infraspinatus*, *triceps*, and *teres major*. The insertion of the muscle is partly on to

[1] It is possible that this muscle is really the *rhomboideus minor*. Not having its origin I cannot be certain about the point.

the scapular ligament, and partly on to the head of the humerus, but chiefly on to the greater tuberosity, and just below the insertion of the *infraspinatus*.

(17) *Infraspinatus*.—This muscle covers over the whole of the infraspinous fossa. It does not, however, arise from the middle of the fossa, only from the spine and from the lower border, except posteriorly; it also arises from the septa between itself and the following muscles: *deltoid*, *teres major*, *teres minor*. It is largely tendinous at its insertion: the tendon arises first just within the muscle, but subsequently reaches the lower surface; it is inserted partly on to the capsular ligament of the humerus, and partly on to the humerus itself.

(18) *Supraspinatus*.—This muscle, unlike the *infraspinatus*, arises from the greater part of the supraspinous fossa; its tendon of attachment first commences within the substance of the muscle.

(19) *Subscapularis*.—This muscle is covered below (on the free surface) by a strong aponeurosis, from which its fibres partly arise; this fascia has a specially strong attachment to the lower angle of the scapula. The muscle arises from the greater part of the subscapular fossa.

(20) *Triceps*.—This muscle has the usual three heads (not reckoning the *dorso-epitrochlear*, which has been already described in connection with the *latissimus dorsi*); the scapular head is largely tendinous on the lower surface; the tendinous aponeurosis gradually diminishes in extent, and terminates just after the junction of the scapular and humeral heads of the muscle. The scapular head arises chiefly from the lower border of the scapula along a line measuring two and a half inches in length; the origin is partially from the septa between itself and the *teres major*, *teres minor*, and *subscapularis*. The origin of the outer humeral head commences just below the head of the humerus; the inner humeral head commences much lower down; anteriorly some of its fibres arise in common with those of the outer humeral head; further back the origins of the two heads are quite distinct. Both humeral heads arise not only from the humerus, but also from the septa between themselves and adjacent muscles.

(21) *Brachialis anticus*.—The origin of this muscle commences just below the *deltoid*.

(22) *Supinator radii longus* arises just in front of the *supinator carpi radialis longior* from the humerus; it also takes origin from the septa between itself and the *triceps*, the *brachialis anticus*, and the *supinator*; the line of origin measures two and a half inches; it is inserted by a broad flat tendon two and a half inches in length.

(23) *Extensor carpi radialis longior* is the most external of the extensor muscles of the hand; it arises chiefly from the lower part of the external condylar ridge of the humerus just below the last muscle, and from the external condyle itself in common with the *extensor carpi radialis brevior*. The muscle is short, not reaching halfway down the forearm; the long tendon passing under the tendon of the extensors of the thumb is inserted on to the inner side of the base of the second metacarpal.

(24) *Extensor carpi radialis brevior*.—This muscle is larger than the last; it rises, in common with the other extensors, from the extensor condyle of the humerus; it does not become free from the *extensor communis* until a point four inches distant from the humerus; it becomes entirely tendinous about two inches further on; the tendon is quite twice the breadth of that of the last extensor; it is inserted on to the base of the metacarpal of the third digit.

(25) *Extensor communis digitorum*.—This extensor is of course the largest of all; it arises from the extensor condyle of the humerus, from the septa between itself and adjacent muscles, and from the fascia covering the deep extensors; it divides into four separate muscles, which end in tendons at various distances from their insertion; the longest tendon is that supplying the third digit; each tendon supplies one of the digits II.–V.; it is inserted on the first and second phalanges, and spreads out into a thin layer almost covering these bones.

(26) *Extensor minimi digiti* appears to be totally absent, unless it is a part of *extensor communis* that is absent; the tendon of that division of the "*communis*" which supplies digit V. is separated from the others at the wrist.

(27) *Extensor carpi ulnaris* is the outermost of the extensors; its origin extends down the arm to a point beyond the middle; the tendon, which is very strong and round rather than flat, is inserted on to the outer side of the base of the last metacarpal.

(28) *Supinator radii brevis*.—This muscle is distinctly double as in the Orang; the posterior boundary is marked by the exit of the nerve; the entire muscle is inserted on to the radius for more than one third of its length; the insertion of the deeper layer extends nearly an inch below that of the upper layer.

(29) *Extensor ossis metacarpi pollicis*.—The origin of this muscle is from the radius and ulna, and from the interosseous ligament; the muscle divides early, and the two tendons pass down in close contact, and are inserted on to radial carpal and base of metacarpal respectively.

(30) *Extensor secundi internodii pollicis*.—This muscle arises from the inner side of the ulna, from the interosseous membrane, and from the septa between itself and the *extensor indicis* and other adjacent muscles; its long tendon is inserted on to the second phalanx of the thumb.

(31) *Extensor indicis*.—This muscle is almost exactly the same size as the last, and their origins are close together, being partly from the septum dividing them; the *extensor indicis* also arises from the upper surface of the ulna, below the origin of the *extensor carpi ulnaris*; it is attached to the index only by a strong tendon which joins that of the branch of the *extensor communis* supplying that digit.

(32) *Extensor primi internodii pollicis*.—This muscle is superficial to the *extensor ossis metacarpi pollicis*, from which, however, it is hardly separable; it arises, with that muscle, from the radius, from the interosseous membrane, and from the septa between

itself and adjacent muscles; its tendon commences at the wrist, and is therefore rather shorter than that of the *extensor ossis metacarpi pollicis*, but almost exactly of the same thickness; the two tendons run in very close contact; it is inserted on to the base of the metacarpal of the thumb on the inner side.

(33) *Pronator radii teres.*—The origin of this muscle is much more distinctly double than in the Orang; its insertion on to the radius is chiefly tendinous, and measures two and a half inches in length.

(34) *Palmaris longus.*—This muscle is very slender, and ends in a tendon about halfway down the arm; towards its origin from the flexor condyle the muscle is not at all distinct. Its tendon is continuous with a vertical tendinous sheet, from which fibres of the *flexor carpi radialis* and of the *flexor sublimis* arise; at the wrist it is continuous with the very dense and stout palmar fascia.

(35) *Flexor carpi radialis.*—It arises from the flexor condyle, from the septa between itself and the *pronator radii teres*, *flexor sublimis*, and *palmaris longus*; the muscle becomes free about three inches in front of the wrist; its tendon is visible upon the under surface of the muscle, first of all about halfway down the arm; the muscular fibres cease only just at the wrist. It is inserted on to the base of the second metacarpal.

(36) *Flexor carpi ulnaris.*—The muscle arises from the flexor condyle and from a considerable portion of the ulna, and from the septa between itself and adjacent muscles, as well as from the fascia covering the arm; it becomes tendinous only on the ventral side, and is inserted principally on to the ulnar distal carpal (pisiform); it measures half an inch in diameter at its insertion.

(37) *Flexor sublimis (perforatus) digitorum.*—The four muscular bellies which together make up this muscle are quite separate from each other halfway down the arm; the undivided muscle arises from the flexor condyle, from the septa between itself and adjacent muscles, and from the radius; the part which arises from the radius mainly belongs to the flexor of the third digit, which has the stoutest tendon, commencing earlier than in the others upon the under surface of the muscle; the actual tendon itself of the fourth digit is the longest; that supplying the little finger is very much more slender than the rest; the tendons supplying digits III., IV., and V. lie superficially to the remaining tendon; a muscular slip measuring three and a half inches in length arises from a tendinous intersection upon that part of the *flexor sublimis* belonging to the little finger, and is inserted on to the deep flexor tendons of digit IV. by a short flat tendon of its own.

(38) *Flexor longus pollicis.*—This muscle is very distinct from the next to be described; it arises chiefly from the radius and from the interosseous membrane, but also from the septum between itself and the *flexor carpi radialis*; its tendon commences on the under surface of the muscle about halfway down the forearm; the tendon is free from muscle on a line with the base of the thumb metacarpal; at this

point it gives off a very slender tendon running to the thumb; the main tendon of the muscle supplies the index.

(39) *Flexor profundus (perforans) digitorum* is a muscle rather larger than the last; it arises chiefly from the ulna and from the interosseous membrane; the three tendons become separate at the wrist after perforating the tendons of the *flexor sublimis*; they are attached to the terminal digits of the fingers (Nos. III., IV., and V.).

(40) There are four *Lumbricales*: the first arises from the deep flexor tendon of the index; it gives off a slip to the tendon of the *flexor sublimis* belonging to this digit; the second muscle arises wholly from the tendon (deep flexor) of digit III.; the third muscle arises from this tendon and from the next one, that of the fourth digit; the fourth muscle arises from the two last tendons of the series; each *lumbricalis* is inserted on to the extensor tendon of the digit to which it belongs.

§ 7. *The Muscular Anatomy of the Hind Limb.*

(1) *Glutæus maximus* arises from the fascia lata, from the ilium itself, and from the coccyx; it is inserted partly on to the fascia covering the thigh and partly by a strong tendon on to the femur just opposite the end of the insertion of the *quadratus femoris*, continuously with the *glutæus maximus*; but arising from the tuber ischii, in common with the *biceps* and other muscles which take their origin therein, is a fleshy mass which is inserted on to the femur continuously with the tendon of the *glutæus*, and which also partly fuses with the *rectus externus* and the femoral head of the *biceps*. I cannot find any sharp demarcation between the fibres of this muscle and those of the *glutæus maximus* at their insertion, though the posterior part, which has a mainly muscular insertion, evidently corresponds to the *ischio-femoral* of the Orang (see p. 211). The length of the line along which the conjoined muscles are inserted is three and a half inches.

(2) *Glutæus medius* arises chiefly from the ilium as far down as on a line with the anterior boundary of the origin of the *glutæus minimus*; it also arises from the fascia lata. The fibres of the muscle rapidly converge towards its insertion; some way in front of the insertion a strong tendinous band is developed within the muscle; the under and upper surfaces of the muscle only become tendinous a short way in front of its insertion. At its insertion (on to the great trochanter) it comes into close connection with the tendon of the *pyriformis*.

(3) *Glutæus minimus*.—This muscle has a fleshy origin of an inch and three quarters in length from the border of the greater sciatic notch. It becomes partly tendinous on the upper surface some way in front of its insertion; its insertion is so perfectly continuous with that of the *scansorius* that it is impossible to say where one begins and the other leaves off. The line of insertion of the two muscles together measures an inch and three quarters.

(4) The *scansorius* is well developed; it arises chiefly from nearly the whole of the

anterior border between the anterior spine and the glenoid cavity, but also—though to a very slight extent—from the fascia lata and from the septum between itself and the *glutæus medius*. Its insertion behind that of *glutæus minimus* has been already mentioned. The muscle begins to be tendinous on the upper surface rather more than an inch away from the actual insertion, at a less distance on the ventral surface; the actual tendon of insertion measures about half an inch in length.

(5) *Pyriformis* runs in close proximity to the *glutæus medius*; it ends in a somewhat rounded tendon, which is attached to the femur, on to the great trochanter, between the insertions of the *glutæi medius* and *minimus*.

(6) *Obturator internus*, together with the *gemelli* (of which the external is the larger), is inserted into the upper part of the fossa behind the great trochanter.

(7) *Obturator externus* has an entirely fleshy insertion just behind the lesser trochanter.

(8) *Quadratus femoris* is fleshy throughout.

(9) *Biceps femoris*.—This muscle has two heads; the ischial head arises from the tuber ischii in common with the *semimembranosus* and *semitendinosus*; it forms a round fleshy belly, which is tendinous on the lower surface near its origin, and becomes tendinous on the outer surface about halfway along; it ends in a flat tendon, which widens out, becoming continuous with the fascia covering this part of the leg, and is also inserted on to the fibula; this upper part inserted on to the fibula remains thicker than the rest. The femoral head arises from the femur and from the septum between itself and the *vastus externus* along a line measuring two inches and three quarters; its fibres are partly inserted on to the tendon of the long head, and partly become continuous with the fascia covering the thigh.

(10) *Semimembranosus*.—This leaves the head of origin common to itself, the *biceps*, and the *semitendinosus* as a flat tendon one inch and three quarters in length, and one quarter of an inch in breadth; it forms a fleshy belly, slightly tendinous on the inner surface at both ends; it is inserted by a short strong tendon on to the inner side of the tibia below the ligament uniting the tibia and the femur.

(11) *Semitendinosus*.—This muscle is rather larger than the last; it leaves the common muscular origin, which it shares with the last two muscles, almost simultaneously with them, *i.e.*, the common head becomes trifurcate. Its tendon of insertion measures rather over an inch and a half in length; it becomes wider at the actual insertion, which is close to and below that of the *gracilis*.

(12) *Iliaco-psoas*.—The two separate muscles are inserted by a common tendon on to the lesser trochanter.

(13) *Sartorius*.—This muscle is roundish at its origin, but becomes flat and strap-shaped before the middle of the thigh; it is more slender than the *gracilis*. Its diameter some way in front of the insertion is three fifths of an inch. At its insertion it becomes much wider. The insertion is half tendinous and half muscular, the

tendinous insertion being anterior and lying just to the outside of that of the *gracilis*. The line of insertion measures one inch and a half.

(14) *Rectus femoris*.—This muscle is partly tendinous and partly muscular at its origin from the ilium below the *scansorius* and just in front of the glenoid cavity; about halfway down the thigh it fuses with the external vastus muscle.

(15) *Vastus*.—The *vastus externus*, *vastus internus*, and *cruræus* were all present; but they were so closely connected the one with the other that it is best to regard them as one muscle arising from the greater part of the surface of the femur, and inserted on to the patella and its ligament.

(16) *Gracilis*.—The *gracilis* arises from the symphysis pubis by a thin tendon; the muscle is flat, and gradually narrows towards its insertion, which is by a tendon rather more than an inch in length and about half an inch in breadth; the insertion lies between that of the *sartorius* and *semitendinosus*.

(17) *Pectineus*.—This muscle arises in front of the *adductor longus*, and is very slightly overlapped by it; its origin is chiefly fleshy, but there is a tendinous surface of small extent on the posterior surface of the muscle, which is overlapped by the *adductor*. The insertion measures three quarters of an inch in length, and lies immediately behind the lesser trochanter; for almost one quarter of its extent it is entirely tendinous, and the whole of the upper surface glistens.

(18) *Adductor longus* arises from the pubis, immediately behind the origin of the *pectineus*, which it slightly overlaps, and from the septa between itself and the adjacent muscles; at a distance of four and a half inches from its origin it fuses with the *adductor magnus*, and is inserted in common with that muscle.

(19) *Adductor brevis*.—This muscle arises below the *adductor magnus*; it consists of two parts: one arises from the pubis, below the *adductor longus*, and from the symphysis, the other arises further back from the ischium and from the septa between itself and the *adductor magnus* and *obturator internus*; the two join just before the insertion; its line of insertion measures an inch and a half in length; it commences about on a level with the middle of the lesser trochanter, and ends on a level with the end of the insertion of the *glutæus maximus*; the insertion is partly muscular and partly tendinous.

(20) *Adductor magnus*.—This muscle is divided into two distinct parts, which are perfectly separate both at origin and insertion: one part is inserted in common with the *adductor longus*, and it is a question whether these two together should not be regarded as the equivalent of the *adductor longus*. The outer part of the muscle arises from the ischium just behind the *gracilis* and in contact with it in front; behind it is in contact with the origins of the *semimembranosus* and the other muscles which arise from the tuber ischii; together with the *gracilis* it completely covers over the deeper part of the *adductor magnus*. The muscle is flattish at first, but afterwards becomes thicker; its origin is fleshy above, but in the middle line below it has a tendon, which soon dies

away. It is inserted on to the inner condyle of the femur. The second part of the *adductor magnus* arises below the first head and the *gracilis* from the symphysis pubis and from the ischium; the line of origin extends from close to the anterior extremity of the symphysis back to a point upon the ischium corresponding to about the middle of the origin of the first half of the *adductor magnus*; it arises not only from the bone but from the septa between itself and the posterior head of the *adductor brevis* and *obturator internus*; at about an inch from its insertion it is joined by the *adductor longus*. The insertion of the muscle upon the femur extends from the end of the first third of the bone up to its very extremity; on the inner side, where the insertion is common to it and the *adductor longus*, the muscle is strongly tendinous; on the outer side the attachment is muscular and formed by coarsely fasciculate fibres.

(21) *Tibialis anticus*.—This muscle is formed of two distinct parts, which, however, originate in common; the two tendons pass close together below the ligament connecting the astragalus with the first metatarsal; the hinder of the two tendons, which is the shortest, is inserted on to the cuneiform bone; the anterior tendon is inserted, in common with the astragalo-metatarsal ligament, on to the proximal end of the first metacarpal.

(22) *Extensor proprius hallucis*.—This muscle arises from the fibula, from the interosseous ligament, and from the septa between itself and the adjacent muscles; it becomes entirely tendinous just at the astragalo-metatarsal ligament, underneath which it passes, and, running along the upperside of the hallux, is inserted on to the distal phalanx.

(23) *Extensor longus digitorum pedis*.—The muscle arises from the fibula, from the interosseous membrane, from the fascia covering the leg, and from the septa between itself and the *tibialis anticus*, *extensor proprius hallucis*, and *peronæus tertius*. The muscle becomes free about two inches in front of the ankle. The tendons of insertion are visible upon the upper surface of the muscle about an inch before they become free from muscular fibres. In the middle of the ankle the muscle splits into two: one division is entirely tendinous, the other is invested on the lower side with muscle for a distance of about an inch beyond the division. The front tendon supplies the second and third digits; it divides rather beyond the middle of the metacarpal into two tendons, of which that supplying digit II. is rather less than half the diameter of that supplying digit III. The second division of the muscle again divides, just at the commencement of the metatarsal region, into two equally sized tendons, which are each as large as the tendon of digit III.; they supply digits IV. and V.; in every case the tendons are inserted on to the terminal of the phalanx of the digit.

(24) *Extensor brevis digitorum* consists of four muscular slips, which supply the thumb and the next three digits; their tendons join the long extensors of the digits just at the commencement of the first phalanx; the four muscles arise in common from the os calcis, but they become almost immediately distinguishable into the four slips;

those supplying the three middle digits lie between the metatarsals, the first of them lying between the second and third metatarsals; their tendons arise at the commencement of about the last third of the metatarsals.

(25) *Peronæus longus.*—This is the outer of the two peroneal muscles (there are *only* two); it arises from the fibula and from the septa between itself and adjacent muscles.

(26) *Peronæus brevis* arises from the fibula and from the septa between itself and adjacent muscles; its tendon, which is superficial to that of the last muscle, is inserted on to the outer side of the head of the first metatarsal; some way before its insertion it gives off a very fine tendon, which passes along the extensor surface of the last metatarsal; at the end of this bone the tendon passes over to the outer side and joins the tendon of the long extensor of this digit.

(27) *Gastrocnemius.*—This has the usual two heads, which join at about the middle of the calf. The outer head is entirely tendinous at its origin from the external tuberosity; for half an inch or so from the point of origin it is fused with the fleshy head of the *plantaris*; the tendon spreads out over the outer surface of the muscular belly, and gradually dies away. The inner head is half fleshy and half tendinous at its origin, which is more extensive than that of the outer head, extending as it does over the condyle ventral of and behind the tuberosity as well as from the tuberosity itself; the relative positions of the fleshy and tendinous parts of the head of origin are precisely those of the fleshy *plantaris* and the tendinous head of the outer half of the *gastrocnemius*; the fleshy parts are both internal. The tendon spreads over the upper surface of the muscle and reaches back rather further than in the case of the outer head; the conjoined muscles become tendinous on the inner surface some distance in front of their insertion (largely muscular) on to the calcaneum.

(28) The *soleus* may be regarded as a third head of the *gastrocnemius*, which is, however, distinct from it nearly up to the point of their common insertion. The muscle arises from the lower surface of the head of the fibula; its origin is fleshy above; below there is a layer of tendon, which extends back, covering nearly the whole of the ventral surface of the muscle, to about the middle of the calf of the leg; further back still it is the upper surface which becomes tendinous.

(29) *Plantaris.*—This is a slender muscle, arising, as already mentioned, in common with the outer head of the *gastrocnemius*; the muscle passes into a slender tendon; four inches from its origin this tendon passes between the *gastrocnemius* and the *soleus*, though in closer connection with the former.

(30) *Popliteus* arises from the external condyle of the femur by a strong thick tendon; this passes just beneath the external ligament of the knee; the muscle is inserted on to the head and shaft of the tibia along a line measuring three inches in length. The tendon of origin of the muscle ends in the interior of the muscle, being ensheathed in muscular fibres.

(31) *Flexor longus digitorum pedis.*—This muscle arises from the anterior two-thirds of the shaft of the tibia and from the septa between itself and adjacent muscles. Its tendon commences a little way in front of the ankle-joint, but it is covered on the palmar surface with muscle continuously; the fibres belonging to itself do not end until the commencement of the *lumbricales*. It divides into three tendons, which supply digits II., IV., V.

(32) *Flexor brevis* arises from the calcaneum below the *abductor hallucis*; at about the middle of the sole of the foot it gives off a delicate muscular slip which ends in a very fine tendon joining the *flexor perforatus* of the fourth digit; beyond this it divides into two tendons, of which the outer is the stronger of the two; this becomes the perforatus tendon of digit III. At the point where the muscle passes into tendon it is reinforced by a muscular slip from the *flexor longus digitorum*; it is difficult, therefore, to say whether the tendon belongs to one muscle or the other. The inner tendon of the muscle becomes the perforatus tendon of the index, the perforatus tendon being furnished, not by the *flexor profundus*, as in the other digits, but by the *flexor longus digitorum pedis*.

(33) *Flexor profundus digitorum.*—The muscle arises from the upper two-thirds of the shaft of the fibula and from the septa between itself and adjacent muscles; the tendon becomes quite free from muscular fibres at the ankle. It gives off a strong branch to the thumb, which runs to the distal phalanx of the same; half an inch beyond this it is joined to the tendon of the *flexor longus digitorum pedis*, just in front of the origin of the branch of the latter going to the last digit; beyond this it divides into two tendons, approximately equal in thickness, which are the perforating tendons of digits III. and IV.

(34) *Lumbricales.*—There are three *lumbricales*. The innermost of these arises from the branch of the tendon of the *flexor longus digitorum* belonging to the index, and from the inner of the two tendons of the deep flexor; the outermost of the three arises partly from the outer surface of the outer of the two tendons of the deep flexor and partly from the tendon of the *flexor longus digitorum* supplying the fifth digit.

(35) *Tibialis posticus.*—This muscle is the deepest of the three flexor muscles; it arises from the tibia, from the fibula, from the interosseous membrane, and from the septa between itself and the two remaining flexors; its tendon of insertion is as large as those of either of the two other flexors; it is inserted partly on to the ligaments of the sole of the foot lying deep of the long flexor tendon and partly on to the tibia.

(36) *Abductor hallucis* arises from the calcaneum and ligaments of the sole of the foot, and is inserted on to the base of the first phalanx of the hallux by a fleshy insertion.

(37) *Abductor minimi digiti* arises principally from the calcaneum, but also from the plantar fascia of the foot; it is inserted by a short tendon on to the base of the first phalanx.

(38) *Flexor brevis hallucis* arises from the cuboid bone by a short flat tendon; it is inserted by a single insertion, in common with the *adductor hallucis*, which is fleshy.

(39) *Adductor hallucis.*—This is a strong fleshy muscle which arises partly from the sheath of the *peronæus longus*, partly from the plantar fascia, and partly from the heads of the metatarsals; the muscle measures one inch in diameter at the middle; it is inserted in common with the fleshy *flexor brevis* on to the base of the first metacarpal.

(40) A very small slender muscle arises by a tendon measuring half an inch in length from the sheath of the *peronæus longus*; the delicate muscular belly in which it ends measures 3 mm. in diameter and about an inch in length; it passes across the *transversus pedis* in close connection with it, but I could not determine its insertion; I found this muscle only in one foot.

(41) *Transversus pedis* is of some size; it arises from the metatarsal ligament of the second, third, and fourth digits; it is inserted on to the thumb in common with the *adductor hallucis*.

§ 8. *Comparison of Musculature with that of the Common Chimpanzee.*

In the following table the principal differences between *Troglodytes calvus* and *Troglodytes niger* are shown (according to Sutton's account of the myology of the latter [1]):—

	T. calvus.	*T. niger.*
Pect. minor	Insertion: coracoid.	Insertion: capsule of shoulder-joint.
Biceps cruris	Ischial head present.	Ischial head absent.
Soleus	From head of fibula only.	From upper third of posterior surface of fibula only.
Flex. prof. digit.	Attached by a vinculum to Flex. long. digit.	No such vinculum [2] (?).
Flex. long. digit.	Supplies digits I., IV., V.	Supplies digits II., V.
Lumbricales	Three.	Four.
Flex. long. poll.	Well-developed; supplies index and pollex.	Absent or feebly developed; supplies only pollex.
Ext. min. digit.	Absent.	Present.

Macalister [3] has noted that in the Chimpanzee the *dorso-epitrochlear* ended in a fascia in the middle third of the arm; it is thus more rudimentary than in *Troglodytes calvus*. The *flexores profundus* and *pollicis* were found by Macalister to be fused into a single muscle; but the double condition shown in the Ape described in the present

[1] Journ. Anat. & Phys. vol. xviii. p. 66 (1884).

[2] This vinculum, however, is stated by Macalister to occur. Sutton does not say it is absent; he does not refer to it.

[3] "On some points in the Myology of the Chimpanzee and others of the Primates," Ann. & Mag. Nat. Hist. vii. (1871) p. 341.

paper has been recorded by Wilder. The *extensor indicis*, which I found to supply the index only, may in the Common Chimpanzee send a tendon to the middle finger also. I have referred above to Mr. Sutton's statement that the fibular head of the *soleus* is the only head present, but that it is more extensive than in the present species. Sir G. Humphry found in a Common Chimpanzee the fibular origin restricted, as in the case of "Sally," to the head of the fibula; but in the specimen dissected by him the tibial head also was present. Dr. Chapman [1] found no *plantaris* in the Chimpanzee [2] dissected by him, and no *transversus pedis*. It is clear from the above very brief and incomplete notes upon recorded investigations into the myology of the Common Chimpanzee that it is not easy at present to say exactly what is the normal arrangement of the muscular structure of that animal; we are evidently not yet in a position to discriminate between what are variations and what are characteristic arrangements. If this is the case with the Common Chimpanzee, which has been dissected by so many anatomists, it is obviously much more the case with the Bald-headed Chimpanzee, of which, at present, only a single specimen has been dissected. I do not think it, therefore, worth while to attempt an exhaustive comparison of its muscles with those of other Anthropoids; the value of such a comparison would be very far indeed from being commensurate with the labour of collecting various papers and abstracting the necessary data. There is no reason to suppose that when other examples of *Troglodytes calvus* have been dissected they will prove to be identical in every point with the individual studied by myself. I must therefore leave to further workers the task of constructing a muscle formula of this Ape for comparison with other Anthropoids.

§ 9. *The Palate.*

The accompanying drawing (Plate XXV. fig. 2) illustrates the palatal rugæ of this Chimpanzee. It will be observed that the folds upon the hard palate, although fairly well marked, are irregular in their arrangement and incomplete compared with what they are in the lower Apes. This holds good for all the Anthropoid Apes so far as they are known, and for Man. Sir Richard Owen says [3], on the other hand, "In the higher Quadrumana the palate is smooth or unridged as in Man." The palate is certainly smoother in Man than in the Chimpanzee, but there are ridges which, however, are much fewer than in the Ape.

The drawing (Plate XXV. fig. 2) precludes the necessity of an elaborate description f the palatal ridges of *Troglodytes calvus*, which, moreover, possibly have some range of variation as they have in Man [4]; it is, however (in my opinion), important to illus-

[1] "On the Structure of the Chimpanzee," Proc. Acad. Nat. Sci. Philadelphia, 1879, p. 52.

[2] Its absence is also asserted by Bischoff and Brühl. Hartmann, however ('Der Gorilla,' p. 52), says that it is normally present.

[3] Comp. Anat. vol. iii. p. 396.

[4] H. Allen, "The Palatal Rugæ in Man," Proc. Acad. Nat. Sci. Philad. 1888, p. 254.

trate a point of this sort in an animal which cannot be readily examined by a person who is treating of the subject of the palatal rugæ.

§ 10. *The Brain.*

I have compared the brain of the Bald-headed Chimpanzee with the brains of two Common Chimpanzees; the latter, however, naturally presented some differences from each other, which rendered the task of comparison more difficult.

The brain of "Sally" weighed, after removal of the pia mater and after an immersion of four months in spirit, $8\frac{3}{5}$ oz.; it had been allowed to dry for about an hour and a half before weighing; it was then damp but not wet.

The two other Chimpanzees' brains were weighed under the same conditions [1], and were found to weigh respectively $6\frac{1}{2}$ oz. and $6\frac{3}{5}$ oz.

These two Chimpanzees were of about the same size, and not much more than half the size of "Sally." They were both a little larger (about 4 or 5 inches taller) than the animal examined by Dr. Symington [2], the brain of which weighed under pretty much the same conditions $8\frac{1}{2}$ oz. I cannot account for the very great difference; it prevents me from attempting to draw any conclusions as to the weight of the brain in *Troglodytes calvus*.

The brain of *Troglodytes calvus* is deeper in proportion to its length than either of the two brains of *Troglodytes niger* with which I compared it.

The lengths of the brain as compared with their height are as follows:—

	Length. mm.	Height. mm.
Troglodytes calvus	108	65
„ *niger* (A)	100	58
„ *niger* (B)	102	62 [3]

The measurements are taken by placing vertical plates beside the brain, and are therefore only true as regards the proportions.

The actual measurements of the brain of *Troglodytes calvus* are as follows:—Length 103 mm., breadth 80 mm., height 62 mm.

In viewing the cerebrum from the upper surface (Plate XXIII. fig. 3), the most striking difference between the two species was the condition of the *parieto-occipital fissure* (the "Simian fissure," as it has been called). In Man this fissure is of small

[1] One of them has been eight months, the other ten months in spirit.

[2] "On the Viscera of a Female Chimpanzee," Proc. Roy. Phys. Soc. Edinb. vol. x. p. 300.

[3] In this Chimpanzee the temporo-sphenoidal lobes projected downwards in a much more marked degree than in the other. The vertical diameter of the brain was naturally increased thereby; 5 or 6 mm. must be allowed for this difference.

extent; the length is generally (according to Quain's 'Anatomy') about an inch. In the Chimpanzee, on the other hand, these fissures on each side are very long; in both of the specimens which I examined they extended to within one-sixth to half an inch of the furrow lying between the cerebrum and cerebellum; and as figured by Hartmann[1] they pass in an almost straight course across the brain, being traceable up to the median furrow of the brain. In the brain of "Sally," on the other hand, these fissures, although recognizable laterally, were connected with the median furrow (on Plate XXIII. fig. 3, *P.o.f.*) by an irregular bent fissure on one side only. A closer comparison of the two brains showed an interesting reason for this difference. In the Common Chimpanzee the parieto-occipital fissure is deep, and its posterior wall is said to be markedly convoluted. This was so, at any rate, with one of the two individuals whose brains are among my stores at the Gardens. If that part of the brain of *Troglodytes calvus* lying between the letters *P.o.f.*? and *P.o.f.* in fig. 3 of Plate XXIII., the median longitudinal furrow of the brain, were infolded, we should get a very close resemblance to the brain of *Troglodytes niger*.

The *Sylvian fissure* of *Troglodytes calvus* presents, at any rate, one very interesting point. It has been more than once pointed out that the posterior and longer of the two branches of the *Sylvian fissure* is more upright in the Chimpanzee than in Man. This was undoubtedly the case with the two brains examined by myself, the angle of inclination being pretty much the same in both. In the brain of *Troglodytes calvus*, however (Plate XXIII. fig. 2 *F.s.*), *the posterior limb of the Sylvian fissure was much more upright than in the Common Chimpanzee*, resembling therefore that of the Gorilla, the Gibbon, and the Orang, though not so upright as in the latter.

The fissure in the brain of *Troglodytes calvus*, which appears to correspond to the anterior branch of the Sylvian fissure as figured by Gratiolet[2], is quite as large as in the Common Chimpanzee, but more horizontal in direction. I take it, however, that this is not the true anterior branch of the Sylvian fissure. For this long fissure, which lies in front of (below) the true anterior branch of the Sylvian fissure, is not continuous with the posterior branch of the Sylvian fissure, as can be seen by raising the temporo-sphenoidal lobe. Comparing the brains of the Chimpanzees with that of the Orang and the Gibbon, the true anterior branch of the Sylvian fissure (*F.s.a.*) is seen to be very short. In *Troglodytes calvus* it is directed more upwards than in *T. niger*.

The *fissure of Rolando* certainly varies in position in the Common Chimpanzee. In one of the two specimens which I have before me this fissure is not much behind the transverse axis of the brain; this is the case also with the brain of *Troglodytes calvus*. But in another Common Chimpanzee the point of the V formed by the two converging furrows is distinctly (more than half an inch) behind the transverse axis.

[1] 'Anthropoid Apes,' fig. 37, p. 192.

[2] 'Mémoire sur les plis cérébraux de l'homme et des primatès,' pl. vi. figs. 2, 6.

It is evident, therefore, that much stress cannot be laid upon this alleged difference between Man and the Chimpanzee. The following measurements will show these differences more clearly:—

	Total length of cerebrum measured from above a vertical plate at each end and covering the cerebrum.	Length between anterior end of cerebrum and point of V in fissure of Rolando.
	mm.	mm.
Troglodytes calvus	100	54
„ *niger* (A)	98	52
„ *niger* (B)	96	57

The fissure of Rolando in the brain of the Bald-headed Chimpanzee has the same two anterior connections that it has in the common species; its shape is that of the letter W; the innermost convexity is, however, much more marked than in either of the two Chimpanzees' brains with which I have compared it. As to the other fissures, they show such variation in individuals that I do not think a detailed description of one brain will serve any useful purpose. I therefore direct attention to the accompanying drawings (Plate XXIII.) of the brain, which will be of more assistance to investigation in the future than any description.

The under surface of the brain shows one noteworthy difference between the two species of Chimpanzee. In the Common Chimpanzee the frontal lobes are, as in the lower Apes, keeled below in the middle ventral line, looking as if they had been artificially pressed together by the thumb and forefinger. There was hardly any sign of this in *Troglodytes calvus*, and in this particular the brain is more like that of the Orang.

The interval between the temporo-sphenoidal lobes was very much less in *Troglodytes calvus* than in the Common Chimpanzee, not very much more than one half. This is partly due to the position of the lobes in question, and is correlated of course with the more vertical direction of the Sylvian fissure already referred to. The apex of the temporo-sphenoidal lobes is decidedly less blunt than in the Common Chimpanzee.

The posterior aspect of the brain is also characteristic. The lateral masses of the cerebellum (Plate XXVIII. figs. 1, 2) come into contact behind, overlapping the median tract, which they largely conceal. This is precisely what occurs in the Orang, but not in *Troglodytes niger*. In that Chimpanzee (Plate XXVIII. fig. 2) the median tract of the cerebellum is not concealed by any overgrowth of the cerebellar hemispheres. The peculiar form of this region of the cerebellum, as compared with that of the Common Chimpanzee, will be best appreciated by a comparison of figs. 1 and 2 of Plate XXVIII., which represent the posterior aspect of the brain of "Sally" and of one of the two Common Chimpanzees belonging to the Prosector's stores.

§ 11. *Conclusions.*

In the preceding pages I have incidentally attempted to criticize the various species of Chimpanzee that have at one time or another been proposed; but the main object has been to endeavour to show that the Chimpanzee which lived in the Society's Gardens from 1883–91 is Du Chaillu's *Troglodytes calvus*, is *not* Duvernoy's *T. tschego* or any other variety, and *is* a perfectly distinct species of Chimpanzee, which has, however, hardly a claim to represent a distinct generic type. *Troglodytes calvus* differs from *T. niger* in well-marked external characters, in less well-marked skull characters, and apparently in its muscular anatomy and brain. I am not, however, desirous of emphasizing too much the myological differences, since we obviously do not know the range of variation in *T. calvus*, or, for the matter of that, in *T. niger*. The skull of *T. calvus* may be said to show an exaggeration of the characters proper to the genus *Troglodytes*, from which I exclude the Gorilla.

III. On the Orang reputed to be Simia morio.

Although perhaps most persons now consider that there is only one species of Orang Outang, more than one name has been given to supposed different forms. The Sumatran Orang, for example, has been regarded as distinct from the Bornean ape, and the smaller Bornean Orang has been distinguished from the larger animal (*Simia satyrus*) under the name of *Simia morio*. The small Orang presented to the Society on 15th April, 1891, which died on September 22nd, was believed to be a representative of the latter species.

The best figures known to me of the large Orang illustrate a paper by Dr. Hermes published some fifteen years ago [1]. In those plates the young and adult Orangs are shown in several ways. Other figures which I have consulted are Gervais's [2], Chenu's [3], Wallace's [4], and Chapman's [5], and that of Flower and Lydekker [6]. I do not trouble to indicate older illustrations, such as those given by Temminck, for most of them show signs of inaccurate drawing or reproduction, and it would be unprofitable to build any conclusion upon them. Of the coloured figures referred to, it seems to me that Dr. Hermes's are far away the best, and they are the only ones besides that of Dr. Chapman which give a good lateral view of the head. If the coloured drawing of the head of "George," which I now exhibit (Plate XXIV.), be compared with Hermes's

[1] Zeitschr. f. Ethnologie, Bd. viii. 1876, pls. xv. & xvi.

[2] Mammifères, vol. i. pl. i.

[3] Encycl. d'Hist. Nat., Quadrumanes, p. 39, fig. 42.

[4] 'The Malay Archipelago,' vol. i. p. 64.

[5] "The Structure of the Orang," Proc. Acad. Nat. Sci. Philad. 1879, pl. xi.

[6] 'Mammals Living and Extinct,' p. 733. The cut is from a drawing by Wolf.

illustration of the side view of the head of a young Orang, a number of important differences at once appear. In the first place, the shape of the head is quite different. The larger Orang shows the "brachycephaly" which is characteristic of the Orang, as compared with the Chimpanzee or Gorilla, to a very much greater degree than does the head of the supposed lesser Orang. Indeed, the head of this animal is not unlike that of a Chimpanzee; its shortness, however, as compared with its breadth becomes plainer after an inspection of the accompanying drawings (Plates XXI. and XXV. fig. 1), which represent the vertex of the Orang and the Chimpanzee. But even here the discrepancy is not very great, the measurement being:—

	Length of cranium.	Breadth of cranium.
Chimpanzee (*Troglodytes calvus*) . . .	140 mm.	116 mm.
Orang (*Simia morio*?)	132 mm.	113 mm.

The difference in the height of the forehead is also very marked. It is well known that this is a character of age, the older Orangs having less lofty foreheads than the young; but "George" was probably not more than four or five years old at the time of his death, inasmuch as none of the permanent teeth had put in an appearance.

Again, the relative baldness of the forehead of the two Apes furnishes a remarkable difference. In the Orang examined by myself the baldness was more pronounced than in the animal figured by Dr. Hermes. It will be noticed that the hair on the temples stops short on a level with the ear, whereas it extends much further forward in the animal illustrated in Hermes's figure, and also in the Orang's head figured by Abel [1]. It is true that in Chenu's figure the hair stops at the same point as it does in the Orang which forms the subject of the present communication; but the forehead of the animal figured by Chenu is much higher, and in other respects it agrees with the typical Orang.

The length of the hair also is greater in the young of the larger Orang. This is shown in Hermes's figure and in the woodcut given by Mr. Wallace. But the length of the hair upon the head seems to be a question of age. It is short in the adult Orang figured by Hermes.

I do not, however, propose on these characters to establish a species, whether called *Simia morio* or by some other name. My object is rather to take the opportunity afforded me of contributing fresh data to the gradually accumulating material, which will ultimately permit of a definite opinion upon the question. In the meantime I submit that the differences between the animal of which a drawing is exhibited (Plate XXIV.) and the typical Orang figured by Dr. Hermes are quite as marked as the differences between, say, a Tartar and an Aryan.

[1] "Some Account of the Ourang Outang etc.," Asiat. Research. vol. xv. pl. i.

In this case the differences are not believed to amount to a difference of species; but if a Mongolian were to come under scientific observation for the first time, the peculiar characters of the face would be undoubtedly sketched and published for purposes of reference. I think, therefore, that it is worth while to publish the drawing of the Orang "George," even if it were definitely known to belong to the same species as the Orang figured by Dr. Hermes, which is far from being proved. At the very least the two drawings exhibit the extreme range of variation of one species. While describing the head I may call attention to the scanty eyebrows and to the slight development of beard upon the chin.

§ 1. *The Hand.*

The back of the hand is illustrated in the accompanying drawing (Plate XXVI. fig. 1), and the palm of the hand in another drawing which I also exhibit (Plate XXVII. fig. 1). I am not acquainted with any good illustrations of this member or of the foot in the Orang.

The back of the hand is hairy down to the distal extremity of the second phalanx in all the fingers except the second (index). But there is a remarkable patch covered with very short stubbly hair, caused, no doubt, by the friction produced as the animal walks resting partly upon the backs of the hands. This patch runs obliquely across the back of the hand, as shown in the drawing, and is about $\frac{1}{2}$ an inch to $\frac{3}{4}$ in breadth. The hairs upon the fingers are short and stubbly; on the index they are nearly absent, a narrow line only on the outer side of that finger being hairy.

The grooves on the palm of the hand may be compared with those of the Chimpanzee. The right hand has in both cases been selected for illustration. They are distinctly more human in the Orang, the greater resemblance to man being chiefly due to the fewness of the cross lines. The two lines also which run to the roots of the third and fourth fingers from the transverse line dividing the palm are seen in the human hand, but are barely traceable in that of the Chimpanzee. It will be noted that there is only one continuous cross line (*a*, *b*), and that the line *e* of the Chimpanzee hand is wanting. The palm of the hand is illustrated in Alix's paper referred to in my description of the Chimpanzee's head. There is also a figure of the palmar as well as the upper surface of the manus of the Sumatran Orang (regarded by Fischer and Anderson [1] as a distinct species and synonymous with Geoffroy's *T. bicolor*) in a paper by Abel [2], but there is no indication of the grooves nor of the patches covered with short hair on the back of the hand; it is very probable that these characters are at least accentuated during life in captivity, which necessarily gives less opportunities for climbing and more for walking upon a hard surface.

[1] Cat. of Mamm. Indian Museum, vol. i.

[2] "Some Account of the Ourang Outang etc.," Asiat. Research. vol. xv. (1825) p. 489.

§ 2. *The Foot.*

The upper and plantar surfaces of the foot (Plate XXVI. fig. 2 and Plate XXVII. fig. 2) will now be described. The great toe, as has often been pointed out, has no nail. The covering of hair extends, as in the case of the hand, as far as the end of the second phalanx; but the hair is considerably longer on the foot than on the hand; the difference in this respect of hand and foot is well illustrated in the accompanying drawings (Plate XXVI. figs. 1, 2). The long hair, however, stops short at the first phalanx; the second is covered with short stubbly hair only.

The lines on the sole of the foot differ from those of the Chimpanzee. The second transverse line (*b* in Plate XXVI. fig. 2) is absent; the line *a* goes right across the sole. Other differences will be apparent on comparing the two figures.

§ 3. *The Muscular System.*

The muscular anatomy of the greater Orang has been described by several anatomists, including Duvernoy [1], Bischoff [2], Chapman [3], Lange [4], and Westling [5]. It might therefore seem unnecessary for me to burden zoological literature with further observations upon a topic which is very far from being new. Nevertheless, I venture to submit the following account of the myology of the animal, sheltering myself from criticism behind the opinion of the foremost authority upon the Anthropoids—Prof. Hartmann.

Prof. Hartmann says:—"The muscular system of Anthropoid Apes is very interesting. . . . . The amount of material which has been collected up to this time is, unfortunately, too scanty to enable us to draw satisfactory conclusions in all cases. We are often unable to decide whether the conditions presented to us in the case of Anthropoids are normal or exceptional. . . . . The assertions on the subject which have been published to the world and accepted as authoritative have already been shown to be to some extent untrustworthy. . . . . Brühl justly remarks that in no department of anatomy more than in that which treats of the muscles is it more essential that we should not decide whether a form is normal or exceptional until it has been repeatedly examined" ('Anthropoid Apes,' p. 150).

[1] "Des caractères anatomiques etc.," Arch. Mus. t. 8 (1855).

[2] "Beiträge zur Anatomie des *Hylobates leuciscus* und zu einer vergleichenden Anatomie der Muskeln des Affen und des Menschen," Abh. Bayer. Akad. Bd. x. (1870).

[3] "On the Structure of the Orang Outang," Proc. Acad. Nat. Sc. Philad. 1880, p. 160.

[4] SB. Akad. Wien, Bd. lxxix.

[5] "Beiträge zur Kenntniss des peripherischen Nervensystem," Bihang K. Svensk. Vet.-Akad. Bd. ix. no. 8.

§ 4. *The Muscular Anatomy of the Fore Limb.*

(1) *Pectoralis major* (Plate XXVIII. fig. 4, *Pect.* 1).—This muscle is divided into two distinct portions, separated by a distance of an inch and a half at their origin, but gradually converging towards their common insertion. The posterior half of the muscle is rather more than an inch and a half wide at its origin; its fibres arise from the sternal part of the 3rd, 4th, and 5th ribs and from the edge of the sternum adjacent; at its origin the muscle is flat and thin, but gradually gets thicker as well as narrower; at about an inch before its insertion it again widens out, and is formed of a wide flat tendon and a narrow muscular strip. The anterior half of the muscle is thick and narrow, being approximately of the same diameter throughout, except at the insertion, where it becomes wider and thinner; it arises by a head, measuring rather less than one-third of an inch in diameter, just below the *omohyoid* of its side from the sternum; it has no connection whatever with the clavicle. It becomes fused with the second part of the pectoral just before their common insertion and lies above it; the line of insertion of the pectoral upon the forearm measures two inches and a half, and commences from the head of the humerus just above the biceps; it is tendinous on the lower surface but muscular above.

(2) *Pectoralis minor* (Plate XXVIII. fig. 4, *Pect.* 2).—This muscle is composed of two perfectly distinct parts: the first arises from the third and fourth ribs at the junction of the bony ribs with their cartilaginous portions; it is partly overlapped at its origin by the second part of the muscle. It measures one inch and a quarter in greatest breadth, and rapidly narrows to the tendon of insertion, which commences (on the inferior surface of the muscle) an inch and a half from the actual insertion.

(3) The second half of the *Pectoralis minor* has a broad thin origin from ribs four, five, and six; but the muscle is already very narrow before it becomes free from the attachment at its origin. It is inserted by a long and narrow tendon just above and in common with the anterior extremity of the tendinous insertion of the *pectoralis major* on to the head of the humerus.

The sterno-clavicular ligament is attached to the coracoid process in common with the tendon of the anterior part of the *pectoralis minor*; its entire length is two inches and three-fifths; it arises by a few fibres from the anterior end of the sternum in front and to the outside of the origin of the *pectoralis major*. It is figured by Miss Westling.

(4) *Coraco-brachialis* arises in common with the *biceps* from the coracoid process; the apparent attachment of the muscle is along a line two inches and three-fifths in length; it is, however, really fixed to the humerus by two separate attachments, between which intervenes a thick tendinous ridge attached at both its ends to the humerus, but free in the middle; upon these are inserted some of the fibres of the *coraco-brachialis*; the anterior end of the tendon is attached to the flat broad tendon

of the *latissimus dorsi*; the posterior attachment of the muscle is to the humerus direct along a line measuring as nearly as possible an inch, ending at the middle of the humerus.

(5) The *biceps* is composed of two very distinct portions: the coracoidal head arises from the coracoid process in common with the *coraco-brachialis*; the two are fused for a length of two and a half inches. This muscle is rather thinner than the humeral half; it fuses with the latter one inch and seven-tenths in front of their common insertion. The muscle is fleshy except just at its origin and for a short way beyond, where it is covered by a glistening tendinous layer; its connection with the humeral half of the muscle is as follows—rather more than half an inch before the fusion of the two the coracoid head becomes tendinous on one side; this tendinous part is inserted on to the fleshy part of the humeral head on the side of the muscle which faces the bone; the fleshy part of the muscle is inserted on to the conjoined tendon of the two heads.

The humeral head arises in the usual way by a strong tendon which gradually passes into muscle; it begins again to be tendinous some little way in front of its fusion with the coracoid head.

(6) *Latissimus dorsi* is a large, flat muscle extending in its origin as far back as the crest of the ilium; it also arises from lumbar fascia and from posterior ribs; the muscle rapidly narrows towards its insertion, and at a point about on a level with where the *teres major* becomes free from its attachment to the scapula divides into two portions, one of which is very small. It has a nearly circular section, and measures in diameter only one-fifth of an inch; its total length is three and a half inches from the point where it leaves the rest of the *latissimus dorsi* to where it joins the *teres major*, in common with which it is inserted. The remaining portion of the muscle passes into a broad flat tendon one inch and one-third in length; the insertion of this tendon is J-shaped, the recurved bit being anterior and joining the insertion of the *teres major*; the straight part of the tendon is inserted on the tricipital grooves just below the insertion of the *pectoralis major*: it is nearly coextensive with the insertion of that muscle. I have already mentioned that the *coraco-brachialis* is partly inserted on to the tendon of the *latissimus dorsi*. Just at the point where *latissimus dorsi* passes into tendon it gives off a *dorso-epitrochlear* slip, which is a round and fleshy muscle about one-third of an inch in diameter; at a distance of two inches from the elbow the muscle passes into a tendinous strip to which are attached some of the fibres of the *triceps* and of the *brachialis anticus*; it is therefore vertical, being apparently attached to the humerus; a little later it becomes free as an extremely fine tendon which lies lightly stretched like a violin-string between the shaft of the humerus and its flexor condyle.

(7) *Trapezius*.—The origin of this muscle from the spines of the vertebra extends back as far as the commencement of the origin of the *latissimus dorsi*; anteriorly the origin reaches the head, but owing to the removal of the brain I could not make out

the exact manner of its origin. It is inserted on to the external third of the clavicle and on to the greater part of the scapular spine.

(8) *Rhomboideus major.*—This muscle arises below the last from the spines of the cervical and first dorsal vertebra; its line of origin measures three and a half inches; it arises by fleshy fibres, among which there is, here and there, a slight admixture of tendon. It is inserted on to the posterior border of the scapula immediately above the insertion of the *serratus* for a length of one and nine-tenths of an inch about two-thirds of the length of the border of the bone.

(9) *Rhomboideus minor.*—This muscle, unlike *rhomboideus major*, has a distinctly tendinous origin of about one quarter of an inch in length; the muscle arises just behind the *rhomboideus major*, but is not overlapped by it, except for about a quarter of an inch anteriorly; the origin of the muscle is about one and a quarter inch in length. Its insertion is not very distinct from that of the last muscle; it occupies the rest of the posterior border of the scapula; it overlaps the insertion of the last muscle before they become joined.

(10) *Rhomboideus occipitalis.*—This is a slender flat muscle, measuring nearly one inch across at the origin from the occipital and gradually diminishing towards its insertion. For the last inch and a half or so of its course it runs parallel to, and in close contact with, the *rhomboideus major*. But it is quite distinct from it, being not flat but cylindrical, and ending in a longish and very narrow tendon of insertion on to the extreme upper angle of the scapula.

(11) *Levator anguli scapula.*—The insertion of this muscle is on to the outer angle of the scapula just above the termination of the line of insertion of the *serratus magnus.*

(12) *Omohyoid* has a fleshy origin from a tubercle on the inferior border of the scapula one inch from the glenoid fossa.

(13) *Serratus magnus* arises from all twelve ribs and by twelve more or less marked digitations; the posterior four or five are less marked than those in front; it is inserted to the whole of the posterior border of the scapula along a line below the insertion of the *rhomboideus*, extending as far as the *teres major* in front.

(14) *Deltoid.*—This muscle is very large; it arises from the last inch or so of the clavicle, from the acromion, and from the spine and posterior border of the scapula, mainly by a thin tendon which forms a fascia covering the underlying *supra-spinatus*; the latter origin forms an almost distinct head. The muscle is fleshy down to just before its insertion; the insertion is mainly on a rough triangular area, the deltoid impression, which measures nearly two inches in length. A few fibres from the *deltoid* are continued on to the *brachialis anticus.*

(15) The *teres major* arises from an area of the scapula near the upper inner border (axillary), from the axillary border itself, and from the septum between itself and the *infra-spinatus*, which is really, as has already been pointed out, partly the origin of

the deltoid. The area of origin of the *teres major* measures rather more than one inch and a quarter in length. The muscle is flat and strap-shaped and of some thickness; it is inserted on to the humerus by a flat tendon, some of which, as has been already explained, belongs to the *latissimus dorsi*; the line of insertion, which is just opposite to that of the greater part of the insertion of the *latissimus dorsi*, measures about an inch and a half.

(16) *Teres minor.*—This muscle has an entirely fleshy origin partly from the axillary border of the scapula, partly from the septum between itself and the *infra-spinatus*; the line of origin measures one inch and three-fifths; it is inserted on to the head of the humerus by an almost entirely fleshy insertion below, and separated by an interval from, the insertion of the *infra-spinatus*.

(17) *Infra-spinatus* occupies the whole of the infra-spinous fossa, to the greater part of which, however, it is not attached; it arises from the spine of the scapula up to the head, from the posterior border, from the axillary border, and from the fascia covering it; it also arises from the septa between itself and the two *teres* muscles. Its tendinous insertion is continuous with, and cannot be separated from, the insertion of *supra-spinatus* and the ligament uniting the scapula with the humerus.

(18) *Supra-spinatus* occupies the whole of the supra-spinous fossa.

(19) *Subscapularis* covers and arises from nearly the whole of the subscapular fossa; the insertion on to the humerus measures one inch and a quarter in length, the lower part of the insertion below the tuberosity being fleshy.

(20) *Triceps.*—This muscle has (excluding the *dorso-epitrochlear*) three heads of origin. The middle or long head arises from the border of the glenoid cavity, and from the inferior border of the scapula for an inch behind this; this origin is chiefly muscular, though tendinous where it is attached to the glenoid border; its inferior surface is covered by six or seven narrow tendinous bands which extend for a very short way down the muscle. The outer head arises from the humerus commencing about half an inch below the insertion of the *teres minor*: the origin of the inner head commences a little below that of the outer head.

(21) *Brachialis anticus.*—This muscle is large and fleshy; it arises from a large portion of the shaft of the humerus on both sides of the insertion of the *deltoid*; on the inner side of the humerus the origin extends a little way above the origin of the internal humeral head of the *triceps*; it passes under a tendinous arch left in the origin of the external humeral head of the *triceps*. The origin of the muscle is also from the septum between itself and the external head of the *triceps*; on the outer side of the insertion of the *deltoid* the origin of the muscle does not extend forwards much beyond the termination of the *deltoid* insertion, from this point downwards the origin of the muscle occupies the whole of the inferior surface of the humerus, coming into contact, on each side, with the origins of the *triceps* and *supinator longus*. Towards the distal end of the attachment some of the fibres arise from a septum between itself

and the *triceps*; this septum is continuous with the *dorso-epitrochlear*; posteriorly it becomes a narrow ligament, inserted on to the flexor condyle of the humerus; an inch and a half from the distal extremity of the humerus the muscle becomes free, and, curving over the joint, is inserted on to the ulna, being continuous also with the ligament binding the humerus and ulna. On the outer face the insertion is muscular; on the inner face it is tendinous anteriorly, and also where it joins the aforesaid ligament.

(22) *Anconæus* is present, and looks like a continuation of the *triceps*.

(23) *Supinator radii longus*.—This is a large muscle; it arises just in front of the *extensor carpi radialis longior*, from the upper part of the external ridge of the humerus; anteriorly to this it is continuous with the fibres of the *coraco-brachialis*, of which it appears to be a continuation; the origin from the bone measures an inch and three-quarters in length. It is inserted by a flat broad tendon, two inches long, upon a prominent ridge on the external border of the radius.

(24) *Extensor carpi radialis longior*.—This muscle arises from the lower part of the external condylar ridge of the humerus, just below the last muscle. Three inches from its origin it becomes a tendon, which passes over the wrist in close connection with the tendon of the next muscle, and is inserted on to the base of the metacarpal of the index; just before its insertion it is reinforced by a thin tendon arising from the *extensor carpi radialis brevior*.

(25) *Extensor carpi radialis brevior* arises from the extensor condyle of the humerus by a tendon common to it and the other extensors; also from the fascia covering the *supinator brevis*, and from the septum between itself and the *extensor communis*; it becomes entirely tendinous three inches from the wrist. At about an inch from the wrist it gives off a thin tendon which, running obliquely forwards, joins the tendon of the *extensor carpi radialis longior* just before its insertion. The main tendon of the present muscle, which is slightly broader than that of the "longior," is inserted into the base of the metacarpal of the middle digit.

(26) *Extensor communis digitorum*.—This muscle arises from the extensor condyle, and lies between the *extensor carpi radialis brevior* and the *extensor minimi digiti*, from the septa between which muscles and itself it also arises; about halfway down the forearm it divides into four muscles, from each of which a tendon arises supplying digits II.–V.; that supplying digit IV. gives off a very thin tendon, which joins the deep extensor of digit III.; they are inserted over the first and second phalanges.

(27) *Extensor minimi digiti* lies between the *extensor communis digitorum* and the *extensor carpi ulnaris*; just before the wrist it divides into two, which join the tendons of the *extensor communis*, which go to the fourth and fifth digits.

(28) *Extensor carpi ulnaris* arises from the extensor condyle and from a considerable length of the ulna; the short thick tendon is inserted on to the outer side of the base of the last metacarpal.

(29) *Supinator radii brevis.*—This muscle appears to be divided into two parts: one superficial and one deep. The upper part of the muscle is covered by a fascia, from which some of the extensors partly arise; it arises from the ligament of the elbow-joint and from the ulna; it passes right round the radius on to the flexor side, and is inserted on to that bone as far down as the beginning of the insertion of the *pronator radii teres*; the lower layer of the muscle is inserted on to the extensor side of the radius.

(30) *Extensor ossis metacarpi pollicis.*—This muscle is considerably the largest of the deep extensors; it takes origin from the radius, from the ulna, from the interosseous ligament, and from the septum between itself and the *extensor secundi internodii pollicis*; the radial origin commences two and a half inches below the bend of the radius, and a little in front of, and below, the attachment of the deep layer of the *supinator radii brevis*; the tendon of this muscle is short (two inches in length), and is inserted on to the radial carpal.

(31) *Extensor secundi internodii pollicis.*—This is a slender muscle, arising from the ulna just below the ulnar origin of the last muscle; it also arises from the interosseous ligament; the tendon, which is long and thin, passes above the tendon of the *extensores carpi radialis* to be inserted on to the proximal end of the last phalanx of the thumb.

(32) *Extensor indicis* arises from the ulna, from the interosseous ligament, and from the septum between itself and the *extensor carpi ulnaris*; it divides into two just before the wrist, and it is inserted on to the first phalanx of the index, and on to the corresponding phalanx of the third digit.

(33) There is an *extensor primi internodii pollicis*, the tendon of which passes in close contact with the tendon of the *extensor ossis metacarpi*; it is inserted on to the inner side of the base of the thumb metacarpal.

(34) *Pronator radii teres.*—This muscle arises from the flexor condyle of the humerus, beside the *palmaris longus* and above the other flexors; it also arises from the radius and from the septa between itself and adjacent muscles; on the radial side, where it is free, it is largely covered by glistening tendon; on the opposite surface it is nowhere free, some fibres taking origin from the *flexor carpi radialis* just at the end of the muscle; its insertion on to the radius, which is fleshy, measures one inch and two-fifths in length, and commences immediately behind the insertion of the *supinator brevis*.

(35) *Flexor carpi radialis* arises from the flexor condyle of the humerus and from the septa between itself and the *pronator radii teres* and the *flexor sublimis*; it becomes free immediately below the insertion of the *pronator radii teres*; its tendon of insertion does not commence until just before the wrist; it is inserted on to the base of the second metacarpal.

(36) *Palmaris longus.*—This muscle is the most external and superficial of the flexors, as well as the smallest; it is hardly more than one quarter of an inch in width at the

widest part; it becomes tendinous about halfway down the arm; the tendon is inserted on to the palmar fascia just at the wrist.

(37) *Flexor carpi ulnaris.*—This muscle arises from the flexor condyle of the humerus, from the fascia covering the forearm, from the septum between itself and the *flexor sublimis*, and from the first two-thirds of the ulna; its tendon of insertion (on to pisiform) is very short and strap-shaped.

(38) *Flexor sublimis* (*perforatus*) *digitorum* arises from the flexor condyle between the *flexor ulnaris* and *flexor carpi radialis*, from the septum between itself and these muscles and also the *flexor profundus*, and from a part of the radius behind the insertion of the *pronator radii teres*; it separates into four tendons in front of the wrist, each of which is inserted on to the second phalanx of digits II.–V., being perforated by the tendon of the *flexor profundus*. All four tendons are approximately equal in size.

(39) *Flexor profundus* (*perforatus*) *digitorum.*—This muscle appears to represent both the muscle so called and the *flexor pollicis longus* of human anatomy, since it arises both from the radius and ulna; it also arises from the interosseous ligament, and from the septa between itself and adjacent muscles. The muscle itself divides into four some way in front of the wrist; of these divisions those belonging to the tendons of digits II. and III. are the most prominent, each with a glistening tendinous surface beneath. The tendons of the two outer digits arise earlier than the other two, from the common muscular mass; the four tendons are associated in pairs, those of the two outer digits forming one pair, those of the two inner digits another pair. Each tendon is towards its insertion not obscurely grooved upon the under surface; more distally still the two halves of each tendon are easily separable; each is inserted on to the terminal phalanx. A small muscular slip arises from the fourth muscle and passes into a long fine tendon, which joins the tendon of the fourth digit some way beyond the origin of the *lumbricales*.

(40) The *lumbricales* are four in number; each passes from the deep flexor to the extensor tendon on the dorsal side of the first phalanx of its digit.

(41) The *pronator quadratus* is about an inch and a half in length; it passes across from the radius to the ulna at the wrist end of these bones.

§ 5. *The Muscular Anatomy of the Hind Limb.*

(1) *Glutæus maximus.*—This muscle has an extensive tendinous origin from the anterior and posterior border of the ilium, and an entirely fleshy origin from the coccyx; the tendon of insertion rapidly narrows towards the actual insertion.

(1*a*) *Ischio-femoral*[1].—This muscle arises in common with the three next muscles from the tuber ischii; its fleshy insertion is on to the femur just above the origin of

[1] I use the name given by MM. Gratiolet and Alix (*loc. cit.* on p. 180 of this memoir).

the femoral head of the *biceps*, and measures two and a half inches, being continuous with that of the *glutæus maximus*.

(2) *Glutæus medius* is largely covered by the last; it arises from the greater part of the fossa of the ilium, and from the tendon of the *glutæus maximus* (=*fascia lata*); the tendon of insertion on to the head of the femur is dorsad of that of the *glutæus minimus*.

(3) *Glutæus minimus*.—This is of course the smallest of the three *glutæi*; its greatest diameter is three quarters of an inch; it arises from the border of the greater sciatic notch; it is inserted partly on to the ligamentous capsule of the head of the femur, partly on to the femur itself between the insertions of the *glutæus medius* and the next muscle.

(4) I am not quite certain what name to give to a triangular fleshy muscle taking origin from the ilium, and inserted on to the femur in front of and below *glutæus minimus*.

(5) *Pyriformis*.—This muscle comes through the great sciatic notch; it adheres closely to the *glutæus medius*, and is inserted by a tendon on to the femur just behind the insertion of that muscle.

(6) *Obturator internus* has, as usual, accompanying it two *gemelli*, and is inserted in common with the next.

(7) *Obturator externus* arises before the last, and is inserted in common with it on to the fossa behind the great trochanter.

(8) *Quadratus femoris*.—This muscle is entirely fleshy; it arises from the tuber ischii below the muscle next to be described; it measures about half an inch across at the widest part.

(9) *Biceps femoris*.—This muscle has two heads: one of them arises from the hip-bones, the other from the femur; the first origin is from the tuber ischii, in common with the last muscle and the two next to be described; the muscle gets wider and thinner towards its insertion, which is partly on to the fascia covering the knee-joint, and partly (in common with the femoral head) on to the head of the fibula; the femoral head of the *biceps* arises from the femur along a line measuring two and a half inches, almost exactly co-extensive with the insertion of the *quadratus femoris*, from the tendon of insertion of which some of its fibres take origin; its insertion is continuous with that of the long head, and is on to the fibula in common with the very small portion of the humeral head which is so attached; some of its fibres seem to run down and become continuous with *flexor*, which muscle, at any rate partly, arises from the tendon of insertion of the *biceps*.

(10) *Semimembranosus* arises by a flat, mainly tendinous, head in common with and below the origins of the *biceps* and *semitendinosus*; it is inserted by a short and stout tendon on to the inner side of the tibia.

(11) *Semitendinosus*.—This muscle is nearly of the same size as the last; its origin

is in common with the last muscle; it becomes free from the *semimembranosus* three quarters of an inch from the *biceps* and one inch and a half from the commencement of the common origin. The muscle is entirely fleshy until an inch and a half before its insertion by tendon; this tendinous insertion is thin and flat, and becomes considerably wider at the actual connection of its fibres with the bone; the insertion is higher up the leg than that of the *gracilis*, but is situated to the inside of it.

(12) *Sartorius.*—This muscle is exceedingly slender; it arises from the anterior end of the ilium, and passes obliquely over the thigh to be inserted by a broad flat tendon on to the tibia above insertions of the *gracilis* and *semitendinosus*.

(13) *Rectus femoris.*—The origin of this muscle is entirely tendinous below, and half tendinous, half muscular above; it arises from the ilium just in front of the glenoid cavity, and from the fascia covering itself and the *vastus externus*; towards its insertion it becomes glistening on the under surface; the insertion is by a flat short tendon on to the patella in common with a part of the tendon of the conjoined *vasti*.

(14) *Vastus.*—I cannot separate the *vastus externus* from the *internus*, or either of them from the *crurœus*; they all form together one muscle, which arises from a large portion of the surface of the femur below the head, and by a tendon from the outer side of the head continuous with the insertion of the *glutœus minimus*. The conjoined muscle is inserted by a wide tendon partly on to the patella and partly on to the ligaments of the knee-cap.

(15) *Gracilis.*—This muscle arises from the symphysis pubis by an origin measuring nearly an inch and a half in length, and lying superficial to that of all the other muscles arising here; the muscle becomes gradually narrower towards the tendon of insertion, which measures rather more than an inch in length; this tendon is at first narrow, but widens out to a diameter of about three quarters of an inch at its actual insertion, which is outside, and for the most part below, that of the *semitendinosus*.

(16) *Pectineus.*—The origin of this muscle is in front of, and in contact with, that of the *adductor longus*; its insertion on to the femur is posterior to and above the lesser trochanter, and below, as well as partly posterior to, the insertion of the *adductor brevis*.

(17) *Adductor longus.*—The origin of this muscle is, as just stated, from the pubis, immediately behind that of the *pectineus*; its insertion is on to the linea aspera of the femur, ventrad of the insertion of the *adductor magnus*; some of the fibres of the *vastus* arise from its tendon of insertion.

(18) *Adductor brevis.*—The origin of the *adductor brevis* is behind that of the *adductor longus*, and slightly overlapped by it; it lies in front of, and is hardly distinguishable from, that of the *adductor magnus*; it is inserted by a very thin and flat tendon between the insertion of the *pectineus* and the *glutœus maximus*; the length of the insertion is three quarters of an inch; it commences just below the trochanter.

(19) *Adductor magnus* is, of course, much the largest of the three adductors; its

origin extends right round from the anterior part of the symphysis pubis to the ischial tuberosity ; it divides near its insertion into two bands of muscle, of which the anterior is the wider; this (the anterior) is inserted along a line measuring an inch and a quarter, and lying between the insertion of the *adductor longus* and the origin of the femoral head of the *biceps* ; the second part is inserted close to the end of the femur.

(20) *Tibialis anticus.*—This muscle arises from the head of the tibia, and from its shaft down to about the middle ; it also arises from the septum between itself and the *extensor communis* and from the fascia covering the leg. It is inserted by a stout tendon measuring one inch and a half in length to the radial tarsal.

(21) *Extensor proprius hallucis* is a slender delicate muscle arising from the fibula and from the interosseous membrane; the area of origin of the muscle is an inch and a half or so in length ; the tendon in which the muscle ends is slender; its expanded flattened extremity is inserted on to the base of the phalanx of the hallux.

(22) *Extensor longus digitorum pedis.*—This muscle arises from the tibia and for rather more than half of the fibula, from the interosseous membrane, and from the septa between itself and the *tibialis anticus* and *peronæus* ; at the ankle-joint the muscle gives rise to three tendons, which are inserted on to the last phalanx of each of the last three toes.

(23) *Extensor brevis digitorum* is represented by the fleshy mass covering the foot; this is really separable into three muscular slips, which supply digits II.–IV. ; the muscle supplying digit III. is partly inserted on to the tendon of the long extensor ; the two extensors supplying digit IV. do not join until long after they have both become tendinous.

(24) *Peronæus longus.*—The muscle arises from the head of the fibula and from its shaft down to about the middle, from the septum between itself and the flexor on one side and the *extensor longus digitorum* on the other; the tendon crosses the foot between the tarsal bones and the metatarsals, and deep of the intrinsic muscles of the foot : it is inserted on to the metatarsal of the hallux.

(25) *Peronæus brevis.*—This muscle arises from the lower part of the shaft of the fibula and from the septum between itself and the *peronæus longus* and from the fascia covering the leg ; its tendon is inserted on to the outside of the last metacarpal.

These are the only two *peroneal muscles.*

(26) *Gastrocnemius.*—The *gastrocnemius* arises by three distinct heads. The outer head arises in common with the *flexor* from the outer head of the femur ; it becomes separate from the *flexor* two and a quarter inches from their common origin. The inner head arises from the femur just behind the internal condyle, and just below, and in front of, the insertion of the hinder part of the *adductor magnus.* The third head, which corresponds to the *soleus* of other animals, including Man, arises by a stout tendon on the under surface of the head of the fibula. The three heads join rather further than halfway down the leg. The common tendon is inserted on to the os

calcis; the muscular fibres continue to within a quarter of an inch of the actual insertion.

The *plantaris* muscle appears to be totally absent.

(27) *Popliteus.*—The muscle runs obliquely across under the surface of the knee from the external condyle of the femur to the tibia. Its insertion on to the latter measures an inch and a quarter in length.

(28) *Flexor longus (perforatus) digitorum pedis.*—The origin of this muscle extends from just below the head of the tibia and the insertion of the *popliteus* to more than halfway down the bone. It is connected also with the origins of the two remaining long flexors. It divides beyond the ankle-joint into three tendons, which go to digits II., III., and V.

(29) *Flexor brevis* is a broad strap-shaped muscle arising from the calcaneum; beyond the trifurcation of the *flexor longus* tendon it divides into three tendons, one of which joins the superficial (perforated) tendons of digit IV., the other two supply digits II. and III.; these branches become the perforated tendons of those digits, being quite indistinguishable in their characters from the perforated tendons of adjacent digits. The tendon supplying the second digit does not become fused to the superficial long tendon, as it does in the case of that supplying the fourth digit; what happens is that the tendon of the *flexor accessorius* takes the place of the superficial tendon, which the tendon of the real superficial tendon perforates; the former runs to the last phalanx of the digit as if it were a branch of the *flexor profundus*. The same thing occurs with the tendon supplying the third digit, only that here the perforating tendon is really the deep flexor.

(30) *Flexor profundus digitorum.*—The origin of this muscle is from the outer condyle of the femur, from the fibula to beyond its middle point, and from the septa between itself and adjacent muscles; it divides at the middle of the sole of the foot into two tendons, which supply digits III. and IV.

(31) There are four *lumbricales*, as in the hand: that supplying the index arises only from the *flexor perforatus* of that digit; the others are attached partly to the deep and partly to the superficial flexors, binding them together in a complicated fashion, of which there is only a trace in the hand.

(32) *Tibialis posticus.*—This muscle lies deep of the other long flexors, and is smaller than either of them; its tendon is inserted on to the wrist.

(33) *Abductor hallucis* is a fleshy muscle arising from the calcaneum; it ends in a tendinous expansion inserted on to the phalanx of the great toe.

(34) *Abductor minimi digiti* is a fusiform muscle, also arising from the calcaneum; it divides into two muscles just before the head of the metatarsal; these soon become long tendons, which are inserted on to the distal extremity of the metatarsal of the little finger and on the proximal end of the first phalanx; the latter tendon is the larger.

(35) *Flexor brevis hallucis.*—This muscle divides near its insertion into two bellies, one of which is inserted in common with the *abductor*, the other with the *adductor*.

(36) *Adductor hallucis.*—This is a large fleshy muscle arising from the plantar fascia and from the heads of metacarpals II. and III.; it is inserted in common with the last muscle.

(37) *Transversus pedis.*—This muscle is much more limited in extent than in the Chimpanzee; it arises along a narrow line of the plantar fascia, measuring four-fifths of an inch in length on a line with the second metatarsal; it is inserted entirely on to the end of the metatarsal of the great toe, and not at all on to the phalanx.

Prof. Huxley, in his 'Manual of the Anatomy of Vertebrate Animals,' mentioned some of the principal muscles of the Anthropomorpha. My dissection of the Orang does not, however, bear out all his statements, though no doubt there are variations. Thus the *transversus pedis* is *not* absent, though it is smaller than in the Chimpanzee. The *adductor brevis* is not absent, as Bischoff stated [1], but is present, as Miss Westling has pointed out [1]. Dr. Chapman [1] speaks of the *scansorius* as "glutæus minimus." It has been shown in the preceding pages that both these muscles are present in the Orang dissected by myself; it is possible, therefore, that in the Orang dissected by Dr. Chapman the *glutæus minimus* was really absent; the probability of the absence of this muscle in the Orang is increased by the fact that Dr. Chapman identified it in the Chimpanzee. Dr. Chapman found, as I did, no trace of a *plantaris*; but Sandifort (quoted by Dr. Chapman) asserted the presence of this muscle. Dr. Hartmann, however, failed to find it; its absence, therefore, must be regarded as typical. The same observer has described a double origin to the *dorso-epitrochlear*, part of it arising from the clavicle; I found nothing of the kind.

§ 6. *The Palate.*

The ridges upon the hard palate of the Orang have been figured by Gegenbaur [2]; but this figure shows certain differences from what I have observed in the individual described in the present paper. The number of these ridges appears to be about the same; but they are much more regular in the palate described and figured by Gegenbaur. This is particularly so with the last four ridges. In both specimens (pl. v.) the palatal ridges are more numerous than in the Chimpanzee, indicating, so far as this character can be made use of, the greater proximity to Man of the Chimpanzee. On the other hand, the great irregularity of the palatal ridges in the Orang is such as is met with in the Anthropoids generally. A peculiar feature about the palate of the Orang which I examined is its deep black pigmentation, shown in the figure (Plate XXV. fig. 3). After it had been allowed to macerate for some days, in order to prepare the skull for

[1] These references will be found on p. 204 of the present memoir.

[2] "Die Gaumenfalten des Menschen," Morph. Jahrb. Bd. iv. p. 573.

examination, the black colour could be rubbed off, staining the fingers. I am uncertain whether to regard it as pathological; if normal, it would strengthen the reasons for regarding this animal as a distinct species of Orang.

IV. EXPLANATION OF THE PLATES.

PLATE XX.

Head of *Troglodytes calvus*, drawn after death in August 1891: full face, natural size.

PLATE XXI.

Troglodytes calvus, head of the same animal, viewed vertically from above, natural size.

PLATE XXII.

A hand and foot of the same, palmar surface, natural size: Fig. 1. Hand; Fig. 2. Foot.—The letters refer to the lines on the palm of the hand and on the sole of the foot, which are described in the text.

PLATE XXIII.

Brain of the same, natural size.

Fig. 1. Lateral view of right side.
Fig. 2. Lateral view of left side.
Fig. 3. Brain, viewed from above.
Fig. 4. Brain, viewed from the underside.

F.s. Sylvian fissure; *F.s.a.* Anterior branch of Sylvian fissure; *P.o.f.* Parieto-occipital fissure; *F.R.* Fissure of Rolando.

PLATE XXIV.

Head of young Orang "George," natural size.

PLATE XXV.

Fig. 1. Head of the same, viewed vertically from above.
Fig. 2. Palate of *Troglodytes calvus* ("Sally"), to illustrate the ridges.
Fig. 3. Palate of *Simia satyrus* (?) ("George").

PLATE XXVI.

Upper surface of hand and foot of Orang ("George"): Fig. 1. Hand; Fig. 2. Foot.

PLATE XXVII.

Palmar surface of hand and foot of Orang ("George"): Fig. 1. Hand; Fig. 2. Foot. —The letters refer to the lines on the palm and sole, which are described in the text.

PLATE XXVIII.

Fig. 1. Brain of *Troglodytes calvus* ("Sally"), from behind. *c.* Cerebellum.

Fig. 2. Brain of *Troglodytes niger*, from behind. *c.* Cerebellum. *x.* Median part of cerebellum not concealed by lateral lobes.

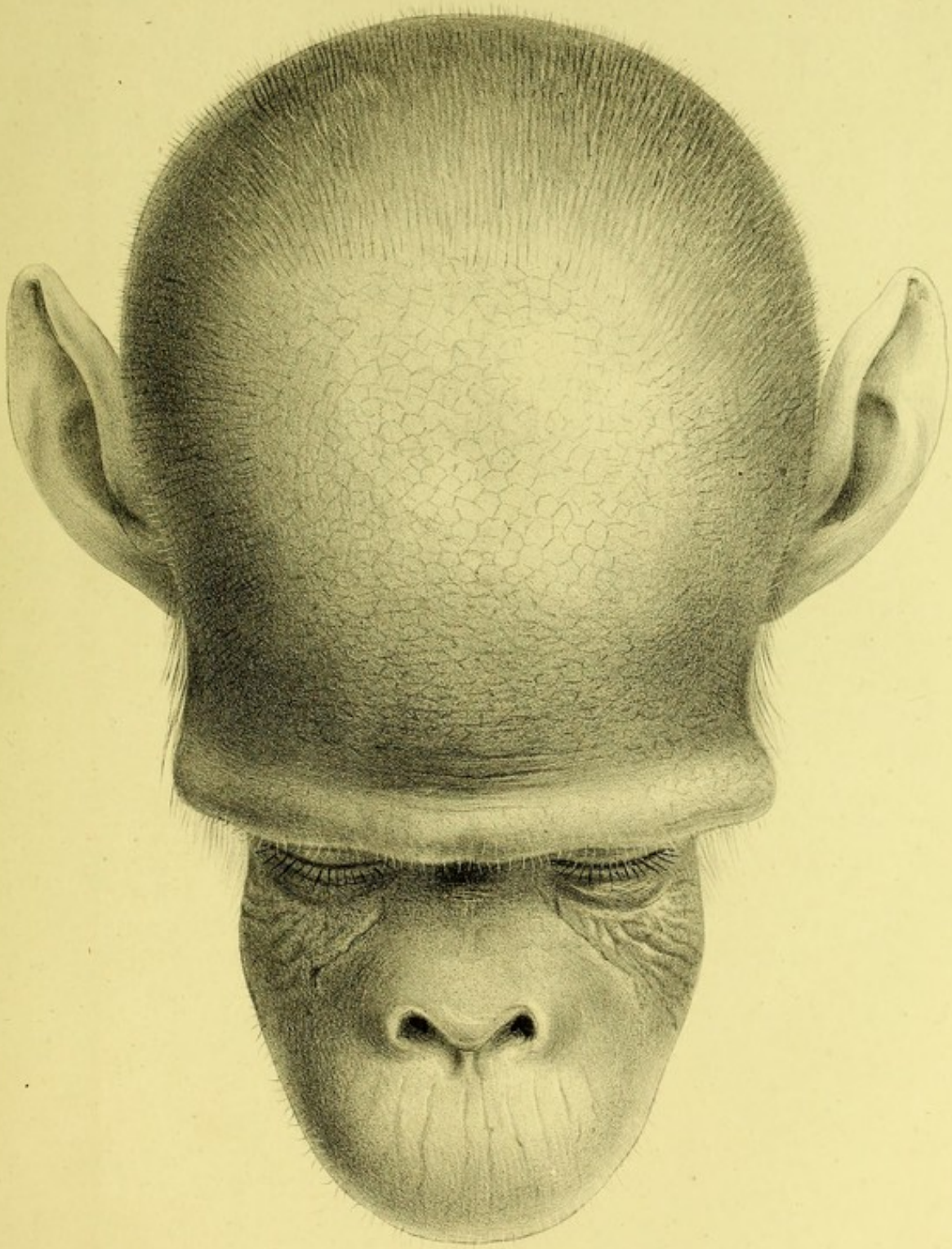
Fig. 3. Ear of *Troglodytes calvus* ("Sally"). *H.* Helix; *T.* Tragus; *F.* Fossa.

Fig. 4. Pectoral muscles of Orang ("George"). *Cl.* Clavicle; 1–5. Ribs; *Pect.* 1. Pectoralis primus; *Pect.* 2. Pectoralis secundus.

J. Smit del et lith.

HEAD OF TROGLODYTES CALVUS
FRONT VIEW

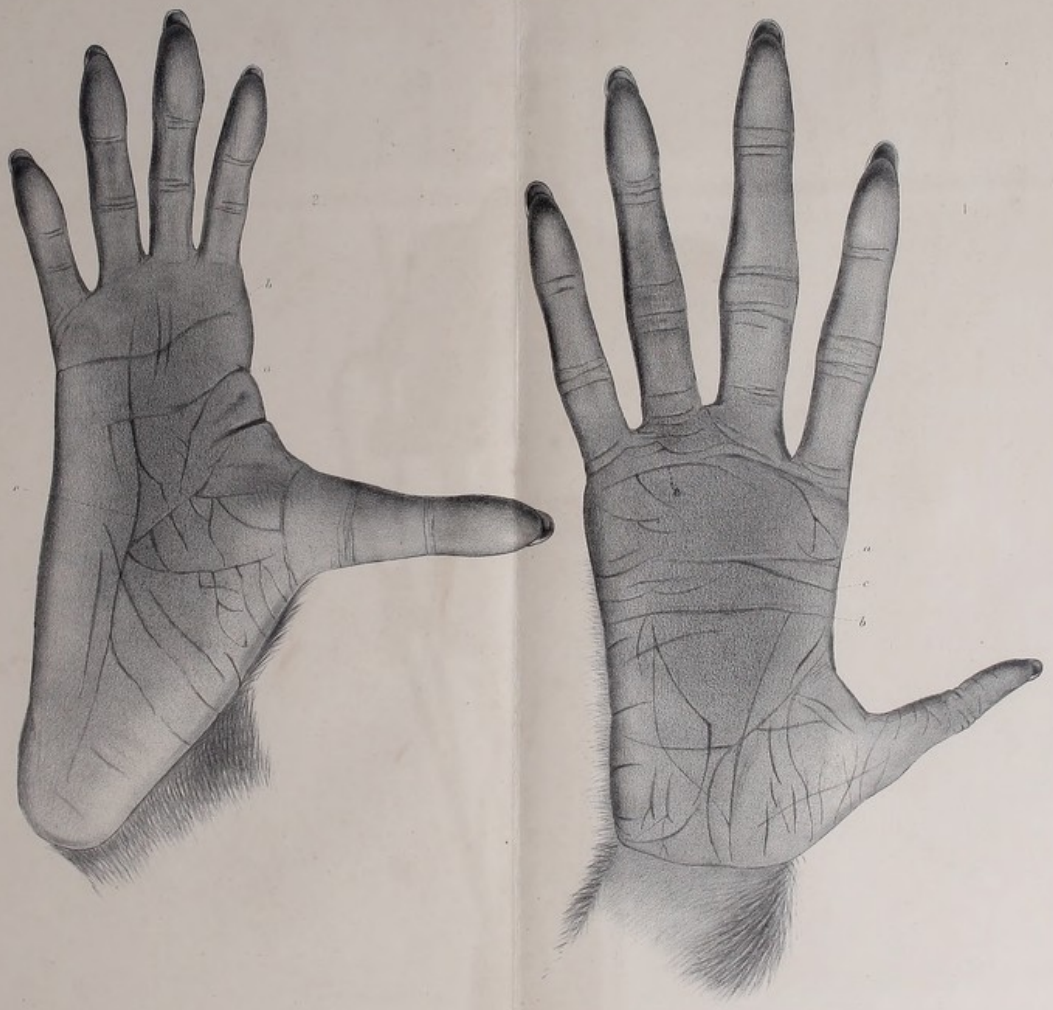
Mintern Bros. imp.



J. Smit del et lith.

Mintern Bros. imp.

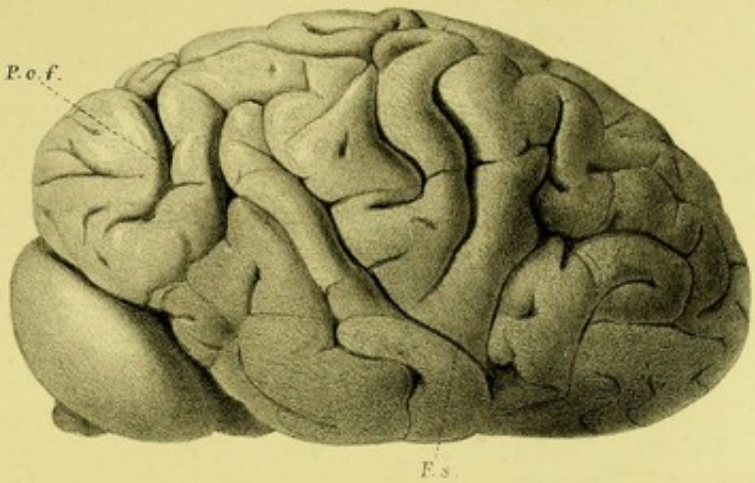
HEAD OF TROGLODYTES CALVUS,
FROM ABOVE.



J. Smit del. et lith.

HAND & FOOT OF TROGLODYTES CALVUS.

Mintern Bros. imp.



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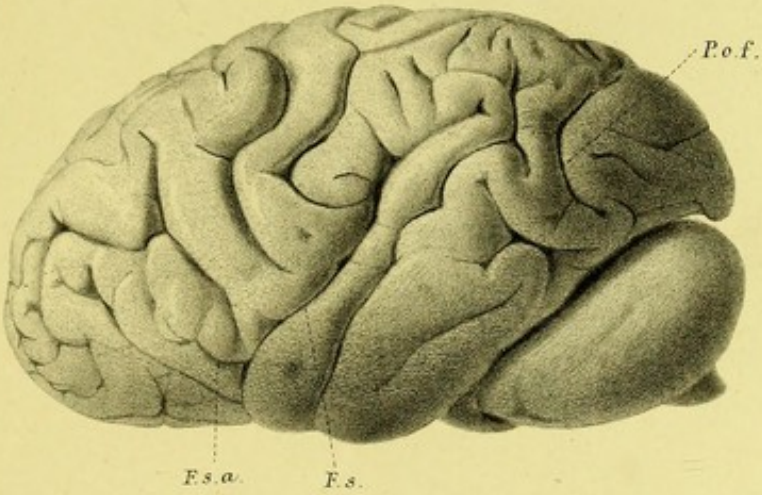

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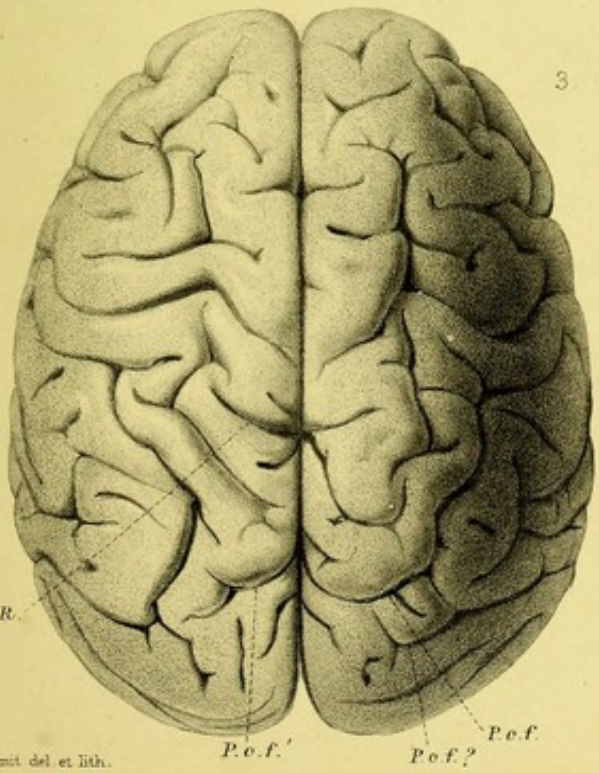
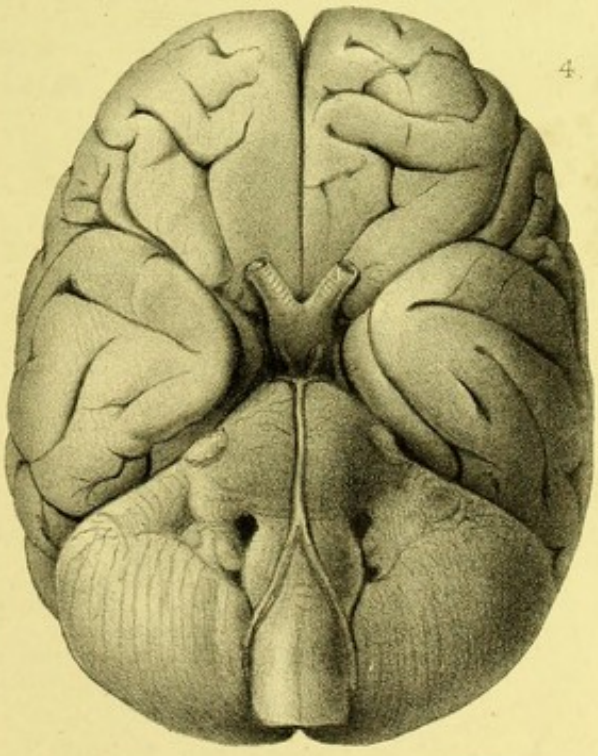


3.



4.

J. Smit del. et lith.

Mintern Bros. imp.

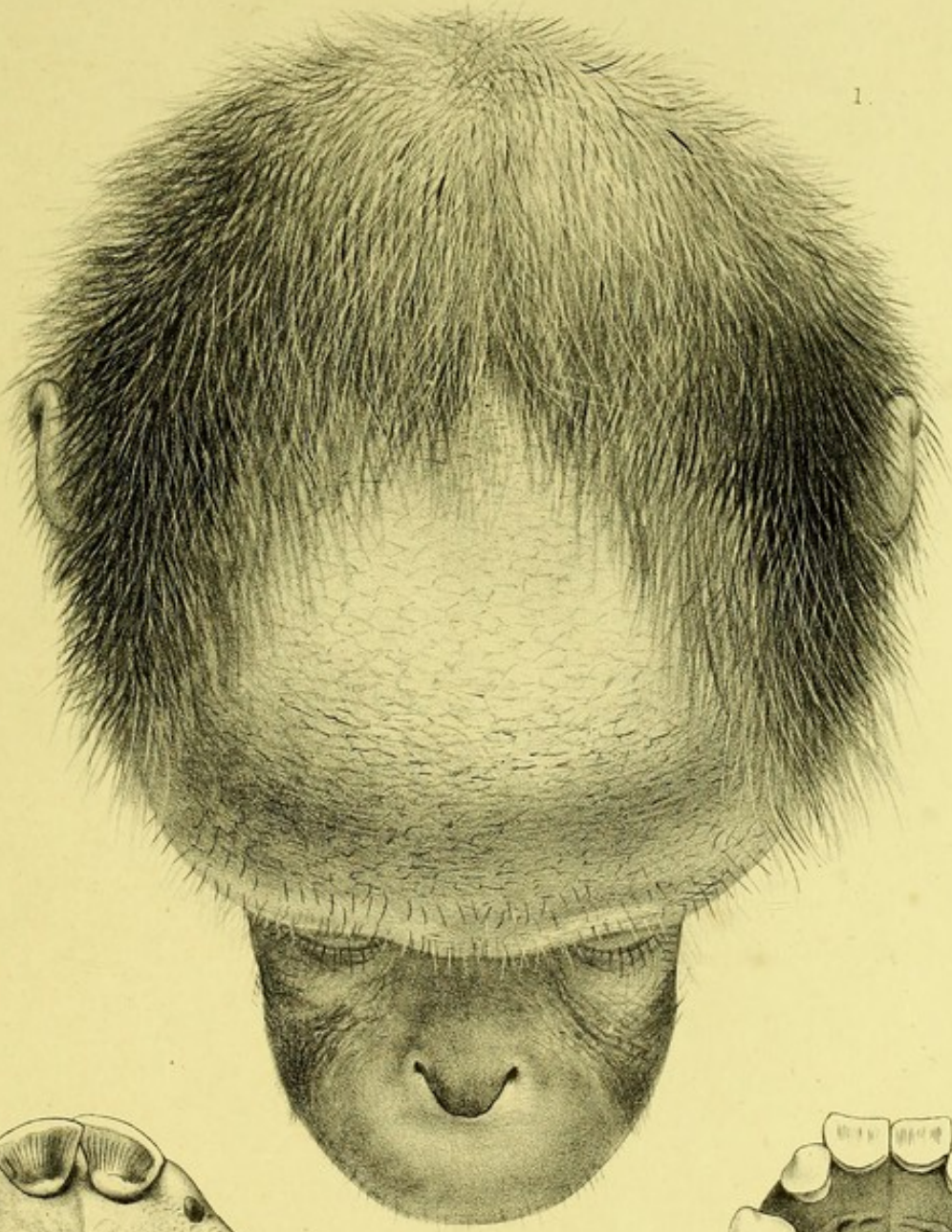
BRAIN OF TROGLODYTES CALVUS.

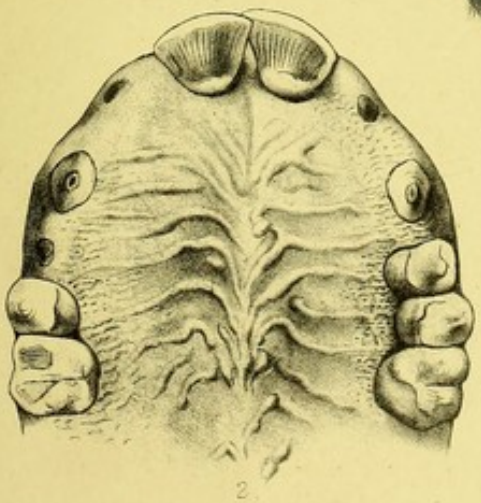
J. Smit del et lith.

HEAD OF ORANG.

Mintern. Bros. imp.

1.





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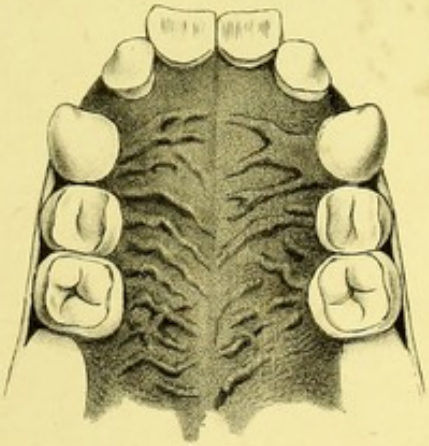


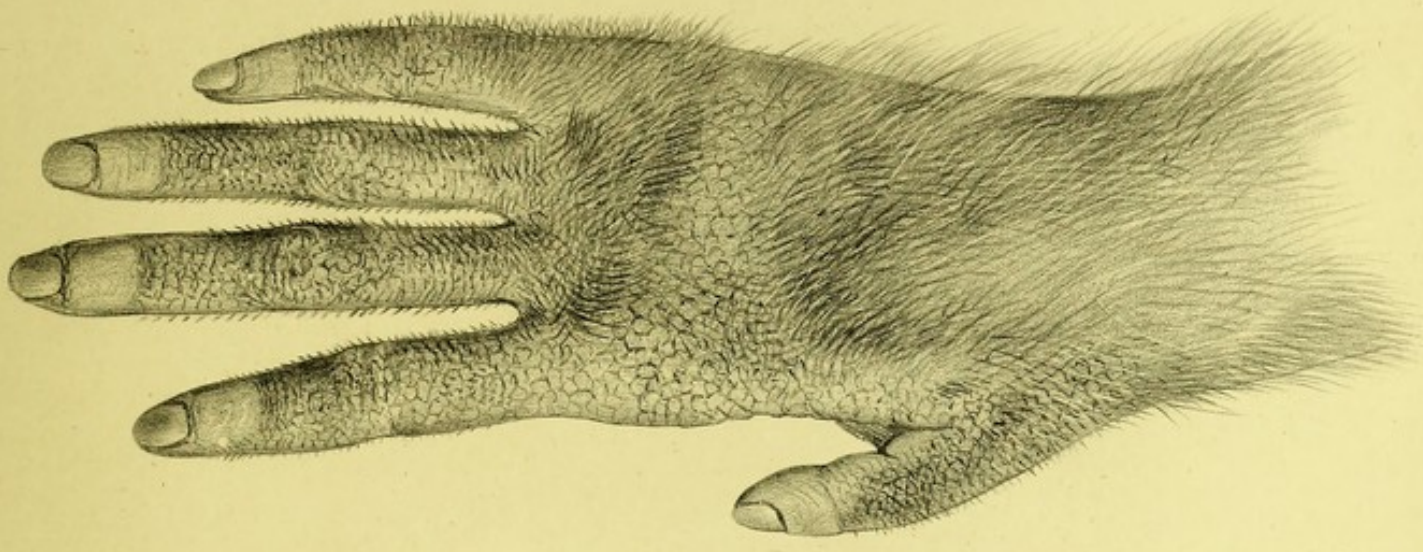
3

J. Smit del. et lith.

Mintern Bros. imp.

HEAD OF ORANG.
PALATE OF CHIMPANZEE & ORANG.

1.



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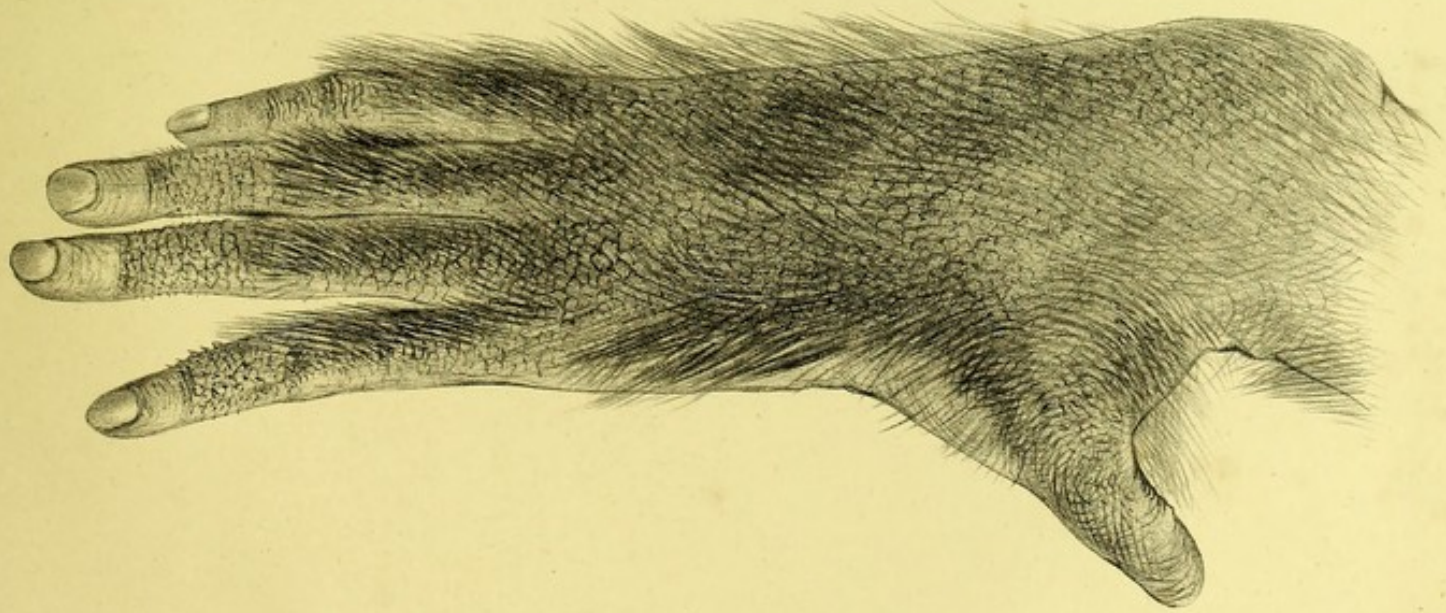
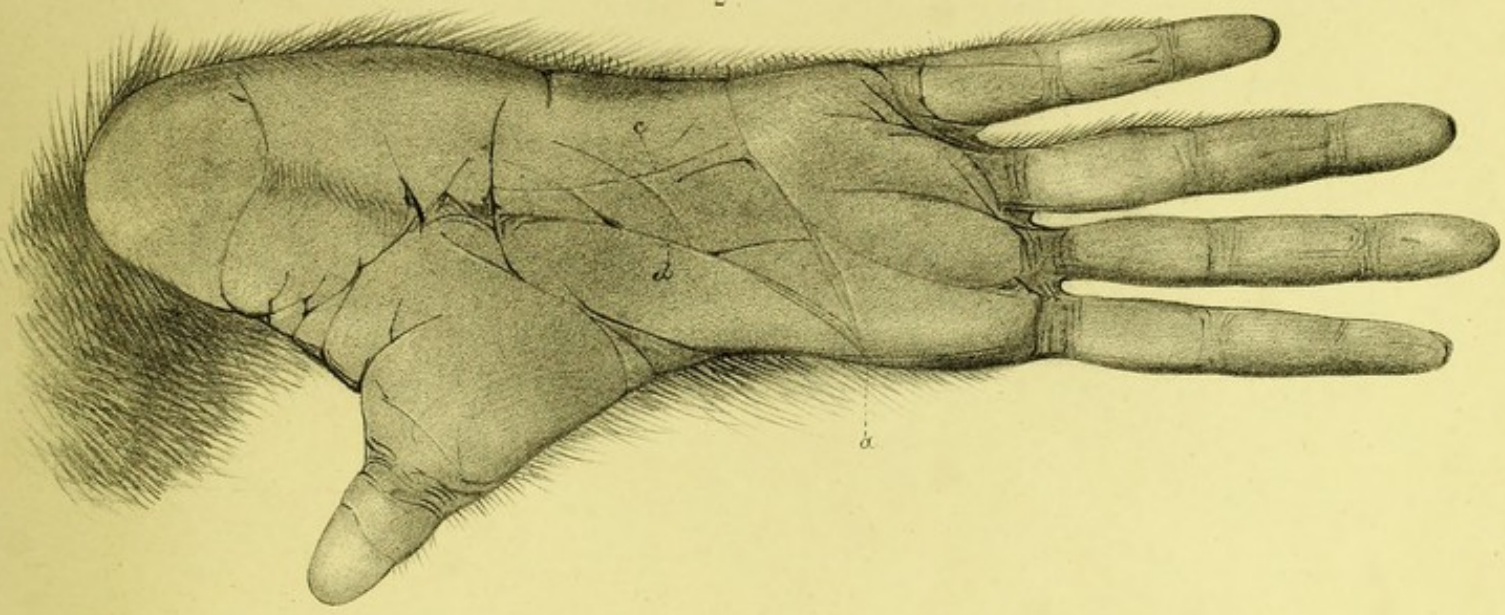


J. Smit del. et lith.

Mintern. Bros. Imp.

HAND & FOOT OF ORANG.
BACK ASPECT.

2



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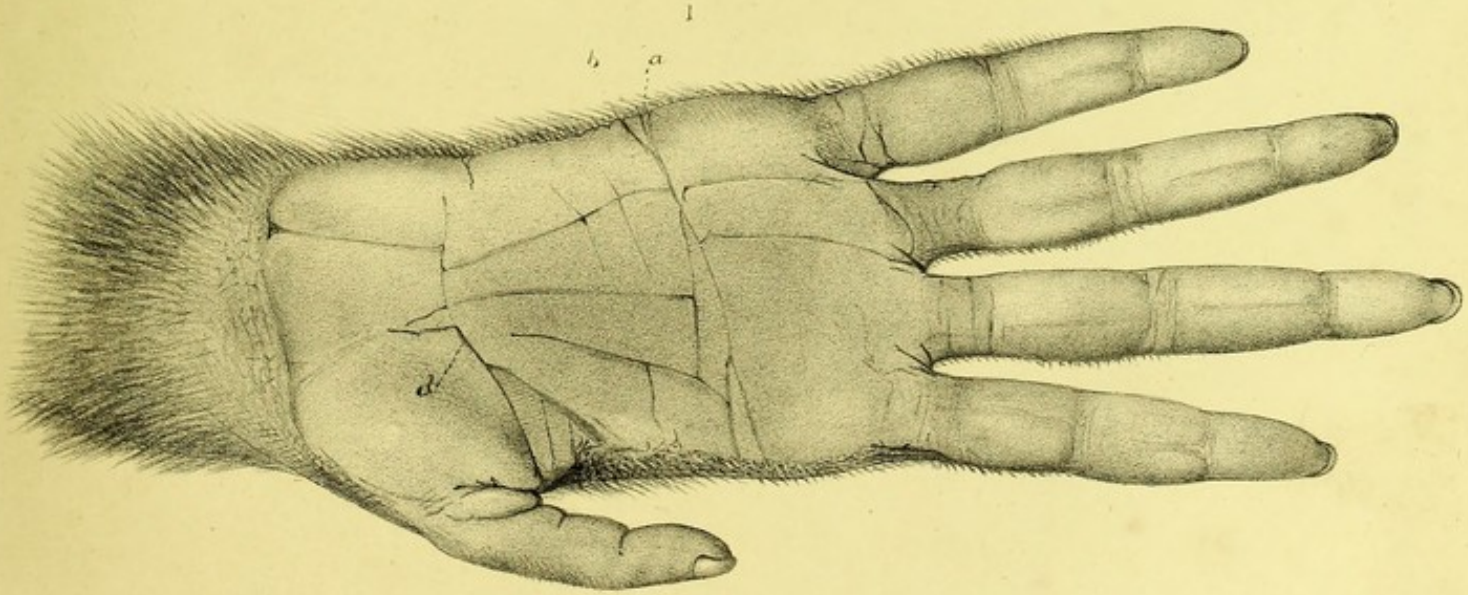
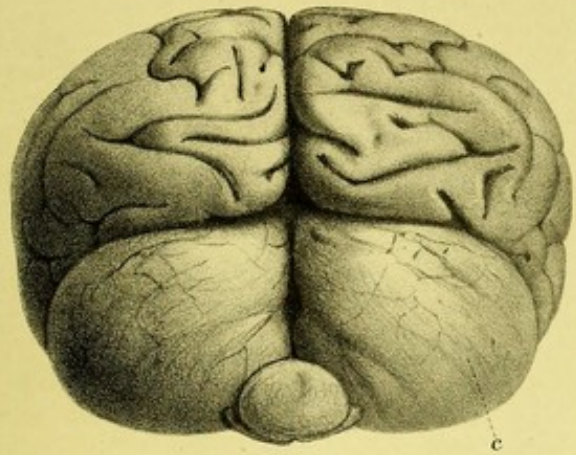


J. Smit del. et lith.

HAND & FOOT OF ORANG.
FRONT ASPECT

Mintern Bros. imp.

1



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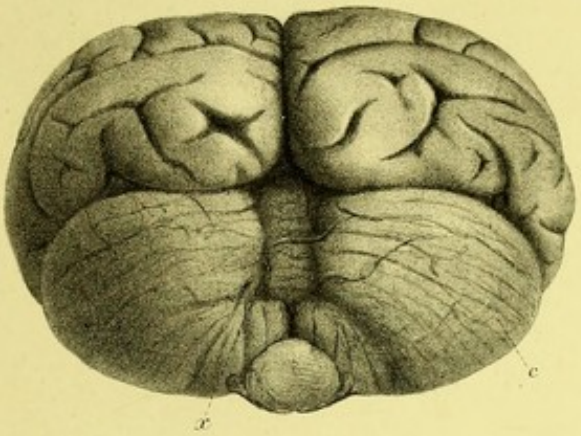

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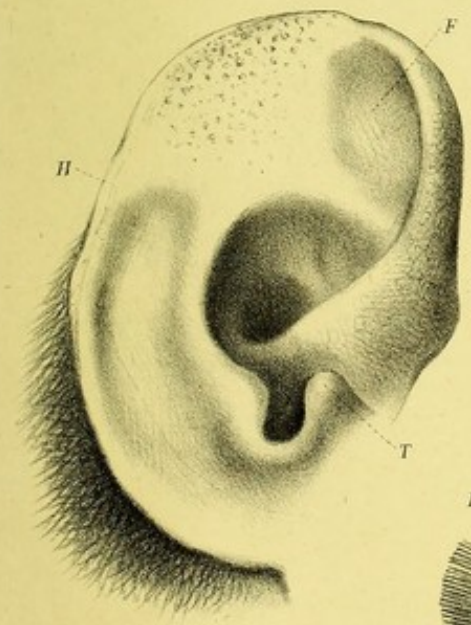

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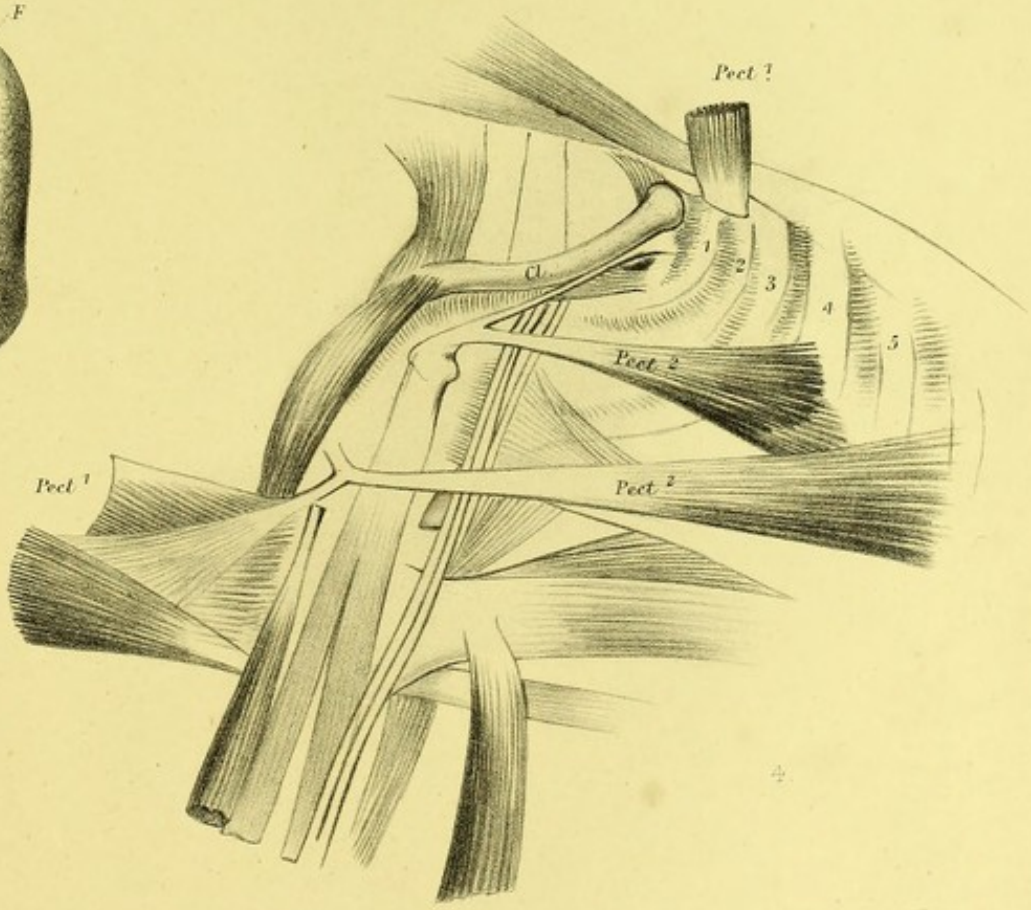

J. Smit del. et lith.

Mintern Bros. imp.

ANATOMY OF CHIMPANZEES & ORANG.

VIII. *On the British Palæogene Bryozoa.* *By* J. W. Gregory, *B.Sc., F.Z.S., British Museum (Nat. Hist.).*

Received May 17th, 1892, read June 14th, 1892.

[Plates XXIX.–XXXII.]

Contents.

I. *Introduction.*

PROBABLY few groups of British Neozoic fossils have been so much neglected as the British Lower Cainozoic Bryozoa. While those of the Crag were carefully monographed by Busk in 1850 and those of the Cretaceous, Jurassic, and Palæozoic rocks have been described in numerous memoirs, but little has been done on the Palæogene fauna. In Morris's 'Catalogue of British Fossils' published in 1843 only one species is mentioned, and it was not till 1850 that some were described and figured by Lonsdale in Dixon's 'Geology of Sussex'; he described four species, of which only one was regarded as new. In 1866 the next contribution was made by Busk [No. 7] in a paper entitled "Description of three Species of Polyzoa from the London Clay of Highgate, in the collection of N. T. Wetherell, Esq., F.G.S." This paper, short though it be, is the best piece of work that has been done on the British Eocene Bryozoa. Since then Mr. G. R. Vine [A, p. 673] has published a list of the recorded species and has subsequently described two collections, both of which are now in the British Museum. With these additions the list numbered twenty-one, but of these only four are here retained, as the remainder are either based on identifications that I have been unable to verify or on indeterminable fragments.

The neglect of this group has no doubt been mainly due to the comparative rarity of specimens: collectors who have devoted a good deal of time to our Lower Tertiaries have only met with a few fragments and have not felt much interest in them. Even in the principal Museums the British Palæogene Bryozoa are very sparsely represented, with the single exception of the British Museum, which contains all the material from many large collections; the collection there now includes all existing types and figured specimens, with the exception of one specimen figured in this communication. The principal part of the Bryozoa collection in the British Museum consists of the

"F. E. Edwards Collection," including Lonsdale's types. Busk's types and many other specimens were obtained with the "Wetherell Collection," while additions from the London Clay of Fareham and Sheppey were made by the acquisition of the collections of Mr. G. R. Vine and Mr. A. Bell.

The present paper therefore consists mainly of a description of the British Museum Collection, and for permission to undertake this I have to thank Dr. H. Woodward, F.R.S. I have of course examined all other available material, including that in the Reed Collection at York, at the Woodwardian Museum, Cambridge, and in the Museum of Practical Geology. I must also thank Mr. E. H. M. Platnauer and Mr. E. T. Newton for valuable assistance when examining the collections under their care; and I am especially indebted to Mr. H. Woods for the kind loan of the Cambridge specimens.

Furthermore I must express my best thanks to my colleague Mr. R. Kirkpatrick, of the Zoological Department, for his ever-ready assistance; owing to his kindness, I have enjoyed every opportunity for the examination of the collections of recent Bryozoa, and especially the type specimens, to which constant reference has been necessary; he has also repeatedly discussed the difficulties that have been met with, and his knowledge of the recent Bryozoa and their literature has always been placed most generously at my service.

II. *Terminology.*

Most of the terms employed have a well-established meaning, and consequently do not require to be here referred to; but the apertures and pores of the Cheilostomata are so important in diagnosis, and have been so differently employed therein, that it seems advisable to define them. At the same time a few alterations in terminology are suggested, as it is hoped thereby to secure greater precision in the description of the fauna.

Orifice. The opening of the mouth of the polypide: it corresponds in size and shape to the operculum. In fossil Membraniporidæ, &c., it cannot be determined.

Aperture. The opening occupied by the membranous area which surrounds the orifice. The aperture may be *primary* and either correspond to the orifice as in *Lepralia* or may be a large space in the middle of which the orifice opened, as in *Membranipora*. Or it may be *secondary*, formed by the peristome rising up into a tube and concealing the original primary aperture; the form of the latter may, however, be always told from the operculum.

Sinus. A notch on the lower side of the aperture, as in *Schizoporella*.

Trypa. A pore which perforates the front wall of the zoœcium; it occurs only in the Microporellidæ: it is generally assumed to correspond to the sinus.

Other names have been previously given to this, but there seem to be valid objections to them all. Jullien has called it the "fenestrula;" but this term is already in use for the interspaces in the zoarium of the Fenestellidæ. D'Orbigny included it among the "special pores," and as such it is often referred to, though this also includes different structures.

The term "zoœcial pore" is hardly definite enough; the terms "true pore," "accessory opening" (*D'Orbigny*), "central pore" (*Busk*), are subject to the same objection.

Peristomial Pore ("Sublabial pore" of Busk). A pore below the aperture which simply leads into the peristomial chamber.

Punctures. A series of pores left between the anastomosing spines of the front wall of *Cribrilina*, &c.

Areolæ. Pits or tubular depressions occurring in linear series around the margins of zoœcia, *e. g.* in *Notamia wetherelli.*

Maculæ. A term suggested for the small irregular cavities in the walls of the zoœcia: they correspond to the main part of the "pores d'origelles" of Jullien [No. 3, p. 607], but since Pergens [No. 7] has thrown such discredit on Jullien's views on these structures it seems hardly advisable to circulate this term. The name is derived from "maculæ," the meshes of a net, as, according to Pergens, they originate simply by non-calcification of part of the wall. When seen on the front wall of a zoœcium they resemble small pits or depressions.

Opesiulæ. A term applied by Jullien to the secondary small apertures, of which a pair usually occur on the front walls of the zoœcia of *Micropora*, &c.

III. *Classification.*

Probably no one who has tried to determine to which of the twenty to thirty families of Cheilostomata some form new to him must be referred will complain of an attempt to arrange these families into groups. Among the Euechinoidea, for example, there are twenty-five families distributed amongst five orders, some of which are divided into sub-orders. But among the Cheilostomata we have as many or more families, without any definite larger groups, except the ill-fated ones proposed by Dr. Jullien [No. 4] and the antiquated ones of Mr. Busk [1]. The inconveniences of this are manifold; the diagnosis of each family has to be of inconvenient length, and the task of discovering the exact systematic position of any species is a matter of much difficulty.

Neither the Rev. T. H. Hincks nor Mr. Waters offer much encouragement to an attempt at any serious alteration, as the former points out emphatically that all classifications at present must be tentative and the latter discourages what he calls "an attack along the whole line." But then all classifications are probably more or less tentative and temporary, and, so far as I am able to judge, some grouping of the families is an essential preliminary to an attempt to revise the families in detail and dissipate the chaos in which at present the fossil Bryozoa are involved.

Though there is of course much uncertainty as to the exact taxonomic value of several characters, there does seem to be a pretty general agreement as to the most important structures. The development of the front wall seems about the leading feature, as so many of the other characters, *e. g.* the aperture, the position and development of avicularia, &c., are correlated with this. The use made by Jullien of the front wall has perhaps prejudiced some workers against this structure; but Jullien has based his classification on modifications that most workers regard as of very slight value, while his method of nomenclature is quite his own. As M. Dollfus has pointed out in an admirable criticism, Dr. Jullien simply does not accept the principle of priority.

[1] Busk of course based his divisions on zoarial characters, and these, though somewhat improved by Dr. Ortmann [No. 1, pp. 3, 4], are now quite inadequate.

Three groups of the Cheilostomata may be conveniently based on the character of the front wall. In one, including the Membraniporidan series, this structure is absent or only imperfectly developed: the name of "Athyriata" (from α and θυρεὸς, an oblong shield) is therefore suggested for it. In a second group the wall is well developed, but there is an additional communication between the exterior and the polypide by means of a pore (trypa) on the front wall or by a sinus on the lower margin of the orifice. The exact homology of these two structures has never, so far as I am aware, been clearly demonstrated, but it has been generally accepted, for example, by Hincks, Waters, and Macgillivray. For this group the name of "Schizothyriata" is proposed. Finally, there is the group in which the calcification of the front wall is complete; it may therefore be called the "Holothyriata."

In addition to these there is a series of forms whose affinities seen very doubtful. With one or two exceptions they are rarely or never found fossil, and my opportunities of studying them have been but limited. They may be divided into two divisions, one of which may be a natural group. This includes the Œtiidæ, Chlidoniidæ, and Eucratiidæ; the terminal or subterminal apertures and simple tubular or pyriform zoœcia of these families suggest that they are among the most primitive of living Cheilostomata. They are here left grouped together, and Busk's name, the Stolonata, is accepted. For the other division Smitt's name of "Cellularina" is adopted; but this is certainly not a natural group. Thus some, such as the Cellulariidæ, Bicellariidæ, and Epistomiidæ (Notamiidæ of Hincks), seem clearly allied by their large membranous areas and aperture to the Membraniporidan group; the Catenariidæ may include representatives of both the Holothyriata (e. g. *Catenicella utriculus*, Macgill.) and the Schizothyriata. Among the latter there may be divisions corresponding to both of the great families; thus *Catenicella amphora*, Busk, is analogous to the Microporellidæ, and *C. pulchella* (Maplestone) to the Schizoporellidæ. It is, however, not improbable that the Catenicellidæ branched off independently from the main Cheilostomatous stem at a very early period.

Without more detailed information upon the anatomical structure of the polypides of the families in this "carpet-bag" group it seems unadvisable to attempt to place them definitely. In the Catenariidæ we have both holostomatous and schizostomatous (e. g. *Claviporella*) genera, but until we know more of the anatomy of the polypides it seems very uncertain as to whether this character possesses the same significance as in those higher Cheilostomata where the skeleton is of a specialized and complex type. Amongst these the hard parts certainly seem to offer reliable classificatory characters.

Through each of the three suborders an evolutionary series can be traced. Thus among the Athyriata the Membranoporidæ seem to be the most primitive, and this family passes up into the Cribrilinidæ and Hiantoporidæ in the manner suggested by Mr. Hincks [No. 2, pp. 199–200, and No. 5 [pt. 3], pp. 471–472 and 479–480] and Mr. Kirkpatrick [No. 2, pp. 616–617].

There seems to be a similar evolutionary series in the Holothyriata, where the main branch develops from the simple *Cyclicoporinæ* through the *Lepralinæ* to the more specialized Smittiidæ; also in the Schizothyriata from the simple *Schizoporella* or *Schismoporella* to such a form as *Adeonella pectinata.*

The division of both the Reteporidæ and Celleporidæ into the schizostomatous and holostomatous groups appears to be generally regarded as inevitable. The dismemberment of the Selenariidæ is more likely to be criticized, but it is not a new idea. It was first done by Prof. Smitt in 1873 [No. 3], and Mr. Hincks [No. 7, p. 125] has given it the sanction of his high authority by the remark in describing *Cupularia umbellata*, Defr., that "this form clearly belongs to the Steganoporellidan series and must be transferred to it."

The survival of the family Selenariidæ seems to me to well illustrate the necessity for a grouping of the families; so long as these have been allowed to remain in independence, such an *olla-podrida* of species of different families agreeing only in zoarial form has been able to hang together. The moment we introduce a more scientific system, define suborders, and try to indicate the affinities of the families, such a group as the Selenariidæ falls to pieces.

These remarks are not intended as a formal defence of the classification. Its publication will be justified only if it is found to aid in bringing the Cheilostomata, and especially the fossil forms, into better order than they are in at present.

Synopsis of the Classification followed.

Order CHEILOSTOMATA.

I. Suborder Stolonata.

Forms with simple tubular zoœcia and terminal or subterminal apertures.

Family 1. Aeteidæ. For diagnosis see Macgillivray, No. 3, p. 195.
2. Eucratiidæ. „ „ „ p. 196.
3. Chlidoniidæ. „ „ „ p. 196.

II. Suborder Cellularina.

A group of forms with simple zoœcia and tufted phytoid zoaria, and probably including representatives of the three following suborders.

Family 4. Cellulariidæ. For diagnosis see Macgillivray, No. 3, p. 199.
5. Bicellariidæ. „ „ „ p. 202.
6. Epistomiidæ (Notamiidæ). „ Hincks, No. 2, p. 98.
7. Catenicellidæ. „ Macgillivray, No. 3, p. 197.
8. Bifaxariidæ. „ „ „ p. 199.

III. Suborder Athyriata.

Cheilostomata with the front wall uncalcified or incompletely calcified.

Family 9. Farciminariidæ. For diagnosis see Macgillivray, No. 3, p. 204.
10. Flustridæ. „ „ „ p. 203.

Family 11. Membraniporidæ. Athyriata with the front wall mainly membranous and occupied by an opesial aperture; this does not correspond to the operculum. The opesium is surrounded by a raised margin. External oœcia.

Subfamily 1. *Membraniporinæ*. Membraniporidæ with open opesia and without, or with but a small, extra-opesial front wall

Subfamily 2. *Electrininæ*. Membraniporidæ with the normal zoœcia tubular and with a terminal opesium.

Subfamily 3. *Lunulitinæ*. Membraniporidæ with patelliform zoaria, and with vibracularia systematically arranged.

Family 12. Cribrilinidæ. Athyriata with a front wall formed by the overarching and branching of one or more spines. External oœcia.

Subfamily 1. *Cribrilininæ*. Cribrilinidæ with the front wall formed by the overarching and fusion of numerous circumareal spines; the interspaces remain as grooves or pores.

Subfamily 2. *Hiantoporinæ*. Cribrilinidæ with the front wall formed of one large spine arising from the margin.

Subfamily 3. *Steginoporinæ*. Cribrilinidæ with the front wall formed by the overarching of spines arising from the peristome.

Family 13. Microporidæ. Athyriata with a calcified front wall. Zoœcia surrounded by raised margins. No internal diaphragms. External oœcia.

Subfamily 1. *Microporinæ*. Zoœcia all normal or onychocellaria (large vicarious avicularia) irregularly distributed.

Subfamily 2. *Selenarinæ*. Microporidæ with patelliform zoaria and vibracularia systematically arranged.

Family 14. Steganoporellidæ. Athyriata without external oœcia and with the zoœcia divided into two chambers by a calcareous diaphragm.

Family 15. Cellariidæ. Athyriata with internal oœcia which open by a pore above the aperture. The zoœcia are surrounded by raised margins; the aperture is situated within the depressed front wall.

IV. Suborder Schizothyriata.

Cheilostomata which are schizostomatous or trypiate (*i. e.* provided with a trypa; see p. 220) or both.

Family 16. Schizoporellidæ. Schizothyriata not provided with a trypa.

Subfamily 1. *Schizoporellinæ*. Schizoporellidæ with simple primary aperture and external oœcia.

Subfamily 2. *Schizoreteporineæ*.[1] Schizoporellidæ with the zoœcia obliquely placed on a unilaminar, reticulate or ramose, erect zoarium.

Subfamily 3. *Schismoporinæ*.[2] Schizoporellidæ with urceolate zoœcia growing in dense masses; aperture terminal or subterminal.

Subfamily 4. *Biporineæ*. Schizoporellidæ with a patelliform unilaminate zoarium, with vibracularia systematically arranged.

[1] *Schizoretepora*, n. gen., for which at present the subfamily diagnosis also serves as the diagnosis, is the type genus; it includes the schizostomatous Reteporas, of which *S.* (*R.*) *tessellata* (Hincks) [No. 2, p. 358, pl. xix. figs. 9–12], is a convenient type.

[2] *Schismopora*, Macgillivray [No. 4, p. 29], is the type genus, and *S. costata* the type species: it does not

Family 17. Adeonellidæ. Schizothyriata with a schizostomatous primary aperture and a variable secondary aperture. Gonœcia and no external marsupia.

Family 18. Microporellidæ. Schizothyriata provided with a trypa.

Subfamily 1. *Microporellinæ*. Holostomatous Microporellidæ with external marsupia.

„ 2. *Schismoporellineæ*. Microporellidæ which are both schizostomatous and trypiate.

„ 3. *Adeoninæ*. Microporellidæ which are holostomatous and have gonœcia, but no external marsupia.

V. Suborder Holothyriata.

Holostomatous Cheilostomata which have the front wall wholly calcified.

Family 19. Lepraliidæ. Holothyriata with a simple primary aperture.

Subfamily 1. *Lepraliinæ*. Lepraliidæ with external oœcia.

Alliance 1. *Cycliopora*. Lepraliinæ with simple zoœcia having orbicular apertures which are often surrounded by raised rims.

Alliance 2. *Lepralia*. Lepraliinæ with the aperture usually horseshoe-shaped and never truly orbicular.

Subfamily 2. *Teichoporinæ*. Lepraliidæ with gonœcia and no external oœcia.

„ 3. *Reteporinæ*. Lepraliidæ with the zoœcia obliquely placed on a unilaminar, reticulate or ramose, erect zoarium.

Family 20. Celleporidæ. Holothyriata with barrel-shaped or urceolate zoœcia, usually growing in heaped masses; aperture terminal or subterminal.

Family 21. Smittiidæ. Holothyriata with a raised secondary orifice; the primary orifice is often denticulate.

Order CYCLOSTOMATA.

Family 1. Idmoneidæ. | Family 2. Heteroporidæ.

IV. *Systematic Synopsis.*

Class ECTOPROCTA.

Subclass GYMNOLÆMATA.

Order *CHEILOSTOMATA.*

Suborder STOLONATA.

Family EUCRATIIDÆ.

Genus Notamia, Fleming, 1828 (non Busk, Hincks, &c.).

Diagnosis. Zoarium erect and phytoid; zoœcia biserial, joined back to back; the apertures of each series respectively open in the same direction. Aperture large, on the front of the cell. Neither vibracula, avicularia, nor oœcia. [Fleming, No. 1, p. 541.]

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appear to have been formally diagnosed; but the list of six species with the figures of their opercula published in the 'Prodromus' leaves no doubt as to its nature. [Macgillivray, No. 1, dec. xvii. pp. 168, figs. 1–6. See also Macgillivray, No. 2, pt. v. pl. ii.]

Species 1. NOTAMIA WETHERELLI (Busk), 1866.

Syn. *Dittosaria wetherelli*, G. Busk, 1866, Geol. Mag. iii. p. 301 ; G. R. Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. pp. 158–159, pl. v. fig. 1.

Records. W. Whitaker, No. 1, p. 594; G. R. Vine, No. 1, p. 673.

Diagnosis. Zoarium in small phytoid tufts; imperfectly known. Branching dichotomous.

Zoœcia elongate, pyriform. Aperture median and symmetrical, oval, the longer axis in the direction of the length of the zoarium. The aperture opens on the upper border and occupies about a quarter of the front of the zoœcium. The surface is ornamented with a double series of areolæ; the innermost series forms an ellipse passing close round the upperside of the aperture and crossing the front wall at about the middle; the outermost series runs close along the hinder margin. The number varies from 8 to 16 in the inner series, and from 20 to 26 in the outer.

Distribution. London Clay, Highgate (Brit. Mus.).

Dimensions. The zoœcia of the specimen figured measure a trifle over ·5 mm. in length.

Figures. Pl. XXIX. figs. 1 *a*, *b*. Part of a zoarium, × 37 diam. Brit. Mus.

Affinities of the Species. This species differs from *Notamia loricata* (Linn.) in that in the recent species the aperture occupies half the front of the zoœcium and is obliquely placed; it also has no regular series of areolæ. The same characters serve to distinguish it from *Notamia americana* (Lamx.)[1]. A nearer ally is the *Notamia prima* (Reuss)[2], which differs from it by the smallness of the mouth and the absence of areolæ.

Remarks. This species was founded by Busk on a specimen in the Wetherell Collection which cannot now be recognized, but other specimens labelled by Busk occur and enjoy almost as much authority as the actual figured specimens. Busk made it the type of a new genus, *Dittosaria*, which has been ignored or overlooked by nearly all subsequent writers. He recognized that it was a close ally of *Notamia* (*Gemellaria*), but distinguished it by its mode of branching; he restricted the old genus to those which at every fork retain a continuation of the main stem in addition to the two branches. But this is not even a specific character, as is shown by the following quotation from Mr. Hincks's [No. 2, p. 20] description of *Notamia* (*G.*) *loricata*:—"The branches are given off from each side of the uppermost pair in a stem close to the top, and at times the stem ascends between them and a triplet is formed in place of the more usual bifurcation." The only other point of difference is that the mouth in this species is not "slightly oblique" as it should be to conform to Mr. Hincks's diagnosis of the genus. But this is hardly of generic value, and Busk certainly regarded the other as the main character. The genus differs from *Pasythea*, Lamx., by the absence of the two notches at the lower corners of the aperture.

[1] *Loricaria americana*, Lamouroux, No. 2, p. 7, pl. lxv. fig. 9.

[2] *Gemellaria prima*, Reuss, No. 7, p. 170, pl. vii. figs. 6, 7.

Note on the Use of the Name *Gemellaria*.—The name *Gemellaria* was first invented for a genus of Bryozoa by J. C. Savigny somewhere about the year 1810; it was not, however, published till 1826 [Audouin, No. 1, p. 242], and then only in the French form of *Gémellaire*; so far as I am aware, it was first used in a Latinized form in 1830 by Blainville [No. 2, p. 425], who did not himself accept it. Before the publication of *Gemellaria* or *Gémellaire* the genus had been described in 1821 by Lamouroux [No. 2, p. 7], who named it *Loricaria*. Audouin, who completed Savigny's work when the latter was disabled by ill-health, of course treated "*Gémellaire*" as a manuscript name and accepted *Loricaria*. Most subsequent authorities, however, have accepted *Gemellaria* and date it from 1805, 1809, or 1811. Johnston [No. 2, p. 293, footnote] seems to have entertained doubts as to the accuracy of this proceeding, but accepted it on the idea that copies of some work of Savigny's had been placed in the principal libraries; he obviously could get no reliable information regarding it.

Mr. Hincks accepts the genus and quotes as its author "Savigny, 1811." The only reference he gives in his Bibliography [No. 2, p. 588] to Savigny is "Iconographie des Zoophytes de l'Egypte," from the 'Description de l'Egypte.' Miss Jelly [No. 1, p. 284] quotes the same work, and so does Macgillivray [No. 3, p. 223], who, however, adds "not seen by me." I regret to have been unable to find any such work; there is none such in the Natural History Museum copy of the 'Description de l'Egypte,' nor is any referred to in "A Bibliographical Account and Collation of 'La Description de l'Egypte'" (London Institution: private circulation, 1838, 8vo, 76 pp.). None of the ordinary bibliographical works of reference give any information regarding it. I therefore cannot help concluding that the authorities who have quoted this mysterious "Iconographie" really refer to Audouin's "Explication sommaire des planches de Zoophytes de l'Egypte . . . . ." That the date of this is 1826 and not 1811 admits of no doubt: the work was only entrusted to Audouin for completion in 1825, and monographs issued in 1821 are quoted. *Loricaria* has therefore the prior claim to adoption, but unfortunately it had been previously used among fishes. Fleming [No. 1, p. 541], therefore, in 1828 renamed it *Notamia*. *N. loricata* he clearly regarded as the type, for the only other species he associated with it (*N. bursaria*) he made the type of a new genus, *Epistomia*. Lamouroux did not include this latter species in his *Loricaria*, but in the Sertularian *Dynamena* [No. 1, p. 79]. Fleming, it must be remembered, only proposed *Notamia* as a change of name owing to the preoccupation of *Loricaria*. The name *Notamia* cannot therefore be separated from its type species and applied to one which both Lamouroux and Fleming assigned to another genus. There is therefore no option but to follow Fleming and substitute *Notamia* for *Gemellaria* and regard the species *bursaria* as the type of *Epistomia*.

The only alternative is to accept Blainville's name *Gemicellaria* [No. 1, p. 425], proposed in 1830, but there does not seem any sufficient reason for a departure from the ordinary rule of nomenclature.

Suborder ATHYRIATA.

Family MEMBRANIPORIDÆ.

Subfamily Membraniporinæ.

Genus Membranipora, Blainville, 1834.

[Blainville, No. 2, p. 447.]

Diagnosis.[1] Membraniporidæ in which the opesial aperture is generally of a simple form and the lamina is absent or but slightly developed.

[1] It will be seen from this diagnosis that in deference to recognized opinion *Amphiblestrum* is accepted; it appears to be an artificial but very convenient group.

Species 1. Membranipora eocena (Busk), 1866.

Syn. *Biflustra eocena*, G. Busk, 1866, Geol. Mag. iii. p. 300, pl. xii. fig. 2; W. Whitaker, 1872, Mem. Geol. Surv. iv. pt. 1, p. 594; G. R. Vine, 1886, Rep. Brit. Assoc. 1885, p. 673.

Biflustra (*Membranipora*) *eocena*, G. R. Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 160, pl. v. fig. 4.

Flustra crassa, Desm., J. Morris, 1843, Cat. Brit. Foss. p. 37; Huxley & Etheridge, 1865, Cat. Foss. M. P. G. p. 332; Huxley & Newton, 1878, Cat. Tert. & Post-Tert. Foss. M. P. G. p. 14.

Diagnosis. Zoarium large, expanded, foliaceous. Bilaminar, the internal face ribbed by long and prominent angular ridges.

Zoœcia quadrangular, arranged in long, oblique lines. The opesia are elliptic and fairly regular, with a strong, slightly raised rim; this is surrounded by a flat area, on the part of which that covers the continuation of the zoœcium are two distinct rounded avicularia. The width of the surrounding area and the prominence of the rim vary somewhat in different parts of the zoarium, but within a restricted area are quite uniform.

Avicularia: usually a pair on the front wall below the aperture.

Figures. Pl. XXIX. fig. 2. Part of zoarium, from a specimen from the London Clay, Highgate; Brit. Mus. No. 49729; × 16 diam. Fig. 3. Another specimen showing back view, × 21.

Distribution. Thanet Sand, Pegwell Bay (M. P. G.). London Clay, Southampton. London Clay, Highgate. Edwards Coll. Brit. Mus. 49729.

? Bracklesham Beds, Bracklesham.

Remarks. This species was founded by Busk, who gave four figures of it; these well show the general form of the zoarium, the thickened longitudinally ribbed back, the form of the opesia, and the large front wall below the aperture. These are the main specific characters. Busk's type was in the Wetherell Collection, but it cannot now be found. Though the figures do not show the pair of avicularia, there can be no doubt of the species, for the Wetherell Collection contains many specimens from Highgate labelled by Busk and Wetherell. The specimen from which the accompanying figures have been drawn is from Southampton. A small specimen in the Edwards Collection from Bracklesham appears to belong to this species, but as it only shows the back view of the inner lamina it is impossible to be certain. The Thanet Sand specimens are so much worn that one cannot be sure of the identification.

The species belongs to the group of *Membranipora* of which *M. savarti* (Aud.) [No. 1, p. 240, pl. x. fig. 10; see also the figures by Smitt, No. 3, p. 20, pl. iv. figs. 92–5] is a convenient type; from this, however, it differs in the absence of the crenulate margin and the two tubercles sometimes present in that species; the area of the front wall is much larger than in Audouin's species, and the back is longitudinally ribbed instead of having the flat surface marked off into regular rectangles as shown by Smitt. The plain prominent rim and large front wall also separate this species from

M. lacroixi (Aud.) [No. 1, p. 240, pl. x. fig. 9]. *M. eocena* is more nearly allied to *Membranipora appendiculata* (Reuss), of which a good figure has been given by Mr. A. W. Waters [No. 12, pl. ii. fig. 3], but from this it differs in that Reuss's species has a single large avicularium on the lower side of the aperture and not quite in the median line; the opesia is also somewhat too large. *M. macrostoma* (Reuss) is another ally; but this has the rim that borders the opesia closer to the margin of the zoœcia, so that the flat depressed marginal space is absent.

Species 2. MEMBRANIPORA BUSKI, n. sp.

Syn. *Membranipora lacroixi*, G. Busk (non Aud.), 1866, Geol. Mag. vol. iii. pl. xii. figs. 1 *a* & *d*; (fide Vine), J. W. Judd, 1883, Geol. Mag. dec. 2, vol. x. p. 527; G. R. Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. vol. xi. pt. 2, pp. 159–160, pl. v. fig. 2 (copied from Busk), fig. 3 (original); H. W. Bristow, 1889, Geol. I. Wight, ed. 2, p. 284.
Membranipora reticulum, Vine (non Linn.), ibid. vol. xii. pt. 1, pp. 59, 60.

Diagnosis. *Zoarium* encrusting or foliaceous. The back is flat and not ribbed.

Zoœcia arranged in long series. Opesia very large: no lamina or front wall, the raised rims of adjoining zoœcia being in contact. The general form is oblong, the length being not much greater than the width, except at the bifurcations of a row, where the two zoœcia are long and narrow. The raised rims are thick and plain.

Avicularia irregularly scattered, small, generally in the lower right-hand corner of the zoœcia.

Oœcia not always present, narrow, globose.

Distribution. Headon Beds, Colwell Bay, I. of Wight; London Clay, Highgate.

Type. Brit. Mus. No. B 4625.

Figures. Pl. XXIX. fig. 11. Part of a zoarium with an oœcium; × 55 diam. Brit. Mus. No. B 4625. Fig. 12. Part of a specimen (Mus. Pract. Geol.) with oœcia, × 55 diam.

Affinities. This species in its general characters very closely approaches *M. lacroixi*, Aud. [No. 1, p. 240, pl. x. fig. 9], and as such the London Clay specimen has been figured by Busk. With this identification I agreed until seeing the specimens in the Museum of Practical Geology: these were collected by Mr. Chapman and are clearly the same as those which he has kindly presented to the British Museum. They, however, show the oœcia, and thus clearly separate the species from *M. lacroixi*, from which, according to Mr. Hincks's diagnosis [No. 2, p. 130], these structures are absent.

Species 3. MEMBRANIPORA CRASSOMURALIS, n. sp.

Diagnosis. *Zoarium* irregular, encrusting.

Zoœcia oval, irregularly distributed. Each zoœcium surrounded by a thick prominent rim. The interspaces between these rims are very narrow. When encrusting ribbed bivalves the zoœcia are more regularly arranged, running along the ribs or pressed into the furrows. Opesia usually occupying the whole of the area, but in some a thin narrow lamina occurs.

Oœcia triangular: surrounded by a rim like that around the zoœcia.

Avicularia sparsely and irregularly scattered over the zoarium: occupying the small triangular areas between the zoœcial margins.

The raised rim is usually plain, but may bear a single minute tubercle, the base of a small spine.

Distribution. Barton Beds, Barton. Bracklesham Beds, Bracklesham.

Type. Brit. Mus. No. 49741.

Figures. Pl. XXIX. fig. 10 *a*. From Barton. Several zoœcia, showing the oœcia, avicularia, bases of spines, and lamina. Fig. 10 *b*. Another specimen, growing on a strongly ribbed *Pecten*.

Remarks. This species appears to be most closely related to that figured by Reuss [No. 14, p. 179, pl. ix. figs. 1, 2] as *Membranipora elliptica* (Hag.) from the Leithakalk (Helvetian) of Eisenstadt. But the London Clay species appears to be certainly distinct from that represented in von Hagenow's original figure [No. 1, p. 268, pl. iv. fig. 6], in which the rims surround the area instead of the zoœcia and thus are separated by a wide space, both in the centre and youngest part of the zoarium; there are neither laminæ nor oœcia. Hagenow remarks on the "vertieften Zwischenräumen" with ring-shaped pores. But as to the identity of *M. crassomuralis* with the Eisenstadt species I do not care to express a definite opinion without seeing Reuss's type. Pergens [No. 1, pp. 15, 16] seems to have entertained the same doubts as to the correctness of Reuss's identification, for though he quotes *M. elliptica* from the Austro-Hungarian Miocenes, he does not include Reuss's reference in his synonymy.

This species belongs to the *M. lacroixi* group, but it differs in the following characters: (1) it has triangular oœcia, whereas these structures are said by Hincks [No. 2, p. 130] to be absent in the recent species; (2) the rim is not crenulate; (3) the avicularia are fewer, and there is never more than one spine on the rim.

From *Membranipora eocena* (Busk) it differs in the absence of any space below the area and outside the rim, and also of the two small lateral avicularia; the zoœcia are also arranged more irregularly.

Membranipora temporaria, Waters [No. 6, p. 288, pl. vii. fig. 16], from the Murray River cliffs, is an allied species, but differs in the presence of two small lateral avicularia and a larger "infra-area."

Another species with which this new one must be compared is *Membranipora loxopora* (Reuss) [No. 2, p. 166, pl. viii. fig. 11: for later figures see No. 14, pp. 39–40, pl. ix. figs. 4, 5; the author's original figure in No. 1, p. 97, pl. xi. fig. 24, has been subsequently repudiated by him], but this has larger front walls, on which the avicularia are placed, instead of in the angles.

Reuss [No. 13, p. 101, pl. xxiv. figs. 4 & 5 *c*] has himself also figured the typical Cretaceous *M. elliptica* from the Unter Pläner of Saxony, and one of his figures shows

pores at the ends of some of the zoœcia in the positions occupied by the oœcia in *M. crassomuralis*; Reuss, however, regards them, no doubt correctly, as avicularia. In the same work Reuss [ib. pl. xxiv. fig. 3, pp. 100–101] has figured a variety of *M. subtilimargo* which resembles *M. crassomuralis* more than does the typical form; but the absence of oœcia and laminæ clearly distinguishes it.

Species 4. MEMBRANIPORA TENUIMURALIS, n. sp.

Syn. *Membranipora lacroixi*, Busk, 1866, Geol. Mag. iii. pl. xii. figs. 1 *b* & 1 *c*; W. Whitaker, 1872, Mem. Geol. Surv. iv. pt. 1, p. 594.

Diagnosis. Zoarium encrusting (or ? sometimes free), spreading as a thin gauze-like layer.

Zoœcia irregularly distributed. Form irregular, oval, quadrangular, hexagonal or polygonal: closely crowded. The opesia are very large, almost as large as the zoœcia: coincident with the area. There are small triangular depressions between the margins of the opesia of the different zoœcia. Walls thin, sometimes crenulate. There is often a pair of tubercles on the margins of the zoœcia, and these may fuse to a single large tubercle on the infra-area.

Avicularia: usually a pair of small ones in the infra-area covering the continuation of the zoœcia.

Oœcia, none.

Distribution. London Clay, Highgate. Clarendon Hill, Fareham, Portsmouth.

Type. Wetherell Coll. Brit. Mus. No. 49736.

Figures. Pl. XXIX. fig. 5. London Clay, Highgate. Brit. Mus. No. 49736 (one of Busk's type specimens).—Figs. 6 & 7. Other specimens from same locality.

Affinities. This is also a species of the puzzling *lacroixi* group. Its nearest ally is probably *M. tuberculata* (Bosc), which it resembles in its tuberculation [No. 1, t. iii. p. 143. Bosc gives as a reference the *Flustra dentata* of O. F. Müller, Zool. Dan. iii. pp. 24, 25, pl. xcv. figs. 1, 2, but this is quite different]. But it differs from this in the greater thickness of the walls in *M. tuberculata* and in the presence in that species of a small front wall; in the new species, moreover, the zoœcia are more regularly hexagonal in form and are more elongated; there is also a small depressed area in the corners between the rims margining the opesia. From the recent *M. membranacea* (Linn.) it differs in the regularly alternate arrangement and rectangular shape of the zoœcia in that species; *M. tenuimuralis* also lacks the hollow marginal spines so characteristic of the recent species.

From *M. lacroixi* (Aud.) it differs in the presence of avicularia, and of the pair of tubercles or knobs; the form of the zoœcia is angular instead of oval, and the margins of the opesia are rarely crenulate. The comparison with *M. lacroixi* is especially necessary as Dr. Pergens makes *M. laxa*, Reuss [No. 11, p. 252, pl. xxxvi. fig. 14], a synonym of this species; and *M. laxa* appears to be the closest ally of the London

Clay Bryozoan. *M. laxa* is a somewhat doubtful species; it has not been referred to by Mr. Waters [No. 12] in his recent revision. Reuss's figure may only represent a specimen in which the whole of the front wall is broken away and only the lateral walls are left; but if that is the case it is certainly not *M. lacroixi*, and in view of Pergens's conclusion it would not be safe to act on this view. Reuss's figure shows more regularly hexagonal zoœcia; the margins appear to be separated entirely by a narrow groove, and there are no tubercles. Hence it seems safest to make a new species for this London Clay form rather than to assert the existence of so doubtful a species as the North Italian Bartonian *M. laxa* in the Lower Eocene of the London Basin.

Species 5. MEMBRANIPORA VIRGULIFORMIS, n. sp.

Diagnosis. Zoarium of elongate, cylindrical, solid shoots, somewhat resembling those of *Cellaria*.

Zoœcia in regular longitudinal series, elongate, rectangular. Opesia large, oval, surrounded by a thick raised and plain non-crenulate rim. A large depressed front wall below the area, often with a pair of triangular depressions.

Oœcia, none.

Avicularia single, prominent, lateral, on the upper left-hand margin of the zoœcia.

Distribution. London Clay, Highgate.

Type. Brit. Mus. No. 49658. Edwards Coll.

Figure. Pl. XXIX. fig. 8. Part of zoarium, × 25 diam.

Affinities. In its mode of growth this species resembles *M. sigillata* (Pourt.) [No. 1, p. 110; see also Smitt, No. 3, p. 8, pl. ii. figs. 64–68], but the zoœcia in that species are more irregular in form and distribution, while their general form is lozenge-shaped instead of rectangular. It also recalls to mind *M. monostachys*, Busk [No. 2, p. 31, pl. ii. fig. 2], but from this it differs by the somewhat pyriform shape of the zoœcia and the more curved instead of flattened front wall of that species.

Among the Lower Tertiary species, this most closely resembles *Membranipora macrostoma* (Reuss) [*Cellaria macrostoma*, Reuss, No. 1, p. 64, pl. viii. figs. 5, 6; *Biflustra macrostoma*, Reuss, No. 11, pp. 274, 275, pl. xxxiii. figs. 12, 13], but in that the subareal portion of the front wall is regularly rounded and has not the pair of triangular depressions seen in the new species.

Species 6. MEMBRANIPORA DISJUNCTA, n. sp.

Diagnosis. Zoarium forming a large encrusting surface; the zoœcia are arranged in disconnected rows, which are radially disposed; there are several centres of radiation in each zoarium.

Zoœcia elliptical; opesia large, surrounded by a prominent rim; the mouth opens at one end of the opesium; the rest is occupied by a thin calcareous lamina.

Avicularia and *oœcia* unknown.

Distribution. London Clay, Highgate.

Type. Brit. Mus. No. 69205. Wetherell Coll. Encrusting *Hippochrenes ampla.*

Figures. Pl. XXIX. figs. 9 *a*, *b*. Fig. 9 *a*, part of zoarium, magnified 4 diam., showing radial growths; fig. 9 *b*, × 12 diam.

Affinities. The mode of growth in loose disconnected rows resembles that often assumed by *M. catenularia* (Jameson) [No. 1, p. 561, name only] (*Pyripora* of Macgillivray) [No. 1, pt. xi. p. 24], but the much greater size of the opesia in this species is quite distinctive.

Genus Lunulites, Lamarck, 1816.

[Lamarck, No. 1, ii. p. 194.]

Diagnosis. A genus of Membraniporidæ with a unilaminate, conical, or cup-shaped zoarium. The zoœcia are arranged in radial rows; radial rows of vibracularia either separate the zoœcia or occur alternately.

Type species. *L. radiata*, Lamk. [No. 1, p. 195].

Species 1. Lunulites transiens [1], n. sp.

Syn. *Lunulites urceolata*, Lonsdale, 1850, in Dixon's Geol. Suss. pp. 159, 160, pl. i. fig. 8; 1878, do. ed. 2, pp. 201, 202, pl. i. fig. 8.

Lunulites ? radiata, Lonsdale, 1850, in Dixon's Geol. Suss. ed. 1, pl. i. fig. 8; 1878, do. ed. 2.

Diagnosis. Zoarium of medium size, depressed, circular, thin, cup-shaped; convex margin curved.

Zoœcia. Opesia with the aperture large, orbicular, elongate; a small lamina at the lower end. The lateral margins are steep; the inner margin slopes more gently. A pair of small tubercles occur on some of the margins between the two zoœcia.

Vibracularia large, aperture clithridiate; the radial series are connected by a groove; they increase in size towards the periphery, and gradually pass into normal zoœcia (whence the specific name). On the concave side the ridges are irregularly distributed and are separated by deep grooves; there are numerous large pores; on the narrower parts of the ridges there may be only a single line of pores.

Dimensions. Diameter ·5 mm.; height 1·25 mm. Taken from a small complete specimen. In some fragments the number of zoœcia is from 18–20; number of zoœcia in a radial series 10.

Distribution. Upper Eocene, Barton Beds, Barton. Middle Eocene, Bracklesham Beds, Bracklesham, Bramshaw, Brook, Whitecliff Bay.

Type. Brit. Mus. No. 49724. From Barton. Edwards Coll.

Figures. Pl. XXIX. fig. 13. Part of zoarium showing back, × 24 diam. Fig. 14. Several normal zoœcia, × 24 diam.—Pl. XXX. fig. 1. Another specimen, showing the

[1] Referring to the gradual passage from vibracularia to zoœcia.

ancestrula. Fig. 2. Part of zoarium from Bracklesham (B 4339), showing the front wall partly broken away. Fig. 3. Part of a worn specimen from Bracklesham, resembling *L. urceolata*.

Affinities. This species belongs to the *L. radiata*, Lamk., group, which the Marquis de Gregorio [No. 1, p. 248] has recently proposed to make into a new subgenus, *Demiclausa*; this, however, is against all rules, as *L. radiata* is clearly the type species of the genus. If, therefore, the separation is to be made, it is the other group that must be renamed and removed. *Demiclausa* is an absolute synonym of *Lunulites*.

This species was figured by Lonsdale as *Lunulites urceolata*, Lamk., but from the latter it widely differs in the fact that the vibracularia are connected by depressions into long radial lines; in *L. urceolata* they are disconnected.

From *Lunulites radiata*, Lamk., this differs by the gradual transition from the vibracularia to the normal zoœcia, and by the presence of a lamina and tubercles on the rim of the opesia. The species agrees most closely with *L. subplana*, Reuss [No. 3, p. 264, pl. xi. fig. 108], but the apertures in that species are not clithridiate, nor does there seem to be a gradual transition from vibracularia to zoœcia. It clearly differs from *Lunulites quadrata*, Reuss [*Cellepore quadrata*, Reuss, No. 1, p. 95, pl. xi. fig. 17; in the explanation of the better figure given in Reuss, No. 11, pl. xxviii. fig. 18, the species is called *Lepralia tetragona*], by the form of the aperture and the absence of the raised rim immediately around it. The original figure gives a suggestion of a similar passage from vibracularia to normal zoœcia.

In the main character of this species it resembles *Lunulites goldfussi*, Hag. [No. 2, p. 102, pl. xii. fig. 5], but that differs by the irregular distribution of the vibracularia.

Genus Biselenaria, nov. nom.

Syn. *Diplotaxis*, Reuss, 1867, *non* Kirby, 1837, Ueber Bry. deut. Unteroligocäns, Sitz. k. Ak. Wiss. Wien, Bd. lv. Abth. i. p. 231.

Diagnosis. A Membraniporid with a bilaminate zoarium, which is small and circular and discoid in form; typically the form is bun-shaped. The zoœcia of the upper layer have regular Membraniporidan apertures, with numerous normal vibracularia irregularly scattered, or one to each zoœcium. The zoœcia of the lower surface are much modified; the aperture is contracted by the great thickening of the peristome; in the zoœcia near the centre the aperture is sometimes completely closed or persists as a long narrow slit; the vibracularia are similarly modified; some of the peripheral zoœcia more nearly resemble those of the upper layer.

Type species. *Biselenaria placentula* (Reuss), op. cit.

Remarks on the Genus and its Affinities.—Reuss practically founded his genus *Diplotaxis* simply on the one character of its bilaminate zoarium; the species included in it are forms of much interest, and there seems to be no reason to question the validity

of the genus, though it has been overlooked or merely mentioned by subsequent authors. Unfortunately, however, the name was preoccupied among Coleoptera by Kirby in 1837, and as it is still in use for that group the Bryozoan genus must be renamed. The nature of the zoœcia of the lower surface is somewhat puzzling; four explanations of their nature may be offered:—First: the zoarium may be fixed, probably in mud; in that case the peripheral zoœcia would be normal; but as they became more central by the growth of the colony they would gradually become aborted and their apertures closed; the distribution of the under zoœcia supports this view. Second: the zoarium may be free and the modified zoœcia of the lower surface may all be swimming vibracula instead of normal zoœcia; in that case the thickening of the peristome would be due to the necessity for greater muscular attachments. Third: the zoarium may be fixed by radical fibres or tubes given off from the modified zoœcia. And fourth: the zoarium may be free and the peculiar lower zoœcia may be gonœcia, as the thickened and contracted apertures resemble those of elements in other genera, such as *Teichopora*, which appear to be clearly gonœcia. So long as the genus remains known only by extinct species it may be impossible to decide between these views, but I am inclined to accept the first, though there are points that make for the second.

The genus differs from the rest of the group by its bilaminate nature and the structure of the inferior zoœcia. It is possible that it ought to be subdivided, one branch including the type species and all the rest of those in which there is a vibracularium to every zoœcium.

Species 1. Biselenaria offa [1], n. sp.

Diagnosis. Zoarium: a small circular disk, thickest in the middle and tapering towards the periphery.

Zoœcia irregular in form and distribution; a group of small ones occurs in the centre; the largest are in a circle at a little distance from the margin. The opesia are large and elliptical, surrounded by a thickened margin; some of the opesia are slightly trigonal. The vibracularia are very irregular in distribution; they resemble the normal zoœcia in general form, but the rim is thicker in proportion to their size.

The zoœcia of the lower side vary from being identical with those of the upper side to being quite closed; all intermediate forms occur, but a spathulate form with the aperture remaining as a slit or small pore is the commonest. Some of the vibracularia have the very typical auriculate appearance.

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. 49759. Edwards Coll.

Figures. Pl. XXX. fig. 4. Zoarium of type specimen: upper surface. Fig. 4*a*. Part of another specimen: under surface. Fig. 5. Upper surface of another zoarium.

[1] *Offa*, a bun.

Affinities. This species differs from the type species, *Biselenaria placentula* (Reuss), in several important respects; the most striking is that in the type there is a vibracularium to every zoœcium, situated just at the apex. This is practically the main character used in the separation of *Cupularia* and *Selenaria*; as in this case it is therefore generic, it might be thought that the two species ought to be separated into two genera, one including *B. placentula*, corresponding to *Cupularia*, and one including *B. offa*, corresponding to *Selenaria*. The two species, however, agree so closely that it would appear to be unnecessary to make a new genus upon this character alone. In merely specific points, the concavo-convex form of *B. placentula*, its more irregular opesia, and the larger size and smaller number of its inferior zoœcia all distinguish it from *B. offa*.

Family CRIBRILINIDÆ.

Genus CRIBRILINA, Gray, 1848.

Diagnosis. Hincks, No. 2, p. 184.

Species 1. CRIBRILINA VINEI, n. sp.

Syn. *Membraniporella nitida*, Johnst. var. *eocena*, G. R. Vine, Notes on Brit. Eoc. Polyzoa, 1889, Proc. Yorks. Geol. & Polyt. Soc. vol. xi. pt. ii. pp. 161–2, pl. v. fig. 6.

Diagnosis. Zoarium encrusting.

Zoœcia large, quincuncially arranged; globose. Orifice large, orbicular; elongated transversely. Margin of the orifice raised, thin and plain.

The front walls of the zoœcia are traversed by 9 or 10 pairs of furrows; the upper 5 or 6 pairs of these are horizontal; the lowest 3 or 4 pairs in a radial fan. There are two or three pores in each furrow. The furrows do not reach the middle line of the front wall, and upon this there is a varying number of fairly large pores.

Avicularia large: a pair on each side of the orifice.

Oœcia large: very globose, often covering the lower part of the adjoining zoœcium. Perforated by numerous, fairly large pores.

Distribution. London Clay, Sheppey.

Type. Brit. Mus. No. B 4514. Vine Coll.

Figures. Pl. XXX. fig. 8. Part of the zoarium, × 55 diam.

Affinities. This species was regarded by Mr. Vine as only a variety of the recent *Membraniporella nitida*; he remarked the presence of a series of small pores in the furrows, and that Mr. Hincks did not mention them in his diagnosis of that species. But the existence of these pores is the generic character that separates *Cribrilina* from *Membraniporella*, and into the former genus this species must necessarily go. From the species to which Mr. Vine referred it, it differs also in the presence of the pores on the oœcia, in that the lower furrows are radial instead of them all being horizontal,

and in other features. From the common and widely distributed *C. radiata* [Moll, No. 1, p. 63, pl. iv. fig. 17] this species differs by its larger orifice and by the furrows being more numerous and differently arranged. Among recent species it most closely resembles *C. philomela*, Busk [No. 8, pp. 132–3, pl. xvii. fig. 6, pl. xxii. fig. 7], to which it is allied by the large size of the orifice and the big globose oœcia; it differs, however, in the oœcia being plain in the recent species, and also in having more pores on the furrows and none in the middle line.

Probably the nearest ally to this species is *Cribrilina manzonii* [*Lepralia manzonii*, Reuss, No. 14, p. 171, pl. i. fig. 6], from Mödling, near Vienna, which agrees with it in the large size of the orifice and the arrangement of the furrows: Reuss does not figure any oœcia, and consequently this important character cannot be used for comparison; but the absence of the pair of large lateral avicularia and the greater number both of pores and furrows in *C. manzonii* are sufficient to distinguish the two.

The species belongs to *Cribrilina*, even restricted as narrowly as is done by Dr. Jullien [No. 3, 604].

Family MICROPORIDÆ.

Genus Micropora.

Diagnosis. Hincks, No. 8, pt. i. p. 161.

Species 1. Micropora cribriformis, n. sp.

Syn. *Membranipora holostoma*, Busk, var. *perforata*, G. R. Vine, 1891, Proc. Yorks. Geol. & Polyt. Soc. vol. xii. p. 60.

Diagnosis. Zoarium encrusting.

Zoœcia oval, sometimes tapering below. The lower part of the front wall is very tumid and rises above the raised margin. The aperture is small; the upper margin is regularly curved, the lower margin sinuous. The front wall is crowded with maculæ, which are very irregular in form and numbers. There is usually a pair of narrow slit-like opesiulæ situated at the extreme margin of the oœcia, just below the corners of the aperture.

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. B 4583.

Figures. Pl. XXX. fig. 6. Part of zoarium. In one of the zoœcia the front wall has been broken away and shows the absence of internal partitions.

Affinities. This species is very clearly marked by the sinuous lower border of the aperture and the cribriform aspect of the whole front wall. Both characters, as well as the form of the zoœcia and other less important points, separate it from *M. holostoma* (Busk) [No. 6, p. 36, pl. iii. fig. 11], from the Crag.

Probably the most nearly allied species is *M. gracilis* (Münst.) [*Cellepora gracilis*,

Münster, in Goldfuss, No. 1, i. p. 102, pl. xxxvi. fig. 13], of which Reuss [No. 11, p. 291, pl. xxix. fig. 13] has given a good figure; from this it is distinguished by the form of the orifice, the absence of a ridge on the lower side of the aperture, and the much greater coarseness of the maculæ. Waters [No. 12, p. 13] includes the Crosara species as a synonym of *M. coriacea* (Esper). The same characters separate it from *M. münsteri* (Reuss) [No. 6, p. 30, pl. x. fig. 2], which is very nearly allied to *M. gracilis*.

As in the new species some of the zoœcia and the opesiulæ are replaced by large pores, while in others these are no larger than some of the maculæ, it is evident that Mr. Hincks is fully justified in refusing to regard the presence of these opesiulæ as an essential character of the genus.

Genus Onychocella, Jullien, 1881.

Diagnosis. Microporidæ with large vicarious avicularia scattered over the zoœcia [Jullien, No. 1, p. 277].

Species 1. Onychocella magnoaperta, n. sp.

Diagnosis. Zoarium encrusting, forming a large compact crust.

Zoœcia usually hexagonal, occasionally becoming rounded at the edges and oval where they are less crowded. Apertures slightly clithridiate, very large, occupying nearly the whole front of the cell; the aperture is restricted by a small lamina at the lower side of the zoœcium. The margins of the zoœcia are raised, plain, and non-crenulate.

Avicularia: large vicarious cells, long and tapering; irregularly scattered over the zoarium.

Distribution. Brockenhurst Beds (Mid. Headon), Brockenhurst.

Type. Brit. Mus. No. 49738. Edwards Coll.

Figures. Pl. XXX. fig. 7. Part of zoarium, × $\frac{55}{4}$ diam., including one of the large tapering vicarious avicularia.

Remarks. The subdivision of the great genus *Membranipora* to which Jullien [No. 1, p. 277] gave the name *Onychocella* appears to be based on more reliable characters than most of the genera which that author has proposed, and it seems to be now generally accepted [see Waters, No. 12, pp. 8, 9]. The nature of the avicularian cells of this new species shows that it belongs to this group. Its nearest ally is *O. angulosa* (Reuss) [No. 1, p. 93, pl. xi. fig. 10], from which it differs in the much smaller size of the aperture in that species. If, as Waters suggests, *Rhagasostoma hexagonum*, Kosch. [No. 1. p. 30, pl. v. figs. 5–7], is only a synonym of *O. angulosa*, it will be unnecessary to compare them further; but if, as appears probable, it is a distinct species, the structure of the aperture will clearly distinguish it from the Brockenhurst form.

O. magnoaperta is closely allied to some Upper Cretaceous species; of these *O. cyclostoma* (Goldf.) [*Eschara cyclostoma*, Goldfuss, 'Petrefacta Germaniæ,' Th. i. 1826, p. 23, pl. viii. fig. 9] appears to be about the nearest; the evidence for referring it to *Onychocella* is given by von Hagenow's figures [No. 2, p. 75, pl. ix. figs. 7, 8, pl. xii. fig. 3]: from this, which is biflustrine in habit, it may be distinguished by its clithridiate aperture; the avicularian cells agree in general character. From *O. koninckiana* (Hag.) *Cellepora* (*Discopora*) *koninckiana*, Hag. *ib.* p. 95, pl. xi. figs. 10, 11] it differs in the ovate shape of the avicularian cells, which in the Maastricht species are lanceolate. *O. santonensis*, D'Orb. [*Eschara santonensis*, D'Orbigny, No. 2, p. 109, pl. 673. fig. 4], agrees with it in the large size of the aperture and the shape of the avicularia; but the oœcia in that species are pyriform, the lamina larger, and the lower side of the mouth straight. *O. drya*, D'Orb. [*Eschara drya*, ib. p. 168, pl. 677. figs. 7–9], has also a large aperture, but this is much wider and not clithridiate; the zoœcia are also different in shape. D'Orbigny has figured amongst his Escharas a large series of species which must be referred to *Onychocella*, though many of them may be reduced to synonyms. rom most of them, such as *O. allica* (D'Orb.), *O. archosia* (D'Orb.), *O. charonia* (D'Orb.), *O. clito* (D'Orb.), and *O. cressida* (D'Orb.), the new species may be distinguished by its large aperture.

The occurrence of the genus *Onychocella* in Cretaceous rocks has been frequently pointed out; the British Museum Collection contains a specimen from the *Calcaire à polypiers* (Bathonian) of Ranville, that must be referred to this genus.

Suborder SCHIZOTHYRIATA.

Family SCHIZOPORELLIDÆ. (*Myriozoidæ* of Hincks.)

Genus Schizoporella, Hincks.

Diagnosis. See Hincks, No. 2, p. 237.

Species 1. Schizoporella magnoaperta, n. sp.

Diagnosis. *Zoarium*, a foliaceous expansion.

Zoœcia somewhat irregularly arranged, though with a tendency towards quincuncial. In shape they are pyriform, well rounded above, tapering below. The front wall is tumid, forming a raised triangular area. A raised lip around the orifice, which is oval; the sinus is median, small but distinct. The zoœcia are separated by a depressed flat margin, around which is a row of large deep areolæ.

Avicularia one on each zoœcium, beside and below the orifice; they have raised, elliptic borders.

Oœcia —— ?

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. 49733. Edwards Coll.

Figures. Pl. XXX. fig. 9. Part of a zoarium from London Clay, Sheppey; Brit. Mus. No. B 4514, $\times \frac{55}{3}$ diam.

Affinities. This species belongs to the group of which the common *Schizoporella unicornis*, Johnst., is a good representative; it agrees with the latter in its umbo, suborbicular mouth, and small sinus. From that species, however, it clearly differs in the much larger size of the aperture and the pyriform shape of the zoœcia in the new species, in which also the umbo is lower down, and there is one lateral avicularium instead of the pair usually present in *S. unicornis*; the areolæ are also limited to a single series. The large size of the aperture at once distinguishes this from most of the Continental Miocene and Lower Cainozoic species, such as *S. goniostoma* [*Cellepora goniostoma*, Reuss, No. 1, p. 87, pl. x. fig. 18; for better figures see Reuss, No. 14, p. 176, pl. ii. fig. 6, pl. iii. fig. 3] and *S. rugulosa* [Reuss, No. 14, p. 169, pl. iii. fig. 2]. *S. dunkeri* [Reuss, No. 1, p. 90, pl. x. fig. 27] agrees in some respects, *e. g.* the single lateral avicularium, the large mouth, and blunt umbo; it is probably the nearest ally of this species. Reuss's species may be distinguished by its higher umbo, marginal avicularia, and shorter and more rectangular zoœcia. Among recent species it agrees closely with *S. simplex* D'Orb. [*Eschara simplex*, D'Orbigny, No. 1, p. 13, pl. v. figs. 5–8], from which it differs in the pyriform shape of the zoœcia.

In the general form of the zoœcia this species agrees strikingly with *Microporella membranacea* (Reuss) [*Eschara membranacea*, Reuss, No. 6, p. 32, pl. v. fig. 6], from Oberburg; the possession of a sinus instead of a trypa, of course, distinguishes it from that species.

Species 2. SCHIZOPORELLA MAGNOINCISA, n. sp.

Diagnosis. *Zoarium* foliaceous.

Zoœcia narrow and elongated; peristome raised and almost subtubular. Aperture large and with a very large sinus; the angles of the peristome above the sinus vary considerably in prominence, but never meet. One line of areolæ. Front wall smooth and evenly convex.

Avicularia: one on each zoœcium, just below the aperture; lateral in position; mandible pointing upwards to the angle between the aperture and sinus.

Oœcia (none ?).

Distribution. London Clay, Copenhagen Fields.

Type. Brit. Mus. No. B 4515. Fragment enclosed in a septarian nodule.

Figure. Pl. XXX. fig. 10, × 30 diam.

Affinities. The large size of the sinus of this species would necessitate its inclusion in *Gemellipora* if that genus of Smitt's [No. 3, p. 35] be accepted. Its nearest ally

appears to be *Schizoporella gonversi* (Reuss) [No. 14, p. 159, pl. vii. fig. 7], from Rauchstallbrunn, but in that species the zoœcia are shorter and broader, the areolæ, fewer, and there is a pair of avicularia above the aperture.

The large size of the sinus allies this species to *Schizoporella beyrichi*, Stol., but it differs in that the zoœcia are elongate and rectangular instead of hexagonal, they are not quincuncially arranged, and the zoarium is not Cellarian (*Cellaria beyrichi*, Stoliczka, No. 1, p. 83, pl. i. fig. 10).

Schizoporella insignis, Hincks [No. 4, pt. 5, p. 134, pl. v. fig. 10], differs in the quincuncial arrangement of the zoœcia, the central umbo, and the raised line at a little distance from the margins of the zoœcia. The shape of the zoœcia and the absence of the tubercles above the aperture distinguish this new species from *S. pauper* (Reuss) [*Lepralia pauper*, Reuss, No. 14, p. 164, pl. v. fig. 4], which has a large sinus. The last two species with which it is necessary to compare this are *S. variabilis* (Reuss) [*Hemeschara variabilis*, Reuss, No. 12, p. 508, pl. i. figs. 1–5] and *S. unicornis* (Johnst.) [*Lepralia unicornis*, Johnston, No. 2, p. 320], which both belong to the same group. From the former the London Clay species is mainly to be distinguished by the size of the sinus. The latter differs by its umbo, the absence of maculæ, and the smaller aperture; the zoœcia, however, agree in general form.

IV. *a. The Systematic Position of the* Adeonellidæ.

The genus *Adeona* was established by Lamouroux [No. 1, pp. 478–482, pl. xix. fig. 2] in 1816 for some Bryozoa with short jointed stems and reticulate zoaria; he took an Australian species, *A. grisea*, as his type: this species has also been made by Macgillivray the type of a genus *Dictyopora*, which is therefore necessarily a synonym. Enlarged figures of the zoœcia have been given by Kirchenpauer [No. 1, pl. i. fig. 8, pl. ii. fig. 10] and Macgillivray [No. 1, pl. 66], and these show that it possesses a trypa or zoœcial pore and a simple holostomatous orifice, and must therefore be referred to the Microporellidæ. But this genus and its allies have long given much trouble to systematists and the classification is still unsettled. Busk's 'Challenger' Report must certainly be held responsible for much of the confusion, as he there founded a genus *Adeonella* based wholly on zoarial characters; in consequence he included in it a miscellaneous series of species that must be divided among the several genera. Thus his *Adeonella distoma* has a trypa and is one of the Microporellidæ, while others, such as *A. polymorpha*, have no such pore and must belong to a different genus and family.

The subject has been attacked by Messrs. Hincks, Waters, and Macgillivray, and each of these has advocated very different conclusions. Mr. Hincks [No. 8, pt. i. pp. 150–158, especially 155 & 157] has discussed the matter at length with the following results: he maintains (1) that as *Adeonella* is based only on zoarial characters it is not distinct from *Adeona*; (2) the latter genus he places among the Microporellidæ, distinguished from *Microporella* by the substitution of gonœcia for external oœcia; (3) as he

regards *Adeonellopsis* as based only on the possession of a peristomial pore he declines to accept it.

Mr. Waters's conclusions [No. 6, p. 294, and No. 10, pp. 3, 32, 33] are very different; he abandons *Adeona* as a synonym of *Microporella*, and speaks of the type species as *Microporella grisea*, form *Adeona*; in his last essay he accepts *Adeonella* for forms without a trypa but with a peristomial pore, the latter a character of very doubtful value.

Mr. Macgillivray's conclusions [No. 2, pt. ix. p. 134] seem to me more, though not entirely, satisfactory. He accepts *Adeonella* in much the same sense as Mr. Waters; but he fully grasps the significance of the absence of the trypa and removes the genus to the *Mucronellineæ* (or Smittidæ). He agrees with Mr. Hincks and differs from Mr. Waters in separating *Adeona* from *Microporella* owing to the absence of external oœcia in the former; finally, he founds the genus *Adeonellopsis* for forms resembling *Adeonella*, but without a peristomial pore.

Before proceeding to discuss these views I must again express my thanks to my colleague Mr. Kirkpatrick for allowing me constant access to the recent species, and especially to Busk's type specimens, and also for the opportunity of frequent discussion of all the points involved.

The first point to be decided is what are the true affinities of *Adeonella*. The first species described by Busk was *A. polymorpha*, and this he seems to have regarded as his type; Mr. Waters certainly includes it in the genus as restricted by him. Mr. Hincks [No. 4, pt. xiii. pp. 294–296] has quoted Busk's remark [No. 8, p. 183] that "as regards the general zoœcial characters there is no difference whatever between *Adeona* and *Adeonella*." This remark seems to me quite inexplicable. *Adeonella polymorpha* has no trypa, which seems to be generally regarded as implying a difference in family. *A. polymorpha* is therefore not one of the Microporellidæ at all, and cannot be synonynous with *Adeona*, which has a trypa *. Macgillivray has clearly recognized this, and has removed *Adeonella* to his Escharidæ. But this seems to me to be going rather too far; in *Adeonella polymorpha* and all the species which seem to be congeneric with it, the primary orifice is always schizostomatous, and therefore the genus cannot enter the holostomatous group: its true affinities appear to me to belong to the Schizothyriata allied to the Schizoporellidæ; the secondary orifice appears to distinguish it from both the Schizoporellidæ and the Microporellidæ; the presence of gonœcia instead of external oœcia still further separates it from the Schizoporellidæ, but allies it to its old associates of the *Adeoninæ*. Its true position therefore appears to be as a distinct family intermediate between the Schizoporellidæ and the Microporellidæ, with one link attaching it to each.

* Macgillivray's figures of *Adeona* (*Dictyopora*) *cellulosa* show an occasional absence of the trypa [Macgillivray, No. 1, dec. v. pl. 47. fig. 1 *a*, *b*]. A dissection of a specimen with the same feature shows that it is due simply to the trypa being overgrown and concealed by the avicularium.

In regard to *Adeonellopsis*, it seems to me absolutely necessary to accept that or Busk's [No. 8, p. 178] *Reptadeonella*, as it is going rather far to place such a species as "*Lepralia*" *violacea*, Johnst., in *Adeona* or *Microporella*. *Reptadeonella* is prior by two years, but it was based only on zoarial characters and was never properly diagnosed, and I therefore prefer to accept Macgillivray's better defined genus [No. 2, pt. ix. p. 134, and No. 3, p. 210].

Reuss has described another species which it is necessary to consider in connection with the Microporellidæ, as it possesses both a trypa and an oral sinus. The species which shows this feature is of such interest in connection with the evolution of this group that it is advisable here to diagnose the new genus necessary for its reception.

Schismoporella[1], n. g.

Diagnosis. *Zoarium* lepralian or escharine.

Zoœcia elongate, oblong (in known species). Aperture orbicular, with a large sinus. The front wall has a zoœcial pore.

Oœcia external, globose.

Type species. *Schismoporella schizogaster* (Reuss)[2], 1847, Helvetian, Austria.

This genus may at first throw doubt upon the assumed homology of the sinus and trypa, the latter being regarded as the more specialized. The occurrence of *Schismoporella* may, however, be explained by a repeated formation of a sinus after the zoœcial pore has travelled well away from the peristome: or else the division of the trypa into two or more pores has very frequently taken place, and there seems no improbability in one of these parts persisting as a sinus. If neither of these explanations is correct, then *Schismoporella* is probably a primitive form uniting characters now divided between two families.

The following synopsis summarizes the classification of this group that is here proposed:—

- *Schizothyriata.*
  - *Schizoporellidæ*: schizostomatous. External oœcia.
  - *Adeonellidæ*: primary aperture schizostomatous. Gonœcia.
  - *Microporellidæ*: trypa present.
    - *Adeoninæ*: with gonœcia.
      - Zoarium fenestrate, &c. *Adeona.*
      - „ foliaceous or encrusting. *Adeonellopsis.*
    - *Microporellineæ*: external marsupia. = *Microporella, Tessarodoma,* &c.
    - *Schismoporellinæ*: with trypa and sinus. = *Schismoporella.*

[1] From σχίσμα, a slit, and πόρος, a pore.

[2] *Cellepora schizogaster*, Reuss, 1847, No. 1, p. 84, pl. x. fig. 9; *Mollia schizogaster*, D'Orbigny, No. 2, p. 388; *Lepralia schizogaster*, Reuss, No. 14, p. 161, pl. iii. fig. 10.

It may be objected that the genera of the *Adeoninæ* are based on zoarial characters; but these are of such a marked description, and lead to such modifications and dimorphism of some of the zoœcia, that they seem certainly of generic value. In regard to *Adeona* and *Adeonellopsis* there is the further difference of the presence of a peristomial pore in the latter.

It seems also advisable to rediagnose *Adeonella* in accordance with this scheme, and consider what species should be included in it. But at present the diagnosis of the genus is the same as that of the family, as I am at present aware of only the one genus; the diagnosis is therefore: "Schizothyriata with a schizostomatous primary aperture and a secondary orifice variable in form. Gonœcia present, but no external marsupia." Before giving a list of the species I had better refer to the question of the value of the peristomial pore, as if Busk [No. 8, p. 167] and Ridley [No. 1, p. 47, pl. vi. fig. 6] are right in considering it of generic importance, then *Adeonella* must be subdivided. Since Mr. Kirkpatrick [No. 1, pp. 77, 78, pl. viii. fig. 5] has shown that this structure in "*Gigantopora*" *lyncoides*, Ridley [No. 1, p. 47, pl. vi. fig. 6], is only formed by the avicularia, little value has been attached to it. Messrs. Hincks [No. 6, pp. 268, 269] and Waters [No. 9, p. 192] also dismiss it as valueless, as the bridge is not always present in different zoœcia of the same zoarium of *Schizoporella biturrita*, Hincks (or *S. tuberosa*, Reuss).

List of Species of Adeonella.

Type. *Adeonella polymorpha*, Busk, No. 8, p. 183, pl.
Adeonella, cfr. *polymorpha*, Gioli, No. 1, pp. 261, 262, pl. xiv. fig. 8.
—— *platalea*, Busk, No. 8, p. 184.
—— *intricaria*, Busk, No. 8, p. 185.
—— *regularis*, Busk, No. 8, p. 186.
—— *atlantica*, Busk, No. 8, p. 186.
—— *pectinata*, Busk, No. 8, p. 189.
(This species has a large lyrula within the secondary orifice and hiding the primary aperture. Busk has not figured the operculum, but its shape shows that the primary aperture is schizostomatous. It ought, perhaps, to be separated as a subgenus.)
—— *polystomella* (Reuss), No. 1, p. 70, pl. viii. figs. 27, 28.
—— *pallasi* (Heller), No. 1, p. 115, pl. iii. figs. 1, 2? = *A. polystomella*.
—— *dispar* (Macgill.). For references *see* Jelly, No. 1, p. 259 (agrees with *Adeonella*, but has a sinus also in the secondary orifice).
—— *sulcata* (M.-Edw.), *Eschara sulcata*, M.-Edwards, No. 1, pp. 47–49, pl. v. fig. 2, non *Flustra sulcata*, Lamouroux, No. 3, p. 609, pl. 92. figs. 3, 4.
—— *fuegensis* (Busk), No. 3, p. 90.

List of Species that have been referred to Adeonella.

Adeonella distoma (Busk), No. 5, p. 127, pl. xviii. fig. 1 = *Adeonellopsis distoma*.

—— ——, var. *imperforata* (Busk), No. 8, p. 188 = *Adeonellopsis*.

(This form has a trypa, but it is covered over by the avicularian cell; by the kindness of Mr. Kirkpatrick I have been enabled to dissect off an avicularium, and thus demonstrate the presence of a trypa. The form is probably entitled to specific distinction, and I therefore record it as *Adeonellopsis imperforata*.)

Eschara pulchra, Stoliczka, No. 2, pp. 87, 88, pl. ii. fig. 10 = *Adeonellopsis*.

—— *coscinophora*, Reuss, No. 1, p. 67. = ,,

—— *mucronata* (Macgill.), No. 1, dec. v. p. 43. = ,, (? *coscinophora*, Reuss).

Cellepora heckeli, Reuss, No. 1, p. 85. = ,, *heckeli* (Reuss).

Lepralia violacea, Johnston, No. 2, p. 325. = ,, (? *heckeli*, Reuss).

Eschara lichenoides, Lamk., No. 1, p. 176. = ,,

Microporella fissa, Hincks, No. 4, pt. ii. p. 381. = ,,

Adeonella japonica, Ortmann, No. 1, p. 54. = ,,

—— *sparassis*, Ortmann, No. 1, p. 54. = ,,

—— *tuberculata*, Ortmann, No. 1, pp. 53, 54. = ,,

} Ortmann does not figure the opercula, and the reference may be incorrect.

Porina subsulcata, Smitt, No. 3, p. 29, pl. vi. figs. 136–140. = ,,

Eschara syringopora, Reuss, No. 1, p. 68, pl. viii. fig. 23. ? = *Teichopora*.

—— *ornatissima*, Stoliczka, No. 1, pl. ii. fig. 7. Probably a *Schismopora* with a peristomial pore.

—— *ciliata*, Pallas, Elenchus, p. 38. = *Microporella*.

Flustra sulcata, Lamx., No. 3, p. 609, pl. 92. figs. 3, 4. = ?

Cellepora imbricata, Lonsdale, No. 1, pp. 507, 508. = *Adeonellopsis*.

Family MICROPORELLIDÆ.

Subfamily Adeoninæ.

Genus Adeonellopsis, Macgillivray.

Species 1. Adeonellopsis wetherelli, n. sp.

Syn. *Flustra*, sp., Wetherell, 1837, Trans. Geol. Soc. (2) iv. pl. ix. fig. 22.

Microporella violacea, var. *fissa*, var. *b*, Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 162, pl. v. fig. 7 *b*.

Microporella violacea, var. *fissa*, var. *a*, Vine, 1891, ibid. xii. p. 61.

Diagnosis. Zoarium erect: branching dichotomous; bilaminar and either flat or cylindrical branches.

Zoœcia tumid: usually pyriform; irregular in form; elongate and ovate or subhexagonal. Lower zoœcia immersed. The orifice is at the summit of a large raised head, the peristome being somewhat tubular; the orifice is oval, lunate, or semi-

circular in shape. The front wall contains an elongate, depressed areola, the floor of which is cribriform, being perforated by from 4 to 8 pores. A line of punctures runs around the margin of the zoœcia.

Avicularia large, pointing obliquely upwards: situated close below the peristome.

Gonœcia sparsely scattered, low; aperture smaller than in the normal zoœcia.

Distribution.[1] London Clay: Fareham (abundant); Highgate; Haverstock Hill; Sydenham; White Conduit House.

Figures. Pl. XXX. fig. 12. Part of a zoarium from the London Clay, Haverstock Hill, × 3 diam. Fig. 12 *b*. Several zoœcia from the upper part of the same specimen. Fig. 12 *c*. Zoœcia from lower in the same specimen. Fig. 13. Zoœcia from base of another specimen.—Pl. XXXI. fig. 1. Another specimen.

Type. Brit. Mus. No. 49756, Edwards Coll.; Highgate. Wetherell's figured specimen is B. M. No. B 4443.

Affinities. Wetherell found a minute fragment of this species in a well at Hampstead, and gave a good but small figure of it; this, however, seems to have escaped subsequent notice. Mr. Vine first described the species, and he regarded it as a variety of the well-known recent species *Adeonellopsis* (*Reptadeonella*, *Microporella*, &c.) *violacea* (Johnst.); from this, however, it differs very markedly in the nature of the avicularia, the cribriform area, the subtubular peristome, &c. The species to which it is most closely allied is *Adeonellopsis distoma* (Busk); from this the main difference is in the avicularian orifice, which is much smaller in proportion to the size of the peristomial orifice, and it is placed below the latter and not included within the rim, which includes both the avicularium and orifice. In the London Clay species the avicularia are always directed very obliquely upwards.

Busk has suggested that Reuss's *Eschara coscinophora* is synonymous with *A. distoma*; but agreeing with Mr. Waters [No. 6, p. 283, and No. 13, p. 162], who records the latter from the Italian Upper Eocenes, I prefer to keep them distinct. The London Clay species agree more with *A. distoma* than *A. coscinophora*. The specimens of the latter which agree most with our species are those from the Middle Oligocene of Söllingen in Prussia, figured by Reuss [No. 7, p. 186, pl. xi. figs. 1–4]: his figure 1 allows of a careful comparison of equivalent zoœcia. The differences between the species are that in *A. wetherelli* the avicularia are oblique or transverse and much larger, the cribriform plate is larger and has more regular pores, and the secondary aperture is more raised.

[1] There seems some confusion as to the localities and horizons of Mr. Vine's types of this species and the next; the specimen figured as var. *b* (*i. e.* fig. 7 *b*) is recorded as from the Bracklesham Beds of the Isle of Wight; the slide is, however, correctly labelled from the London Clay.

Species 2. ADEONELLOPSIS INCISA, n. sp.

Syn. *Microporella violacea*, var. *fissa*, var. *a*, Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 162, pl. v. figs. 7, 7 *a*.

Diagnosis. Zoarium erect, bilaminar, and forming thick, short, subcylindrical shoots.

Zoœcia elongate, lanceolate, quincuncially arranged. The orifice is oval or suborbicular; it opens on the sloping upper surface of the high tumid head, which also bears a large peristomial pore. A pair of large avicularia occur immediately below the orifice. The zoœcia are sharply defined by lines of depression marked by rows of areolæ. The trypa is a median narrow slit.

Gonœcia ——.

Distribution. London Clay: Haverstock Hill (? Bracklesham Beds, *fide* Vine).

Type. Brit. Mus. No. 49661.

Figure. Pl. XXX. fig. 11. Part of Mr. Vine's type.

Affinities. This species in its slit-like trypa closely resembles *Adeonellopsis perforata* (Reuss) [*Eschara perforata*, Reuss, No. 11, p. 231, pl. xxxiii. fig. 5], but the latter has no peristomial pore. It differs from *A. wetherelli*, Greg., by the pair of avicularia forming a peristomial pore, instead of having one median avicularium; the trypa is also different. The specimen figured by Reuss [No. 7, pl. xi. fig. 6] as *Eschara diplostoma*, Phil., also belongs to this genus, but differs in the form of the trypa and of the orifice. The two other forms (figs. 5 and 7) associated with it by Reuss seem different, and that represented in fig. 7 is probably a second species of *Schismoporella*.

Suborder HOLOTHYRIATA.

Family LEPRALIIDÆ.

Subfamily LEPRALIINÆ.

Genus LEPRALIA, Hincks, 1880 (non Johnst. &c.).

Diagnosis. Hincks, No. 2, p. 297.

Species 1. LEPRALIA LONSDALEI.

Syn. *Eschara brongniarti*, pars, Lonsdale (non M.-Edw.), 1850, Dixon, Geol. Suss. pp. 161, 162, pl. i. fig. 9*.

Diagnosis. Zoarium thick, encrusting.

Zoœcia small, ovate; very irregularly distributed. Form irregular, varying from somewhat elongate to short and round. Aperture lepralian, very large: lower margin straight or curved outwards; the lateral constriction is, however, very slight. Surface

granular. Zoœcia separated by deep depressions. A line of areolæ around the margin; these vary with the size of the zoœcia from 10 to 15 or 18.

Avicularia: usually one; lateral, placed close beside the orifice.

Distribution. Bracklesham Beds, Bracklesham Bay.

Type. Brit. Mus. No. 49734. Edwards Coll. (Encrusting.)

Figure. Pl. XXXI. fig. 2. × 55 diam.

Affinities. The shape of the orifice shows that this species is a true *Lepralia*, using that term, of course, in its modern restricted sense. It was figured by Lonsdale as *Eschara brongniarti*, a mistake due to his having failed to separate it from the Bryozoan on which it is encrusting. A comparison of his figure 9* with his figure 9 shows that he has included two different forms under one name.

Among the species of *Lepralia* it most resembles *Lepralia angiostoma*, Reuss [No. 11, pp. 291, 292, pl. xxx. fig. 3], but it may be distinguished by the smallness of the orifice in the Austrian species.

Genus Umbonula, Hincks.

Diagnosis. Hincks, No. 2, pp. 316 and cxxxviii.

Species 1. Umbonula bartonense, n. sp.

Diagnosis. Zoarium adnate, encrusting; forming a large and fairly thick crust over shells.

Zoœcia very crowded: quincuncially arranged; small, pyriform. Peristomial aperture semicircular or slightly clithridiate; lower margin straight; very large, sometimes occupying more than half the front of the zoœcium. The front wall is occupied by a large umbo, formed on an avicularian cell, the opening of which is just below the aperture and is hidden by the prominence of the umbo. Around the margin of the zoœcium runs a line of areolæ; those of the lower half are large, and from them furrows run some way up towards the umbo; the areolæ are small around the aperture.

Avicularia and external marsupia none.

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. 49741.

Figure. Pl. XXXI. fig. 4. Portion of zoarium, × 55. diam.

Gottardi's *Eschara prominens* [No. 1, pp. 306, 307, pl. xiv. fig. 4] probably belongs to this genus, but the species is so diagrammatically figured that I cannot be quite sure. The genus is a convenient one, though, as Mr. Waters has pointed out, it is a very close ally of *Lepralia*, and perhaps ought not to be separated from it. The aperture in this species is typically lepralian.

Species 2. UMBONULA CALCARIFORMIS[1], n. sp.

Diagnosis. Zoarium, a thick encrusting mass.

Zoœcia roughly hexagonal in shape: short and thick. The front wall granular. The aperture is suborbicular, somewhat irregular on the lower margin from the ingrowth of the avicularia. The front wall is very tumid, and bears a large avicularian cell, this is attached to the front wall and continues over it as a pair of sharp pointed processes. The pore of the avicularium is raised and close beside the zoœcial aperture. The avicularium is always lateral and oblique.

Oœcia globose, low, and comparatively small.

Distribution. London Clay, Fareham.

Type. Brit. Mus. No. B 3831. (Growing on *Hornera.*)

Figure. Pl. XXXI. fig. 3. × 55 diam.

Affinities. The shape of the aperture, the tumid front wall, and the umbonate avicularium all agree with the genus *Umbonula*. Amongst the other species it probably is most nearly allied to *U. bartonense*, Greg., but from this it may be distinguished by its suborbicular aperture, the lateral position of the avicularia, and the pores of these being terminal instead of in the angle overhung by the umbo.

Subfamily TEICHOPORINÆ.

Genus TEICHOPORA[2], n. g.

Diagnosis. Zoarium foliaceous or encrusting: in large flat surfaces.

Zoœcia pyriform, much expanded above; elongate. Aperture large, holostomatous, orbicular; surrounded by a raised ring. Usually long sinuous lines of marginal areolæ continuous across successive zoœcia.

Gonœcia with the aperture contracted either marginally or by a bar or a central spot.

Species 1. TEICHOPORA CLAVATA.

Diagnosis. Zoarium in large foliaceous expansions.

Zoœcia clavate, the lower part being much restricted in width. Orifice very large; the surrounding ring is continuous with the ridge on the front wall of the zoœcia. Punctures large and numerous.

Avicularia: usually one, just below the orifice; lateral.

[1] From the spur-shape of the avicularian cell.

[2] From τεῖχος, the wall of a fortress.

Gonœcia irregularly scattered. Orifice much restricted, either at the margin or by the central calcareous plate, the knob of which has a small central pit.

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. 49733. Edwards Coll.

Figures. Pl. XXXI. fig. 5. Part of zoarium of the type. Fig. 6. Basal zoœcia. Fig. 7. Part of a large specimen (B. M. No. 49757) showing gonœcia.

Remarks on the Genus. This is a Lepralidan with a simple orbicular aperture and thickened peristome, and gonœcia instead of external marsupia. The last character as well as the form of the aperture distinguish it from *Lepralia*; the absence of a secondary orifice separates it from the Smittidæ.

Affinities of the Species. The nearest ally of *T. clavata* is a specimen from the German Oligocene, described by Stoliczka [No. 1, p. 87, pl. ii. fig. 8] as *Eschara crenatula*, from which it differs by its plain margin. *Eschara semitubulosa* (Reuss) [No. 11, p. 272, pl. xxxiii. fig. 3] probably also belongs to *Teichopora*, though in the absence of knowledge as to the oœcial characters one cannot be quite sure: the greater length of the zoœcia and the more uniform width of the Austrian species clearly distinguish it. Mr. Waters has suggested that *E. semitubulosa* is a synonym of Reuss's earlier species, *E. syringopora* [No. 1, p. 68, pl. viii. fig. 23, and No. 11, p. 269, pl. xxxii. fig. 1]; but in the latter the orifice is smaller, the zoœcia expanded below, and the front wall has a long furrow instead of being tumid and solid. Mr. Waters's own figures [No. 12, p. 20, pl. iii. figs. 2–4] more resemble the English species, though the different nature of the closure, the general form of the zoœcia, and the proportions of the orifice show them to be distinct.

Amongst other species that will probably prove to belong to this species are *Eschara stipitata* (Reuss, MS. Manzoni) [No. 3, p. 60, pl. xii. fig. 3], and *Eschara sulcimargo*, Reuss [No. 1, p. 58, pl. v. fig. 18].

Genus Meniscopora[1], n. g.

Diagnosis. A genus of Lepraliidæ with a simple primary orifice, usually biconvex in shape, with the lower margin a much flatter curve than the upper. Gonœcia and no external marsupia.

Affinities. This genus differs from *Teichopora* by the shape of the orifice and the form of the zoœcia. From most other Lepraliidæ it differs by the presence of gonœcia; when this cannot be determined, it may be distinguished from *Lepralia* (sensu stricto) by the form of the aperture, and from *Umbonula* by the absence of the umbo: these are the two genera which it most resembles in general aspect.

[1] From μηνίσκος, a lune, referring to the shape of the orifice.

Species 1. MENISCOPORA BIGIBBERA[1].

Syn. *Eschara brongniarti*, Lonsdale, 1850 (non M.-Edw.), in Dixon, Geol. Suss. pp. 161, 162, pl. i. fig. 9.

Diagnosis. *Zoarium* erect, bilaminar; forming large flat foliaceous expansions.

Zoœcia regularly quincuncial in arrangement. Surface plain. Shape pyriform. Aperture large, semicircular, but with the lower margin somewhat curved outward. The main part of the front wall is a raised triangular area; at the upper part are two prominent humps. The zoœcia are separated by depressed furrows; a line of large round punctures occurs along the margin.

Avicularia: one large marginal pair beside the lower corners of the aperture; mandible pointing outwards.

Distribution. Bracklesham Beds, Huntingbridge.

Type. Brit. Mus. No. 49732. Edwards Coll.

Figures. Pl. XXXI. fig. 8. Part of the type from Huntingbridge. Fig. 9. Fragment with gonœcium.

Affinities of the Species. As this species was identified by Lonsdale with M.-Edwards's *Eschara brongniarti* it is necessary to compare the two: the fact that the English species has the aperture wider than long, has two humps and a raised triangular area of front wall, is quite sufficient to distinguish them. M.-Edwards's figure [No. 2, p. 335, pl. xi. fig. 9] leaves the generic position of his species quite uncertain; but even should it prove to be a *Meniscopora*, which is not probable, there need be no confusion between the species.

This species has a certain resemblance in general aspect to the *Eschara fenestrata*, Reuss [No. 11, p. 290, pl. xxxii. fig. 5], which Waters [No. 12, pp. 18, 19] regards as a synonym of *Lepralia bisulca* (Reuss) [No. 11, pp. 270, 271, pl. xxxii. fig. 10]; but the latter has external oœcia.

Family CELLEPORIDÆ.

Genus CONESCHARELLINA, D'Orbigny, 1851.

[D'Orbigny, No 2, pp. 446, 447.]

Syn. *Batopora*, Reuss; *Fedora*, Jullien.

Diagnosis. A genus of Celleporidæ with a small, conical, hemispherical, or spherical free zoarium; uni- or multi-laminate. The zoœcia are holostomatous; the aperture is usually on the highest part of the front wall, and is generally orbicular or clithridiate. Oœcia large and globose; comparatively rare.

Distribution. *Recent.* S. Atlantic, Australia.—*Fossil.* Eocene: England. Oligocene: Germany, Austria, Italy. Miocene: Austria.

[1] *I. e.* two-humped, referring to the prominences on the front wall.

Species 1. CONESCHARELLINA CLITHRIDIATA, n. sp.

Syn. *Cellepora*, sp., Wetherell, 1837, Trans. Geol. Soc. ser. 2, vol. v. pl. ix. fig. 21; Busk, 1866, Geol. Mag. vol. iii. p. 301.
Cellepora sp. (*pumicosa*?), Vine, 1890, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 164.

Diagnosis. Zoarium a small, thick, globular mass; base contracted (? attached).

Zoœcia few in number and irregularly distributed and not arranged around a central cell. The apertures of the zoœcia are clithridiate in shape; they are large and terminal. The zoœcia are tumid and generally hexagonal in outline; the front walls are granular and steep; the zoœcia are separated by deep depressions.

Oœcia very large in proportion to the size of the zoœcia; globose, tumid, overhanging the aperture. Only rare zoaria show them, but then they are numerous.

Distribution. London Clay: Highgate, Sydenham, &c.

Type. Brit. Mus. No. B 1357 (Wetherell's specimen, No. 69554).

Dimensions. The largest zoarium is 1 mm. in diameter.

Figures. Pl. XXXI. fig. 10. A zoarium from the London Clay, Hampstead; Brit. Mus. No. 69554.—Fig. 11. A zoarium from Sydenham with oœcia.

Affinities. A charming little figure of a specimen of this species has been given by Wetherell. The species, however, was not named and it has been missed by all subsequent workers. His specimen is in the British Museum collection, along with a great number from the London Clay at Sydenham. This species belongs to the group of which *Cellepora globularis*, Bronn [No. 2, p. 654], was the first described species; as Reuss [No. 9, pp. 113, 114] has, however, pointed out, several distinct forms have come in time to be included under this name. The specimen recently figured by Gioli [No. 1, pp. 263, 264, pl. xiv. fig. 9] appears to be quite distinct. Pergens's short synonymy [No. 4, p. xvi] shows much discrimination.

The nearest ally of this species, *C. scrobiculata* (Koschinsky) [No. 1, p. 63, pl. vi. figs. 2, 3], has a hemispherical or conical zoarium, the base being expanded instead of contracted as in all the English specimens; the aperture in the Bavarian species is also circular and surrounded by a rim. The new species differs from *C. multiradiata*, Reuss [No. 11, p. 265, pl. xxxi. figs. 1–4, and Waters, No. 12, pp. 32, 33], as in that the zoœcia are barrel-shaped, the apertures flush with the surface of the zoarium, and it is composed of several layers; the oœcia also are much larger. From the Miocene *Conescharellina rosula* (Reuss) [No. 1, p. 78, pl. ix. fig. 17, and Manzoni, No. 3, p. 54, pl. ii. fig. 6] the London species differs in its clithridiate aperture and the less elevated zoœcia. The same characters also separate it from *C. stoliczkai* (Reuss) [No. 10, pp. 223–226, pl. ii. figs. 2–4].

In agreement with the zoologists I accept the name *Conescharellina* in preference to Reuss's *Batopora*, which has been adopted by most palæontologists. There seems little room for doubt as to the identity of the two. D'Orbigny's genus was diagnosed

exceptionally well for D'Orbigny, and its claims cannot be so quietly set aside as Reuss has done in the two lines in which he refers to it. *Batopora* is the better name, but that is of course a mere matter of detail.

Genus Orbitulipora, Stoliczka, 1862.

[Stoliczka, No. 1, p. 90.]

Type species. *O. haidingeri*, Stol. op. cit. p. 91, pl. iii. fig. 5.

Diagnosis. A Celleporidan with a bilaminar zoarium composed of a flat round disk supported laterally by a short stem. The zoœcia of the disk are usually arranged around a small central zoœcium. The zoœcia are holostomatous, with a large and typically orbicular aperture. The oœcia are narrow, but globose and elevated. Small avicularia and vibracula may or may not occur.

Species 1. Orbitulipora petiolus (Lonsdale), 1850.

Syn. *Cellepora? petiolus*, Lonsdale, 1850, Dixon, Geol. Suss. p. 151, pl. i. fig. 10; Morris, 1854, Cat. Brit. Foss. ed. 2, p. 120; Mourlon, 1881, Geol. Belg. pp. 180, 191, 202; Vine, 1890, Proc. Yorks. Geol. & Polyt. Soc. xi. pp. 163, 164, pl. v. fig. 10; Reuss, 1867, Sitzb. k. Ak. Wiss. Wien, Bd. lv. Abth. 1, p. 217.

Diagnosis. Zoarium: disks rather large for this genus; thick at the margins and depressed in the centre. The stem is short and, so far as known, unjointed; when broken away it leaves a large round scar.

Zoœcia numerous; usually in fairly regular radial rows; the apertures are orbicular in the centre, but become elliptical at the margin; those adjoining oœcia have the margin nearest incurved owing to the overgrowth of the oœcium. Separated by interspaces which are often marked by punctures.

Oœcia very irregularly distributed; sometimes absent from the whole of one surface of a disk, at others there are a few irregularly scattered, at others nearly every zoœcium has one. They are globose, but narrow.

Distribution. Bracklesham Beds: Bracklesham, Bramshaw, Brook, Whitecliff Bay (common).—*Foreign.* Belgium: Bruxellien, Laekenien, Wemmelien, and Tongrien.

Type. Brit. Mus.

Figures. Pl. XXXI. fig. 12. Zoarium, ×4 diam. Fig. 12 *a*. Part of the same, × 18 diam., to show the oœcia. Fig. 13. Another specimen, to show the stem. Fig. 14. A young specimen in the Conescharellidan stage.

Affinities of the Species. This species differs from *O. haidingeri* mainly by the fact that the peripheral zoœcia open upwards instead of outwards, a point well seen in a comparison of Stoliczka's and Lonsdale's figures. *O. haidingeri* is the nearest ally of the English species; if the two species should prove to be identical, Lonsdale's name will have the prior claim to adoption.

Affinities of the Genus. The British Museum contains a large number of specimens of this species, and these well show its range. One of the smallest specimens, having a zoarium barely 1 mm. in diameter, is of interest as showing that this genus passes through a *Conescharellina* (or *Batopora*) stage ; the small central zoœcium is surrounded by an irregular series of others having the tumid forms, granular walls, and terminal apertures of that genus. This therefore shows that *Conescharellina*, and especially such a species as *C. clithridiata*, is a more primitive form than *Orbitulipora* with its remarkably specialized zoarium.

The species is also clearly distinct from *O. lenticularis*, Reuss [No. 11, p. 289, pl. xxx. figs. 12–14], as to the generic position of which I do not feel able to express an opinion from Reuss's figures.

Family SMITTIDÆ.

Genus Mucronella, Hincks, 1880.

Diagnosis. Hincks, No. 2, p. 360.

Species 1. Mucronella angustoœcium, n. sp.

Syn. *Porella concinna*, var. *eocena*, G. R. Vine, 1891, Proc. Yorks. Geol. & Polyt. Soc. vol. xii. p. 61.

Diagnosis. Zoarium: unilaminar flat surfaces (? erect or encrusting algæ).

Zoœcia irregular, but with a tendency towards a disposition along radial branching lines. Shape approximately hexagonal. The zoœcia are tumid, rising from a flat surface. Orifice suborbicular: the peristome is high and thickened, especially on the lower margin ; it here bears a small simple mucro. The thick bases of a pair of marginal spines occur on the lower angles of the orifice. The thick lower lip has a distinct median transverse depression. Surface granular. Zoœcia separated. About a dozen areolæ occur around the lower half of the zoœcia.

Oœcia numerous, granular, globose, but narrow. In one case there are two oœcia to one zoœcium.

Avicularia: none.

Distribution. Barton Beds, Barton ; London Clay, Fareham.

Type. Brit. Mus. No. 49739. Edwards Coll. From Barton.

Figures. Pl. XXXI. fig. 15. Barton Beds. Brit. Mus. No. 49739. Fig. 16. Part of a zoarium from the London Clay, Fareham.

Affinities. This species reminds one at first sight of the common recent *Mucronella ventricosa* (Hass.), and it clearly belongs to the same group ; it differs from that species, however, by the small simple mucro, the narrow instead of elongate oœcia, the position of the marginal spines, and in less important points. Probably its nearest ally is *M. hörnesi* (Reuss) [1], of the Middle Oligocene ; the new species, however, may be distinguished by its low instead of elongate oœcia. In this character it most resembles

[1] *Lepralia hörnesi*, Reuss, No. 8, pp. 633, 634, pl. xiii. fig. 5, and No. 7, pp. 173, 174, pl. vii. fig. 12.

M. chilopora (Reuss)[1], but the general form of the zoœcia and the structure of the mucro are quite distinct in the two species.

Mr. A. Bell's collection of Fareham Bryozoa having recently passed into the possession of the British Museum, I am able to identify with this species the specimen referred to by Vine as *Porella concinna*.

Mr. Waters, in his 'Revision of the North Italian Bryozoa,' does not quote *Mucronella* from the Eocene deposits of that country. The genus occurs in the Austrian Leithakalk (Helvetian), as at least two species, *M. serrulata* (Reuss)[2] and *M. tenera* (Reuss)[3], seem referable to it.

Mr. Waters [No. 11, pp. 14, 15] has shown that under the name "mucro" several distinct structures have been confused together, and he has proposed the dismemberment of *Mucronella* and the incorporation of most of its species in *Smittia*. The generic value of variations in the secondary orifice and its peristomial tube certainly appears very doubtful, but there does seem sufficient difference between this group of species of *Mucronella* and normal *Smittiæ* to justify the limitation and retention of Mr. Hincks's too comprehensive genus.

Genus Smittia, Hincks, 1880.

Diagnosis. Hincks, No. 1, p. 340.

Species 1. Smittia tubularis[4], n. sp.

Diagnosis. Zoarium erect; narrow cylindrical or shoot-like branches; branching dichotomous.

Zoœcia arranged alternately. Shape pyriform; ovate or elongate-ovate. Front wall tumid; surface granular. Secondary orifice orbicular or a distinct spout-like depression often shown on lower margin. Peristome thin. A row of large areolæ occurs around the margin.

Oœcia small, flattened, the lower side covered by the upper margin of the secondary orifice.

Avicularia large, lateral, on a prominent tubercle obliquely below the orifice.

Distribution. London Clay, White Conduit House.

Type. Brit. Mus. No. 49744. Edwards Coll.

Figures. Pl. XXXII. fig. 1 *a*. Zoarium, nat. size. Fig. 1 *b*. Several zoœcia, enlarged. Fig. 1 *c*. Basal zoœcia.

[1] *Cellepora chilopora*, Reuss, No. 1, p. 91, pl. xi. fig. 4, and No. 14, p. 168, pl. iv. fig. 1.

[2] *Cellepora serrulata*, Reuss, No. 1, p. 85, pl. x. fig. 12; and *Lepralia serrulata*, Reuss, No. 14, p. 167, pl. ii. figs. 2, 3 (? pl. iv. fig. 4).

[3] *Lepralia tenera*, Reuss, No. 14, p. 167, pl. ii. fig. 4, pl. iii. fig. 11.

[4] Referring to the subtubular orifice.

Affinities. This appears to be a very well-marked species, with its elevated peristome, its tumid front wall, and its large lateral avicularia and marginal punctures. The secondary orifice is so raised and subtubular that it first seemed that the species belonged to *Porella* (or *Tessarodoma*); but its secondary orifice and external avicularia show that the resemblance is superficial and that it is truly a *Smittia*. Its mode of growth, however, is exactly that of *Tubucellaria*; it lacks, however, the peristomial pore of that genus, and the peristome is not so raised. It is not improbable that some of the specimens figured as fossil forms of *T. opuntioides* (Pall.) may belong to this species. Such may be the specimen figured by Michelin [No. 1, pl. 46. fig. 21] as *Vincularia fragilis*, Defr., and some of Reuss's *Cellaria michelini*.

Smittia is well known in the Continental Upper Eocene and Oligocene [1], but none of the species with which I am acquainted sufficiently resemble this one to necessitate a comparison.

Order *CYCLOSTOMATA*.

Family IDMONEIDÆ.

Genus IDMONEA, Lamouroux, 1821.

[Lamouroux, No. 2, p. 80.]

Diagnosis. Pergens, No. 3, p. 342.

Type species. *Idmonea triquetra*, Lamx. No. 2, p. 80, pl. 79. figs. 13–15.

Species 1. IDMONEA GIEBELI, Stoliczka, 1862.

Syn. *Idmonea* (*Tubigera*) *giebeli*, F. Stoliczka, 1862, Olig. Bry. Latdf., Sitzb. k. Ak. Wiss. Wien, Bd. xlv. p. 81, pl. i. fig. 6; F. Schreiber, 1872, Bry. Mittelolig. Grünsand Magdeburg, Zeit. f. gesammt. Naturwiss. Bd. xxxix. p. 479.

Idmonea giebeliana, F. Stoliczka, 1865, Foss. Bry. Orakei Bay, Novara Reise, Geol. Theil, Bd. i. Abth. ii. Pal. p. 115, pl. xviii. figs. 4–6; F. W. Hutton, 1880, Man. New Zeal. Moll. Coll. Mus. Geol. Surv. N.Z. p. 196.

Diagnosis. Zoarium cylindrical, straight, erect branches; mode of branching unknown. The back of the zoarium is a full flat curve; the front is well raised.

Zoœcia in series of five; one forms a median row, on each side of which are two pairs placed on a line a little above the central zoœcium. The outermost zoœcia are the longest, but only slightly exceed the others. The walls are granular. Peristome entire, even.

Oœcia small, replacing one of the median zoœcia.

[1] See *e. g.* Waters, No. 12, pp. 21, 22.

Distribution. London Clay, Haverstock Hill.—*Foreign.* Oligocene: Latdorf, Magdeburg, &c., Germany. Palæogene: New Zealand.

Type. Brit. Mus. No. 49656.

Figures. Pl. XXXII. fig. 3 *a*. Part of zoarium, including an oœcium. Fig. 3 *b*. Transverse section.

Affinities. Busk has divided the genus *Idmonea* into two groups: in one the zoœcia all open in two lateral groups and the two innermost ones are the longest; in the second, corresponding to the genus *Tervia* of Jullien, the outermost are the longest and between the lateral series there are some zoœcia irregularly scattered. A third group may, however, be added, including species, such as the present, in which the outermost zoœcia are the longest, but in which there is only a single median row of zoœcia, and the lateral series are opposite.

I am aware of the existence of only six specimens of *Idmonea* from the London Clay; two of these are quite unrecognizable internal pyritous casts, one of which is identified by Mr. Vine as *Idmonea coronopus*, Defr., and the other as *I. gracillima*. A specimen which Mr. Vine tells me is that figured by him as the former is now in the British Museum Collection, but it is labelled, and correctly so, from the London Clay of Sheppey. Mr. Vine [B, p. 165, pl. v. fig. 12] has figured a third specimen also as *Idmonea gracillima*, Reuss, but it is an *Entalophora*. The remaining three small specimens belong one to each of these three groups of *Idmonea*. This helps one to realize that the British Eocene Bryozoan fauna was a singularly diversified one.

Lonsdale [No. 2, pl. ix. fig. 24] has also figured a specimen as *Idmonea coronopus*, but the figure is unrecognizable and I have not been able to find the specimen.

The only noticeable difference between the London Clay specimen and the type figure is in the greater length of the zoœcia in the former; but that may be only due to the fragments having come from a different position in the zoaria. The New Zealand specimen is more doubtful; Hutton quotes it, but Waters, in his paper on the New Zealand Cyclostomata [No. 8, pp. 337–350, pl. xviii.], does not refer to it. Miss Jelly [No. 1, pp. 118, 119] makes it a synonym of *I. milneana*, D'Orb., but I fail to see why it should be included with this rather than any other species of the genus.

Species 2. IDMONEA BIALTERNATA, n. sp.

Diagnosis. Zoarium sinuous, in thin elongated branches, evenly rounded in front, with a flattish curve at the back.

Zoœcia of medium length, thick, with large apertures; walls granular. They are arranged in two pairs; each pair open close together; the two pairs are placed alternately. Peristome thick, plain.

Oœcia: ? a small dilatation at base of the inner zoœcia.

Distribution. London Clay, Islington.

Type. Brit. Mus. No. 49662.

Figures. Pl. XXXII. figs. 2 *a*, 2 *b*. Zoarium and section.

Affinities. This species belongs to the first of the groups of *Idmonea*, including those with the zoœcia all in lateral series. It most closely resembles a specimen figured by Manzoni [No. 4, p. 5, pl. iii. fig. 10] as *I. carinata*?, Röm. A comparison with the figures both of Römer [No. 1, p. 21, pl. v. fig. 20] and Reuss [No. 1, pp. 44, 45, pl. vi. fig. 27] would seem to show that the query after the identification was very well founded; in the number of zoœcia, the shape and structure of cross-sections, and other points, Manzoni's figures markedly differ from those of the larger pluriserial triangular species figured by Römer from the North-German Chalk. From the typical *I. carinata* the London Clay species can be very readily distinguished.

Idmonea reticulata, Reuss [No. 11, pp. 281, 282, pl. xxxiv. fig. 13], belongs to the same series, but differs in the smaller size and more regular arrangement of the zoœcia and apertures, which are grouped in triplets instead of pairs. The same characters also separate the new species from the *I. laticosta*, Mars. [No. 1, p. 29, pl. ii. fig. 11], of Danian age, which belongs to the same group.

Species 3. IDMONEA SERIATOPORA, Reuss (?).

Syn. *Idmonea seriatopora*, Reuss, 1847, Foss. Polyp. Wiener Tertiärbeckens, p. 46, pl. vi. fig. 32; Manzoni, 1878, Brioz. foss. Mioc. Austr. Ungh., Denk. k. Ak. Wiss. Wien, Bd. xxxviii. Abth. 2, p. 6, pl. vi. fig. 12.

Diagnosis. Zoarium of thick irregular branches, composed of many zoœcia, well rounded at the back.

Zoœcia very irregularly arranged, the lateral ones the longest. There are no regular series arranged on either side of a medial line. Three zoœcia often open in an oblique line.

Peristome elliptic; border irregular.

Distribution. London Clay, Haverstock Hill.—*Foreign.* Leithakalk (Helvetian), Austria.

Type. Brit. Mus. No. B 4510.

Figures. Pl. XXXII. fig. 4 *a*. Part of a zoarium, × 18 diam. Fig. 4 *b*. Mouth, × 32 diam. Fig. 4 *c*. Transverse section, × 18 diam. Fig. 5. Back view of zoarium.

This species belongs to the subgenus *Tervia* of Jullien.

Affinities. The irregular distribution of the zoœcia of this species reminds one of *I. compressa*, Reuss [No. 1, p. 46, pl. vi. fig. 22], but the zoarium is not so laterally compressed. Its closest ally is *Idmonea seriatopora*, Reuss, as figured by Manzoni [No. 4, pp. 6, 7, pl. ii. fig. 8, pl. v. fig. 17]; to the original and no doubt diagrammatic figure of Reuss it has a less decided resemblance. But the London Clay specimen is not sufficiently large to allow of a more definite comparison; hence I do not feel able positively to affirm the occurrence of the Austrian Miocene species in the

English Eocenes. Among the species which M. Jullien [No. 2, p. 501, pl. xvii. figs. 72, 73] has referred to his genus *Tervia* it most resembles *Tervia solidula*.

Species 4. IDMONEA CORONOPUS, Defrance, 1821.

Syn. *Idmonea coronopus*, Defrance, 1821, Dict. Sci. Nat. t. xxii. p. 565 (non Atlas, pl. xlvi. fig. 2, as stated by Bronn); Blainville, 1830, ibid. t. lx. p. 385; id. 1834, Man. d'Actinol. p. 420; Milne-Edwards, 1836, in Lamarck, Anim. sans Vert. ed. 2, t. ii. pp. 281, 282; id. 1838, Mém. Crisiées, Ann. Sci. Nat. Zool. sér. 2, t. ix. pp. 215, 216, pl. xii. fig. 3; Michelin, 1844, Icon. Zooph. p. 172, pl. xlvi. fig. 16; Bronn, 1848, Index Palæont. Nomencl. p. 606; Lonsdale, 1850, in Dixon, Geol. Sussex, pp. 153–155, pl. ix. fig. 24; Hagenow, 1851, Bryoz. Maastr. Kreidebild. p. 25; Lonsdale, 1878, in Dixon, Geol. Sussex, ed. 2, pp. 204–206, pl. ix. [10] fig. 24; Harris and Burrows, 1891, Eoc. and Oligoc. Paris Basin, p. 61.

Retepora trigona, Morren, 1828, Desc. Corall. foss. Belgio, Ann. Gron. p. 37, pl. x. figs. 1–3 (identification *fide* Michelin); Galeotti, 1838, Mém. Géogn. Brabant, p. 187, pl. iv. fig. 13; Nyst, 1844, Coq. et Polyp. foss. Terr. Tert. Belg., Mém. Cour. R. Ac. Belg. t. xvii. pp. 619, 620.

Chrysisina coronopus, Mourlon, 1881, Géol. Belgique, t. ii. p. 180.

Hornera flabelliformis, Vine (non Blainv.), Proc. Yorks. Geol. & Polyt. Soc. vol. xi. p. 166, pl. v. fig. 15; id. ibid. vol. xii. p. 53.

Diagnosis. *Zoarium* small, erect, rising from an encrusting, expanded base. The branches fork several times; they are triangular in section and well rounded behind; they end bluntly.

Zoœcia in short transverse series, alternately arranged. The zoœcia are single at the base, but rapidly increase to rows of four; this decreases to three above. The innermost zoœcia are the longest.

Peristome even, usually oblong with rounded angles; younger and isolated zoœcia have oval or even circular apertures.

Wall granular.

Distribution. *British*: Bracklesham Beds, Bracklesham (Brit. Mus., Dixon and Vine Collections).—*Foreign*: Calcaire grossier, Parnes, Grignon, Chaumont, &c.; Laekenien; Uccle (near Brussels), de Forêt, d'Assche.

Figures. Pl. XXXII. figs. 6 *a*, 6 *b*.

Affinities and Differences. As this species belongs to the typical group of *Idmonea* it clearly differs from *Idmonea* (*Tervia*) *seriatopora*, Reuss. As there is no median line of zoœcia it differs from *Idmonea giebeli*, Stol. From the third British Eocene species it may readily be distinguished, as in that the zoœcia are always in alternate pairs.

Genus HORNERA, Lamouroux, 1821.

[Lamouroux, No. 2, p. 41.]

Diagnosis. Pergens, 1889, No. 3, p. 353.

Type species. *Hornera frondiculata* (Lamarck), 1816, No. 1, pp. 182, 183.

Species 1. HORNERA FAREHAMENSIS, n. sp.

Syn. *Hornera ramosa*, D'Orb., G. R. Vine, 1891, Proc. Yorks. Geol. & Polyt. Soc. xii. pp. 54–56.

Diagnosis. *Zoarium* thick, dichotomously branching tufts; the branches do not anastomose.

Zoœcia open somewhat regularly on the anterior side; the orbicular apertures form straight lines around the branches. In the middle line there is often an irregular and crowded series. The apertures are flush. The interzoœcial pores are of medium size, but not very abundant, numbering from twice to thrice as many as the zoœcia. The posterior side of the zoarium is deeply perforate, the punctures occurring in simple series, occasionally branching.

Distribution. London Clay, Fareham.

Type. Brit. Mus. No. B 3831.

Figures. Pl. XXXII. figs. 7–9.

Affinities. This species has been identified by Mr. Vine as *H. ramosa*, D'Orbigny [No. 2, pp. 937, 938, pl. 608. figs. 6–10, pl. 773. figs. 1–3]; from that species it appears to me to differ by the following characters: (1) the sections of the branches are round and not subtriangular; (2) the central series of zoœcial apertures are very irregularly distributed; (3) the species figured by D'Orbigny has the exceptional character of a series of tubular prominences probably zoœcial (see pl. 773. fig. 2); (4) the zoarium is irregularly branched and does not form the cupuliform structure shown by D'Orbigny (pl. 608. fig. 6).

The nearest ally of this species appears to me to be *Hornera concatenata*, Reuss (No. 11, pp. 71, 72, pl. xxxv. figs. 5, 6), but in that species the pores on the back are few and far between, the number of zoœcia in a transverse series is less, the pores on the front wall are much less numerous, and there is no irregular middle series.

Genus ENTALOPHORA, Lamouroux, 1821.

[Lamouroux, No. 2, p. 81.]

Diagnosis. Pergens, No. 3, p. 357.

Species 1. ENTALOPHORA TERGEMINA [1], n. sp.

Syn. *Idmonea gracillima?*, Reuss, Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. vol. xi. pp. 165, 166, pl. v. fig. 13.

Diagnosis. *Zoarium* thick, apparently short. In section it appears quadrangular, with the angles well rounded. Surface minutely pitted.

Zoœcia crowded, long, expanding above; series of three or four open together along a straight line; there are four such triplets at not quite the same level in a series around the zoarium. There are 12 or 13 in a complete series. The zoœcia are somewhat infundibuliform, and have a somewhat quadrangular aperture.

[1] *Tergeminus*, triple, referring to the apertures being usually in triplets.

Distribution. London Clay, Sheppey.

Type. Brit. Mus. No. B 4509.

Figures. Pl. XXXII. figs. 10 *a*, 10 *b*.

Affinities. The specimen which serves as the type of this species is that which Mr. Vine figured as *Idmonea gracillima*, Reuss, but as it belongs to a different family there is no necessity to compare it with that species. It reminds one, in the form of the zoarium, of *Entalophora clavula*, Reuss [1]; from this it differs in the serial arrangement of the apertures. The same character separates it from *Entalophora palmata*, Busk [2].

This species seems to me to be most allied to *Entalophora wanganuiensis*, Waters (No. 5, pp. 340, 341, pl. xviii. fig. 1): but the New Zealand species has only 10 zoœcia in a series; these are verticillate, and the zoœcia are not infundibuliform.

Family HETEROPORIDÆ.

Genus HETEROPORA, Blainville, 1830.

[Blainville, No. 1, p. 381.]

Diagnosis. Pergens, No. 3, p. 369.

Species 1. HETEROPORA GLANDIFORMIS [3], n. sp.

Diagnosis. Zoarium very small, globular, free (the largest specimen is less than 3 millim. in diameter).

Zoœcia irregularly bent tubes. The orifice varies from orbicular to subhexagonal in shape; they are surrounded by a strong raised rim. The zoœcia are crowded, but interzoœcial spaces occur on the surface of the zoarium; these are, however, entirely filled in the interior. Secondary pores numerous, somewhat less in number than the normal zoœcia, irregularly scattered; they also have a thickened, slightly raised rim.

Distribution. Barton Beds, Barton (common). Bracklesham Beds, Bracklesham Bay. ? London Clay, Highgate. (One somewhat doubtful specimen: Brit. Mus. No. 49596.)

Type. Brit. Mus. No. B 4511. Edwards Coll.

Figures. Pl. XXXII. fig. 11. A zoarium from Barton; external view. Figs. 12 *a*, *b*. Fragments to show internal structure.

Affinities. In the form of the zoarium this species resembles most closely some specimens of *Heteropora conifera* (Lamx.) [No. 2, p. 87, pl. 83. figs. 6, 7; see Haime, No. 1, pp. 208, 209, pl. xi. figs. 1 *a–c*], figured by Haime, but the zoœcial characters are quite distinct. *H. stellulata*, Reuss (No. 1, p. 35, pl. v. figs. 21, 22; Manzoni, No. 4,

[1] *Pustulipora clavula*, Reuss, No. 1, p. 41, pl. vi. fig. 11. For later figures see Reuss, No. 1, p. 194, pl. ix. figs. 3, 4.

[2] *Pustulopora palmata*, Busk, No. 6, p. 108, pl. xviii. fig. 2; and Manzoni, No. 4, p. 11, pl. ix. fig. 34.

[3] From *glans*, a bullet.

p. 18, pl. xi. fig. 44), has certain affinities, but the raised triangular or oval zoœcia and numerous pores of that species are quite distinctive. *H. stipitata*, Reuss (No. 1, p. 35, pl. v. fig. 19; Manzoni, No. 4, p. 19, pl. xi. fig. 45), has also more numerous cancellate pores and a greater thickness of wall. Most of the specimens are less than 2 millim. in diameter and are perfectly spherical; the largest is about 2·5 millim. in diameter, and is somewhat flattened and presents a slight resemblance to some specimens in the *Conescharellina* stage of *Orbitulipora*.

V. *Miscellaneous Records.*

As the Bryozoa are rare in the English Lower Tertiaries, the following records are inserted in the hope that they may lead to search in those horizons.

Diachoris intermedia, A. W. Waters, A, p. 224 (non Hincks); G. R. Vine, A, p. 673, B, p. 160, C, p. 54.

Distribution. Middle Eocene, Bournemouth.

The British Museum contains some specimens of Bryozoa from the same horizon, but they are quite indeterminable. Mr. Waters has also recorded *Lepralia*, sp., *Membranipora*, sp., and *Flustræ*, from the same horizon.

Ditaxia variabilis, D'Orb., G. R. Vine, C, p. 58.

The specimen on which this identification was founded is now in the British Museum (B 4589), but it seems to me to be generically indeterminable. It came from the London Clay at Fareham.

Cribrilina radiata (Moll), A. W. Waters, 1883, in H. M. Klassen, A, p. 244; W. Whitaker, B, vol. i. p. 237.

Distribution. Woolwich and Reading Beds (Blackheath Beds); Park Hill, Croydon.

Flustra crassa, Desm., J. Morris, No. 1, p. 37; T. H. Huxley and R. Etheridge, A, p. 332; W. Whitaker, A, p. 594; G. R. Vine, A, p. 673; J. L. Lobley, A, p. 96.

Distribution. London Clay, Primrose Hill and London District.

Flustra, sp., W. Whitaker, T. H. Huxley, and R. Etheridge, A, pp. 574, 577, 581; T. H. Huxley and E. T. Newton, B, p. 14; W. Whitaker, B, vol. i. p. 213.

Distribution. Thanet Beds, E. of Faversham. Woolwich and Reading Beds, Dulwich, Sundridge.

Polyzoa, indet., H. W. Bristow, A, p. 284.

Distribution. Bembridge Beds. (This is the only evidence known to me of the occurrence of Bryozoa in the British Upper Oligocene.)

Hornera minuta, Vine, B, p. 166, C, p. 53. Bracklesham Beds.

The specimen appears to have been lost.

Hornera? flabelliformis, Blainv., Vine, B, p. 166, pl. v. fig. 15, and C, p. 53.

The specimen upon which this record is founded is now in the British Museum; it is partly immersed, with the zoœcial orifices downwards, the basal portion alone being visible: it is likely to belong to *Idmonea*, and to be the same species as that figured by Lonsdale, No. 2, pl. ix. fig. 24, as *I. coronopus*, Defr.

Lichenopora mediterranea?, Blainv., Vine, C, p. 60.

VI. *Stratigraphical Distribution.*

No.	Species.	Author.	Thanet Sands.	Woolwich & Reading Beds.	London Clay.								Bracklesham.						Barton.	Headon.		
					Copenhagen Fields.	Farnham.	Hampstead.	Highgate.	Islington.	Portsmouth.	Sheppey.	Sydenham.	Bracklesham.	Bramshaw.	Brook.	Huntingbridge.	Stubbington.	Isle of Wight.	Barton.	Colwell Bay.	Brockenhurst.	
1.	Notamia wetherelli	(Busk)						—														
2.	Membranipora eocena	(„)	—					—														
3.	—— buski	n. sp.																		—		
4.	—— crassomuralis	„											—						—			
5.	—— tenuimuralis	„				—	—	—		—												
6.	—— virguliformis	„						—														
7.	—— disjuncta	„						—														
8.	Lunulites transiens	„											—	—	—	—		—	—			
9.	Biselenaria offa	„																	—			
10.	Micropora cribriformis	„																	—			
11.	Onychocella magnoaperta	„																			—	
12.	Cribrilina vinei	„									—											
13.	Schizoporella magnoaperta	„																	—			
14.	—— magnoincisa	„			—		—															
15.	Adeonellopsis wetherelli	„				—	—	—				—										
16.	—— incisa	„					—															
17.	Lepralia lonsdalei	„											—									
18.	Umbonula bartonense	„																	—			
19.	—— calcariformis	„				—																
20.	Teichopora clavata	„																	—			
21.	Meniscopora bigibbera	„														—						
22.	Conescharellina clithridiata	„						—			—											
23.	Orbitulipora petiolus	Lonsd.											—	—	—		—	—				
24.	Mucronella angustoœcium	n. sp.				—													—			
25.	Smittia tubularis	„				—																
26.	Idmonea giebeli	Stol.				—																{ Oligocene, Germany. Palæogene, New Zealand.
27.	—— bialternata	n. sp.						—														
28.	—— seriatopora	Reuss				—																{ Calc. gross. France. Laekenien, Belgium
29.	—— coronopus	Defr.									—											
30.	Hornera farehamensis	n. sp.			—																	
31.	Entalophora tergemina	„								—												
32.	Heteropora glandiformis	„					?					—							—			
33.	Lichenopora, sp.	„																	—			

VII. *Affinities of the Fauna.*

The preceding list shows that the Bryozoa included in the present paper belong to three fairly distinct faunas, but a comparison of the three shows that they possess certain features in common. In the first place, each of the three faunas is numerically small, both in species and individuals, in comparison with the wealth of forms that inhabited the contemporary seas of the Mediterranean basin.

The stunted and dwarfed aspect of the three faunas is apparently due mainly to climatic conditions. As has been pointed out in a recent revision of our Eocene Echinoids [1], the British seas of that period were confined to the south by a land barrier which stretched across France and Northern Germany. Hence to the south of this area the Bryozoa flourished under favourable conditions in a tropical and subtropical ocean, while on the other side the seas were open to the chilling influences of the northern ocean. The land barrier was breached in Middle Eocene times, but the conditions were not seriously modified till later: then, with the gradual change to the brackish and freshwater deposits of the Oligocene, the marine Bryozoa cease to be represented in the British Palæogene.

The Echinoids of the period belong to the same genera as their contemporaries in the Mediterranean basin, but their generally dwarfed aspect and rareness indicate that they lived under unfavourable conditions. The Bryozoa present exactly the same parallel.

An effort has been made to explain the paucity of Bryozoa in English deposits of this period as due simply to unfavourable lithological conditions of life and preservation. The prevalence of clay and sharp sand is quoted as unfavourable to the growth of Bryozoa. But this is hardly sufficient. The shelly sands of the Bracklesham, on the contrary, would seem to indicate the conditions that would be most favourable to the existence and preservation of Bryozoa. That the clay shores of the London Clay and Barton are wholly responsible for the rarity of the Bryozoa is not likely to be accepted by any one who has dredged on the great mud-flats off the Essex coasts, where it is often difficult to procure a shell not encrusted by them. In other districts, such as the Paris basin, Belgium, and North Germany, which were also to the north of this land barrier, and where the lithological characters of the sea-floors were quite different from those of England, the Bryozoa are equally rare and stunted.

Hence, it is to geographical questions rather than to the lithological conditions of the sea-floor that we must attribute the marked characters of our Palæogene Bryozoan fauna.

The singular diversity of the fauna is another feature which supports the view that it is to be regarded as a remnant or an offshoot from one that was much greater and richer. Mr. Waters [Nos. 12 & 13], in his revision of the Oligocene Bryozoa of North Italy, admits 88 species, representing 35 genera. But the British fauna contains only

[1] Gregory, Proc. Geol. Assoc. xii. 1891, pp. 51, 52.

25 species, belonging to 17 genera. If we take the case of the species of a single genus, we find the same point very instructively shown. Thus the genus *Idmonea* is represented by only five specimens, of which two from Mr. Vine's collection appear to me to be indeterminable; *Idmonea* may be conveniently divided into three groups or subgenera, and one of the three recognizable specimens belongs to each of these three groups. This consideration ought to stimulate the search for more material, as the specimens already known appear to represent but a fragment of the fauna.

The high proportion of peculiar species in this fauna would not excite surprise in any of the higher groups, except the Bryozoa; but when we consider the vast range both in space and time claimed for some species, a few words of explanation are required. In the first place, rare though the Bryozoa are in the English beds, they appear to have been even scarcer in contemporary deposits of other parts of the same basin; the meagre lists given by Stremme (No. 1), Marsson (No. 2), Michelin (No. 1), Milne-Edwards (No. 2), and Mourlon (No. 1) show the paucity of Bryozoa at this time in Northern France, Germany, and Belgium.

The great range in time usually accorded to species of Bryozoa raises the general question as to the value of species in this group; their growth in colonies is the main reason for the "lumping" tendencies of zoophytologists. In the Cheilostomata species are usually founded, if only on one specimen, yet on hundreds of zoœcia: in a colony of this size great variation is inevitable; many of the polypites are crushed out by growth-pressure, and their zoœcia are malformed or aborted; the older zoœcia become immersed and lose their characters; the younger zoœcia at the tips of the branches are immature. Hence it is easy to pick out two zoœcia in a zoarium which differ far more markedly than do two zoœcia taken from different species; but that no more proves that the two species should be merged than that two species of frogs are identical because they resemble one another more closely than they do the tadpoles from which they have developed.

Dr. Waagen—'Pal. Indica' (xiii.), 'Salt Range Fossils,' iv. pt. 2, 'Geol. Results,' 1891, pp. 235, 236—has recently pointed out the disastrous effects that have been wrought by palæontologists "lumping" species and neglecting slight but definite differences; and one worker on Bryozoa has recently expressed his doubts as to the accuracy of the identification of recent and Cretaceous species. With this opinion I feel strongly disposed to concur, but will here only say that, so far, I have seen no Cretaceous species of Cheilostomata identical with a living one. If there are such constant differences, it seems certainly advisable to recognize them by name, whether we call them species, forms (Smitt), or mutations (Waagen). Unless this be done, if we accept species as ranging from the Jurassic to the present, then we must abandon all hope of deriving from the Bryozoa any assistance in the study of the geographical distribution of the past, though the group presents characters that should give its evidence great value.

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IX. EXPLANATION OF THE PLATES.

PLATE XXIX.

Fig. 1. *Notamia wetherelli* (Busk), p. 226. Fig. 1 *a*, front view; 1 *b*, lateral view. London Clay, Highgate. Brit. Mus. No. 49731. × 37 diam.

Fig. 2. *Membranipora eocena* (Busk), p. 228. London Clay, Highgate. Brit. Mus. No. 49729. × 16 diam.

Fig. 3. *Membranipora eocena* (Busk). View of the back of the zoarium. London Clay, Highgate. Brit. Mus. No. 6330. × 12 diam.

Fig. 4. *Membranipora eocena* (Busk). Woolwich and Reading Beds, Croydon. Brit. Mus. × $\frac{55}{2}$ diam.

Fig. 5. *Membranipora tenuimuralis*, n. sp., p. 231. London Clay, Highgate. Brit. Mus. No. 49736 (part of one of Busk's types of *M. lacroixi*). × $\frac{55}{2}$ diam.

Fig. 6. *Membranipora tenuimuralis*, n. sp. London Clay, Highgate. Brit. Mus. No. 49736. × $\frac{55}{2}$ diam.

Fig. 7. *Membranipora tenuimuralis*, n. sp. London Clay, Highgate. Brit. Mus. No. B 4331. × 55 diam.

Fig. 8. *Membranipora virguliformis*, n. sp., p. 232. London Clay, Highgate. Brit. Mus. No. 49658. × 25 diam.

Fig. 9. *Membranipora disjuncta*, n. sp., p. 232. London Clay, Highgate. Brit. Mus. No. 69205. Fig. 9 *a*. × 4 diam., to show general arrangement of the zoarium. Fig. 9 *b*. × 12 diam., to show structure of the zoœcia.

Fig. 10 *a*. *Membranipora crassomuralis*, n. sp., p. 229. Barton Clay, Barton. Brit. Mus. No. 49741. × 32 diam.

Fig. 10 *b*. *Membranipora crassomuralis*, n. sp. Barton Clay, Barton. Brit. Mus. No. 49740. × 32 diam. Another specimen growing on a strongly ribbed *Pecten*.

Fig. 11. *Membranipora buski*, n. sp., p. 229. Headon Beds, Colwell Bay. Brit. Mus. No. B 4625. × 55 diam.

Fig. 12. *Membranipora buski*, n. sp. Headon Beds, Colwell Bay. Mus. Pract. Geol. Specimen with numerous oœcia. × 55 diam.

Fig. 13. *Lunulites transiens*, n. sp., p. 233. Barton Beds, Barton. Brit. Mus. No. 49724. × 24 diam. View of the external layer of the zoarium.

Fig. 14. *Lunulites transiens*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. B 4339. × 24 diam.

PLATE XXX.

Fig. 1. *Lunulites transiens*, n. sp., p. 233. Bracklesham Beds, Bracklesham. Brit. Mus. No. B 49724. × $\frac{55}{\frac{3}{4}}$ diam. The centre of a zoarium, with the "ancestrula."

Fig. 2. *Lunulites transiens*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. B 4339. × 18 diam. In the lower part the front wall has been broken away.

Fig. 3. *Lunulites transiens*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49723. × $\frac{55}{\frac{3}{4}}$ diam. Part of a worn zoarium resembling *L. urceolata*, Lamk.

Fig. 4. *Biselenaria offa*, n. sp., p. 235. Barton Beds, Barton. Brit. Mus. No. 49766. Upper surface of the zoarium. × 18 diam. Fig. 4 *a*. A fragment of another zoarium showing the zoœcia of the under surface. Brit. Mus. No. 49766. × 18 diam.

Fig. 5. *Biselenaria offa*, n. sp. Barton Beds, Barton. Another specimen: upper surface. Brit. Mus. No. 49759. × $\frac{26}{2}$ diam.

Fig. 6. *Micropora cribriformis*, n. sp., p. 236. Barton Beds, Barton. Brit. Mus. No. B 4583. × 55 diam.

Fig. 7. *Onychocella magnoaperta*, n. sp., p. 237. Brockenhurst Beds (Mid. Headon), Brockenhurst. Brit. Mus. No. 49738. × $\frac{55}{\frac{3}{4}}$ diam.

Fig. 8. *Cribrilina vinei*, n. sp., p. 238. London Clay, Sheppey. Brit. Mus. No. B 4514. (Vine's type of *Membraniporella nitida*.)

Fig. 9. *Schizoporella magnoaperta*, n. sp., p. 239. Barton Beds, Barton. Brit. Mus. No. 49733. × $\frac{55}{\frac{2}{3}}$ diam.

Fig. 10. *Schizoporella magnoincisa*, n. sp., p. 240. London Clay, Hampstead. Brit. Mus. No. B 4515. × 30 diam.

Fig. 11. *Adeonellopsis incisa*, n. sp., p. 247. London Clay, Haverstock Hill. Brit. Mus. No. 49661. × 55 diam.

Figs. 12 & 13. *Adeonellopsis wetherelli*, n. sp., p. 245. London Clay, Haverstock Hill. Brit. Mus. No. 49756. Fig. 12 *a*. A zoarium, × 3 diam. Fig. 12 *b*. Upper zoœcia of the same, × 55 diam. Fig. 12 *c*. Lower zoœcia of the same, × 18 diam. Fig. 13. Basal zoœcia: No. B 3832; × 18 diam

PLATE XXXI.

Fig. 1. *Adeonellopsis wetherelli*, n. sp., p. 245. London Clay, Fareham. Basal zoœcia. Brit. Mus. No. B 4623. × 55 diam.

Fig. 2. *Lepralia lonsdalei*, n. sp., p. 247. Bracklesham Beds. Bracklesham. Brit. Mus. No. 49734. × 55 diam.

Fig. 3. *Umbonula calcariformis*, n. sp., p. 249. London Clay, Fareham. Brit. Mus. No. B 3831. × 55 diam.

Fig. 4. *Umbonula bartonense*, n. sp., p. 248. Barton Beds, Barton. Brit. Mus. No. 49741. × 55 diam.

Figs. 5–7. *Teichopora clavata*, n. sp., p. 249. Barton Beds, Barton. Brit. Mus. No. 49733. × 55 diam. Fig. 5. Normal zoœcia. Fig. 6. Basal zoœcia: No. 49757. Fig. 7. Part with a gonœcium: No. 49659. × 55 diam.

Fig. 8. *Meniscopora bigibbera*, n. sp., p. 251. Bracklesham Beds, Huntingbridge. Brit. Mus. No. 49732. × 55 diam.

Fig. 9. *Meniscopora bigibbera*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49734. × 55 diam. Fragment with gonœcium.

Fig. 10. *Conescharellina clithridiata*, n. sp., p. 252. London Clay, Hampstead. Brit. Mus. No. 69554. × 18 diam.

Fig. 11. *Conescharellina clithridiata*, n. sp. London Clay, Sydenham. Brit. Mus. No. B 1357. × 18 diam. Another zoarium with oœcia.

Fig. 12. *Orbitulipora petiolus* (Lonsd.), p. 253. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49760. Fig. 12. Zoarium, × 4 diam. Fig. 12 *a*. Zoœcia, × 18 diam.

Fig. 13. *Orbitulipora petiolus* (Lonsd.). Bracklesham Beds, Bramshaw. Brit. Mus. No. B 4349. × 12. Zoarium with stem.

Fig. 14. *Orbitulipora petiolus* (Lonsd.). Whitecliff Bay. Specimen in *Conescharellina* stage. Brit. Mus. No. B 4347.

Fig. 15. *Mucronella angustoœcium*, n. sp., p. 254. Barton Beds, Barton. Brit. Mus. No. 49739.

Fig. 16. *Mucronella angustoœcium*, n. sp. Brit. Mus. No. B 4579. × 55 diam.

PLATE XXXII.

Fig. 1. *Smittia tubularis*, n. sp., p. 255. London Clay, White Conduit House. Brit. Mus. No. 49744. × 55 diam. Fig. 1 *a*. Nat. size. Fig. 1 *b*. Upper zoœcia, × 55 diam. Fig. 1 *c*. Basal zoœcia, × 55 diam.

Fig. 2. *Idmonea bialternata*, n. sp., p. 257. London Clay, Islington. Brit. Mus. No. 49662. Fig. 2. Part of zoarium with oœcium. Fig. 2 *b*. Section.

Fig. 3. *Idmonea giebeli*, Stol., p. 256. London Clay, Haverstock Hill. Brit. Mus. No. 49656. × 55 diam. Fig. 3 *a*. Part of zoarium including an oœcium. Fig. 3 *b*. Transverse section.

Fig. 4. *Idmonea* aff. *seriatopora*, Reuss, p. 258. London Clay, Haverstock Hill. Brit. Mus. No. B 4510. Fig. 4 *a*. Part of zoarium, × 18 diam. Fig. 4 *b*. Mouth, × 32 diam. Fig. 4 *c*. Transverse section, × 18 diam.

Fig. 5. *Idmonea* aff. *seriatopora*. Back view of a zoarium, × 55 diam.

Fig. 6. *Idmonea coronopus*, Defr., p. 259. Calcaire grossier, Parnes. Brit. Mus. Fig. 6 *a*. Nat. size. Fig. 6 *b*. An entire colony, × 18 diam.

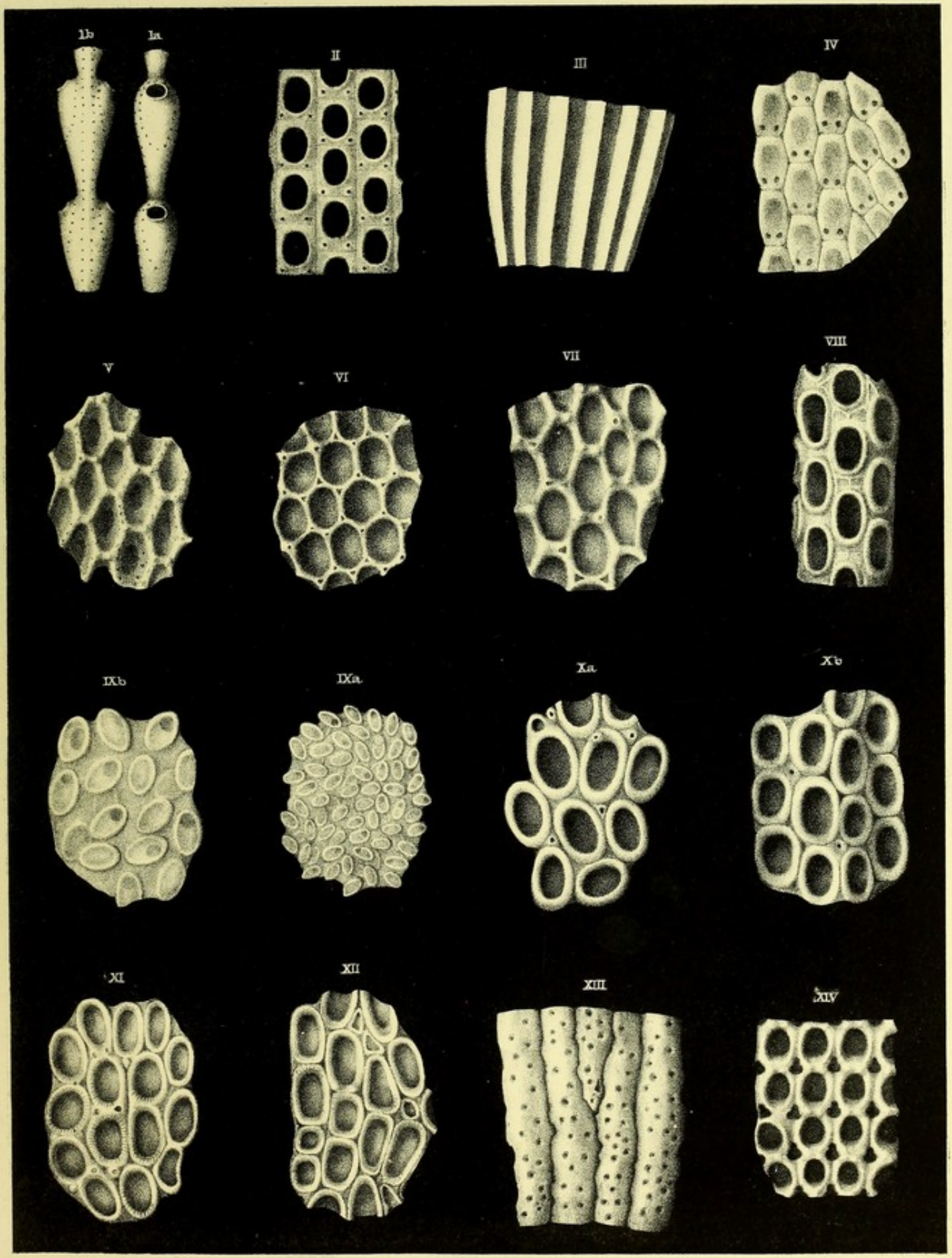
Figs. 7–9. *Hornera farehamensis*, n. sp., p. 260. London Clay, Fareham. Brit. Mus. No. B 3831. Fig. 7 *a*. A zoarium, nat. size. Fig. 7 *b*. View of back, × 18 diam. Fig. 8. Part of another zoarium, × 18 diam. Fig. 9. Basal zoœcia of another specimen, × 18 diam.

Fig. 10. *Entalophora tergemina*, n. sp., p. 260. London Clay, Sheppey Brit. Mus. No. B 4509. Figs. 10 *a* & 10 *b*. Two views of the same specimen, × 55 diam.

Figs. 11 & 12. *Heteropora glandiformis*, n. sp., p. 261. Barton Beds, Barton. Brit. Mus. No. B 4511. Fig. 11. An entire zoarium, × 18 diam. Figs. 12 *a* & 12 *b*. Broken transverse sections showing internal structure. No. B 4512. × 18 diam.

Fig. 13. *Lichenopora*, sp. Barton Beds, Barton. Brit. Mus. No. B 4583. × 10 diam.

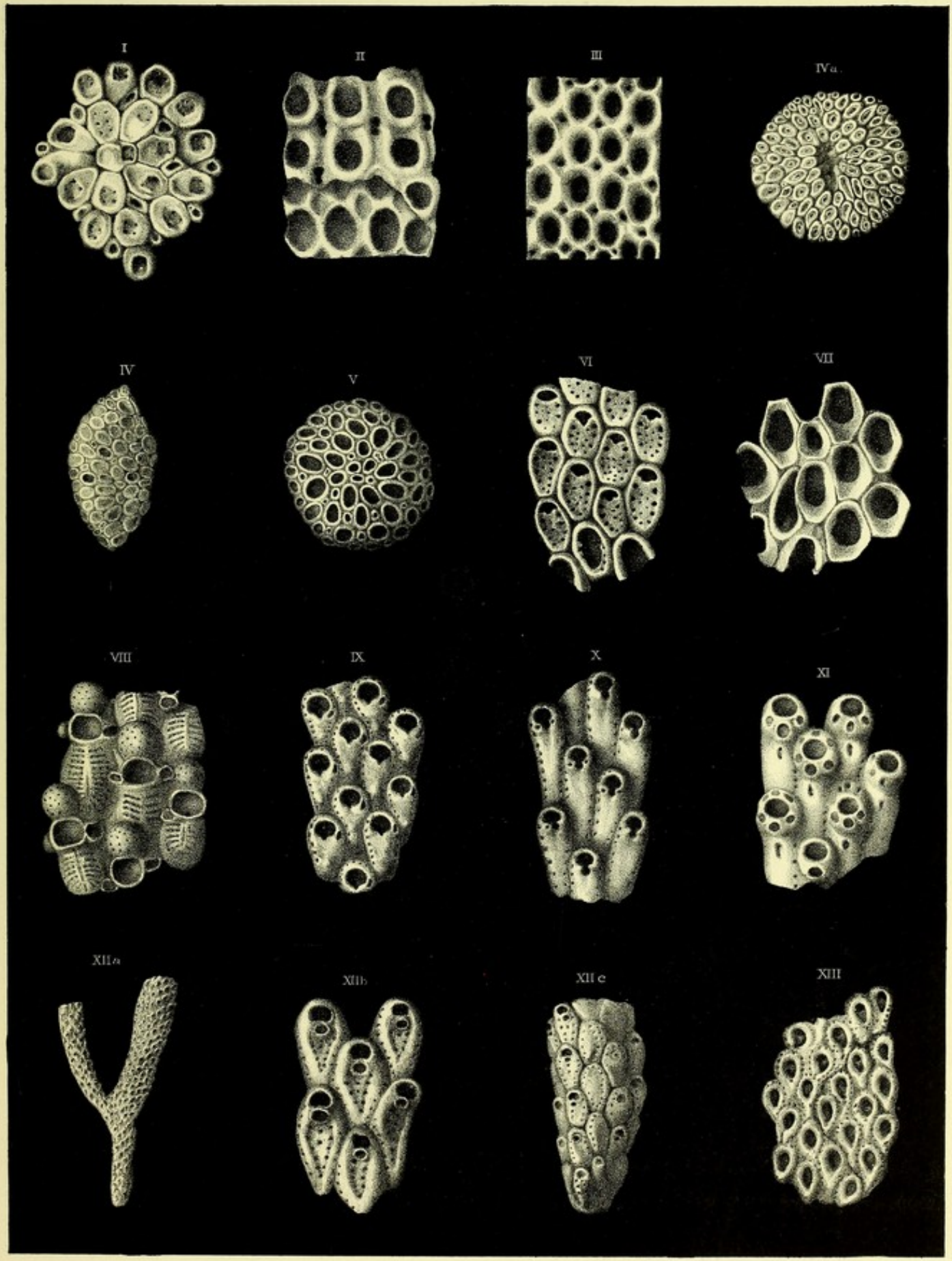
The numerator of the magnifying-power 'fractions' represents the original magnification, and the denominator the reduction from the size of the field of the microscope.



E.C.& G.M.Woodward del.et lith.

West, Newman imp.

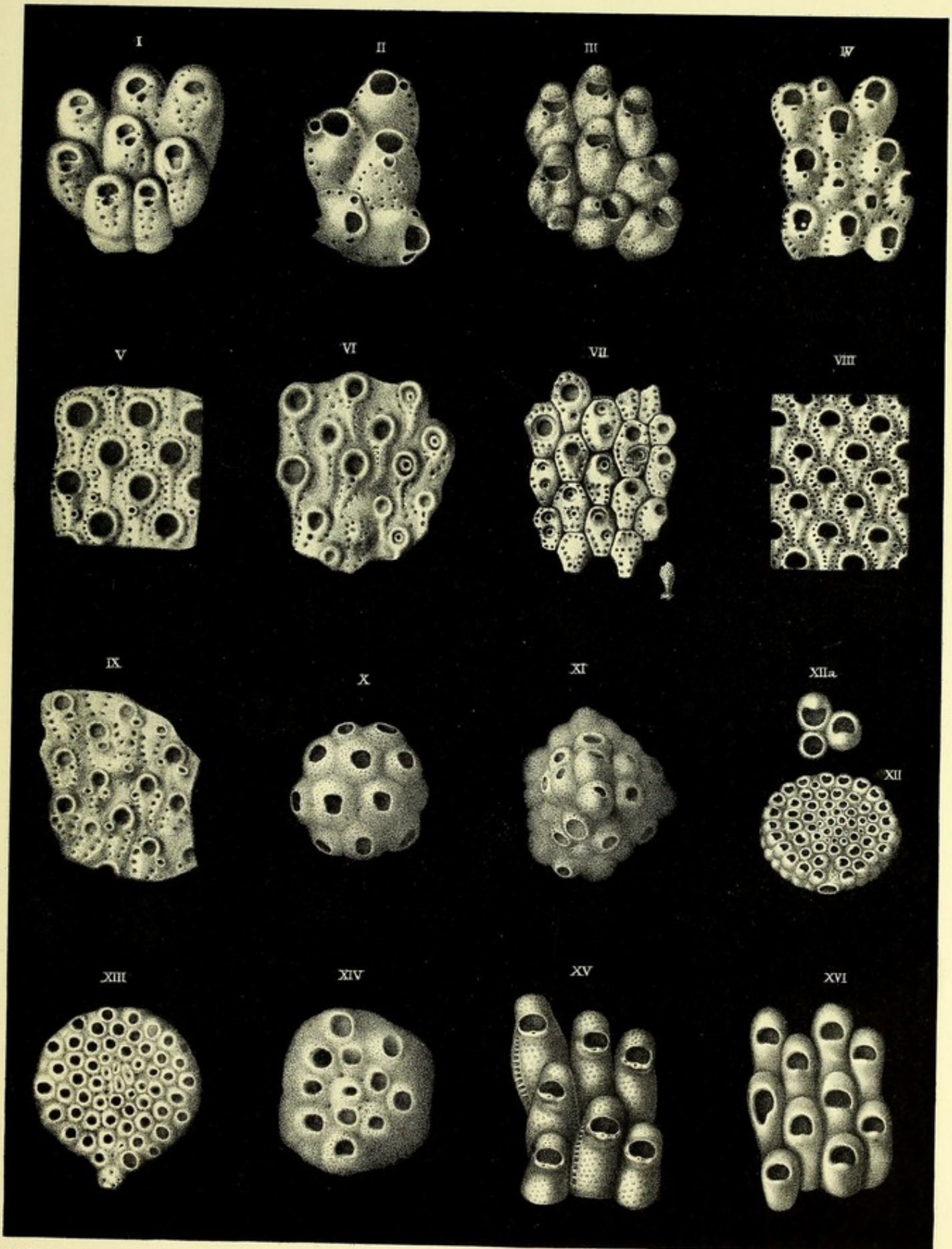
BRITISH PALÆOGENE BRYOZOA.



E.C.&G.M.Woodward del. et lith.

West, Newman. imp.

BRITISH PALÆOGENE BRYOZOA.



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West, Newman imp.

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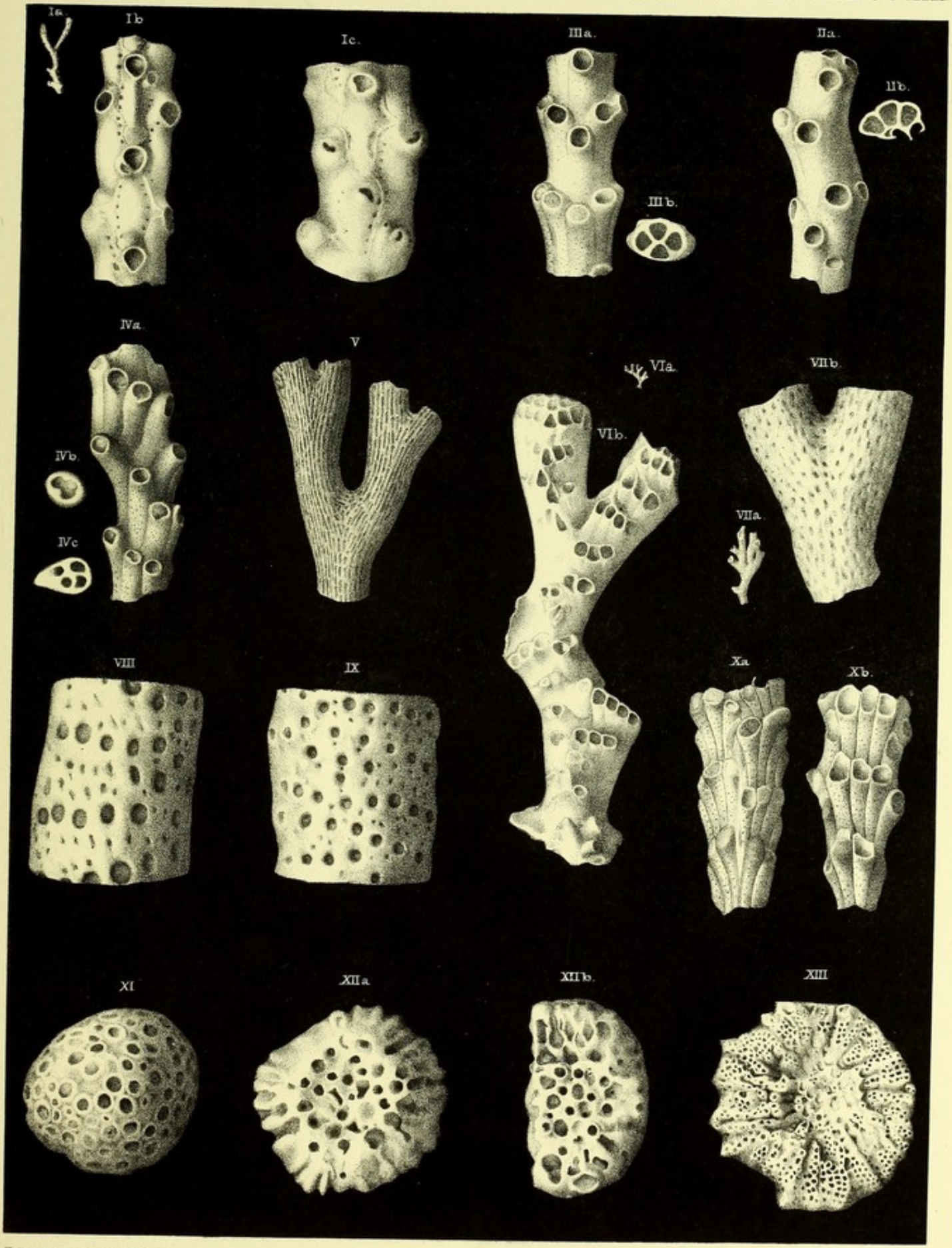

E.C.&G.M.Woodward del. et lith.

West, Newman imp.

BRITISH PALÆOGENE BRYOZOA.

IX. *On additional Bones of the Dodo and other Extinct Birds of Mauritius obtained by* Mr. Théodore Sauzier. *By* Sir Edward Newton, *K.C.M.G., F.L.S., C.M.Z.S., and* Hans Gadow, *Ph.D., M.A., F.R.S., F.Z.S.*

Received October 31st, 1892, read November 1st, 1892.

[Plates XXXIII.–XXXVII.]

In 1889 the Government of Mauritius appointed a Commission to enquire into the "Souvenirs Historiques" of that island; and in furtherance of their object, at the instance and under the able direction of their President, Mr. Théodore Sauzier, they continued the exploration of the Mare aux Songes—the marsh in which the late Mr. George Clark, upwards of five-and-twenty years ago, made the discovery of a vast deposit of bones of the Dodo [1] and other animals, mostly now extinct, and the only locality in Mauritius where remains of the Dodo have been found in any quantity [2].

This exploration has been very successful, for not only have many Dodos' bones, some of them new and others represented only by imperfect specimens, been recovered, but also a considerable number of the bones of other birds, materially adding to our knowledge of those which had been but partially described, and proving the former existence in Mauritius of species either vaguely indicated by old voyagers or wholly unsuspected to have been members of its fauna. Besides these there have been found many remains of the large extinct Lizard, *Didosaurus mauritianus* [3], and several carapaces, more or less entire, though none absolutely perfect, belonging to one or other of the extirpated Tortoises.

Nearly the whole of these specimens have been sent by Mr. Sauzier, on behalf of the Commission over which he presided, to the Museum at Cambridge, with a view to their determination and to the description of such as are new, and this task has been undertaken by the present writers.

Before proceeding to its execution, it may be as well to recall the fact that up to the present time, beside bones of *Didus ineptus*, those of the following birds have been obtained from this marsh and described as under:—

Lophopsittacus mauritianus (Owen).	Lower Jaw. R. Owen, Ibis, 1866, pp. 168 *et seqq.*
	Tibia. A. Milne-Edwards, Ann. Sc. Nat. sér. 5, vi. pp. 91 *et seqq.* (1866).

[1] Ibis, 1866, pp. 141 *et seqq.* [2] Proceedings of the Zoological Society, 1890, pp. 402 *et seqq.*

[3] Günther, Journal of the Linnean Society, Zoology, xiii. pp. 322 *et seqq.*

Astur, sp. indet.	Metatarsus. *Id. op. cit.* xix. art. 3 (1874).
Ardea garzetta, Linnæus.	Tibia. *Id. loc. cit.*
Aphanapteryx broecki (Schlegel).	Lower Jaw, Tibia, Metatarsus. *Id. op. cit.* x. pp. 325 *et seqq.* (1868).
Fulica newtoni, A. Milne-Edwards.	Pelvis, Tibia, Metatarsus. *Id. op. cit.* viii. pp. 195 *et seqq.* (1867).

All these are species which no longer occur in the island.

Bones of a species of *Phœnicopterus* have also been found (G. Clark, Ibis, 1866, p. 144, and A. Milne-Edwards, Ann. Sc. Nat. sér. 5, xix. art. 3).

The present collection contains not only bones of the above-named birds, but also those of a Finch (?), an Owl, four other species of Heron, a Bittern, a Darter, a Gannet, a Goose, a Duck, a Grebe, two species of Pigeon, one of which is probably the extinct *Funingus (Alectorœnas) nitidissimus*, a Water-hen, and two Petrels, of which we proceed to describe and characterize as new :—

Strix sauzieri,
Astur alphonsi,
Butorides mauritianus,
Plotus nanus,
Sarcidiornis mauritianus, and
Anas theodori.

In naming these species we wish by the first and last to commemorate the services to science of Mr. Sauzier ; while the *Astur*, being in all probability identical with that recognized but left unnamed by Professor Milne-Edwards, may be appropriately dedicated to him.

Of birds previously distinguished we have now for the first time the following parts :—

Didus ineptus.—Atlas, Prepelvic or "intermediate" (18th) Vertebra, complete Pubic Bones, and Metacarpals.

Lophopsittacus mauritianus.—Sternum (?), Femur, Metatarsus, beside Lower Jaw far larger than that first described.

Aphanapteryx broecki. — Upper Jaw, third Cervical Vertebra, Pelvis, Humerus, Femur [1].

Fulica newtoni.—Cervical vertebræ (third and ninth or tenth), Sternum, Sacrum, Humerus, Ulna, and Femur [1].

[1] There is a large series of tibiæ (39 right and 50 left), which must belong to one or the other of these two species, but except in a few cases it is impossible to distinguish between them.

One specimen at least of each of the bones now first described has been kindly presented by Mr. Sauzier, on behalf of the Commission of which he is President, to the Museum of the University of Cambridge, as well as a series of other bones in proportion to the extent of the collection. The remainder, including a magnificent skeleton, which has been mounted in that Museum and is doubtless the most complete in the world, of *Didus ineptus*, will be ultimately deposited in the Museum of Mauritius at Port Louis.

1. Lophopsittacus mauritianus. (Plate XXXIII. figs. 1–8.)

A complete tibia obtained previously from Mauritius and having been assigned, although not described, by M. Milne-Edwards to *Lophopsittacus mauritianus*, made it easy to recognize 46 other tibiæ taken from the Mare aux Songes as belonging to the same species of Parrot.

Several femora, varying from 58 to 63 mm. in length, are likewise easily referable to the same species.

There is also a left tarso-metatarsus of 35 mm. in length, typically flattened and broadened out, with the outer condyle turned backwards and outwards in accordance with the reversed fourth toe. The plantar tuberculum near the proximal end of the bone is partly broken off, but sufficiently preserved to show the two canals lying side by side, through which the tendons of the deep flexors of the hallux and other three digits passed. Near the inner or tibial margin of the second metatarsal is a deep impression, caused by the insertion of the tendon of the m. tibialis anticus. The position of this insertion, near the inner side of the second metatarsal, instead of near the middle of the third metatarsal, is typical of Parrots. Above this impression is a deep oblique groove, in which lodged the tendon of the m. extensor digitorum in its oblique course from under the bony tibial bridge to the inner side of the foot. This peculiar groove exists also in *Necropsittacus rodericanus*, *Calyptorhynchus funereus*, *Cacatua galerita*, *Licmetis tenuirostris*, and *Macrocercus macao*, but apparently not in *Stringops*, *Domicella*, or *Trichoglossus*, although the tendons run in precisely the same direction, passing over the tarsus without leaving any impression upon the bone. The erratic occurrence of this groove, intensified by age, but absent in a fully adult *Stringops*, detracts from its taxonomic value.

The following measurements show that the relative lengths of the femur, tibia, and metatarsus from Mauritius are so similar to those of other Old-World Parrots that the bones in question can without doubt be referred to one species only. The measurements show also that this species was considerably larger than *Necropsittacus rodericanus*, agreeing in the length of its hinder extremity with *Cacatua galerita*.

	Necropsittacus rodericanus.	*Lophopsittacus mauritianus.*	*Calyptorhynchus funereus.*	*Cacatua galerita.*	*Palæornis alexandri.*
	mm.	mm.	mm.	mm.	mm.
Femur	46–49	58, 61, 63	55	60	37
Tibia	59–63	88, 93 (type specimen), 99	74	86	50
Metatarsus	22	35	25	27	18
Total length of hind limb	127–134	181–197	154	173	105
Width of sternum at level of 1st rib	20·0	27·5	....	32	
Distance from spina externa to height of crista sterni	20·0	22·0	....	32	
Distance from spina interna to subclavian ridge	13·5	16·0	....	20	
Greatest length of mandibles	57	65, 71, 78	....	53	
Greatest width of mandibles	50	65	....	41	

The most interesting part of this Parrot is the enormous underjaw. One pair of underjaws is absolutely complete but for a few particles of bone being broken off from the anterior margin. The left mandibles of two other specimens are nearly complete. A fourth specimen is represented by the posterior half of the left mandible only. These four jaws vary somewhat in size. The distance from the posterior angle (*p* in fig. 5, Plate XXXIII.) to the anterior end of the complete symphysis is in the largest and best preserved specimen 78 mm., in the next 71, in the third only 65 mm. The smallest specimen of the extinct Mauritian Parrot is consequently still 8 mm. larger than that of *Necropsittacus rodericanus*. The width of the mandibles shows the same proportions. Each underjaw has a distinct additional articulating facet, about 7 mm. in length, for the ventral surface of the outer process of the quadrate, which carries the jugal bone. Such an additional facet, besides the usual one at the ventral end of the quadrate, is indicated in *Cacatua galerita*, broad and well developed in *Stringops*, *Calyptorhynchus*, and *Ara*: in fact, in many Parrots with powerful and broad underjaws.

It seems rather improbable that such an enormous jaw should be associated with a Cockatoo of moderate size; but, curiously enough, the comparison of the greatest length of the mandibles with the total length of the hinder extremity shows that *Necropsittacus rodericanus* had actually a proportionately larger jaw than the species of Mauritius, because the length of the jaw should not be more than 50 or 51, while it is in fact 57 mm. Of course it is hardly necessary to observe that there can scarcely be any correlation between the length of the whole leg and the size of the bill and head in a Parrot; but, having to deal with scanty remains of birds whose anatomical structure is otherwise unknown, we have to be grateful for small mercies. At any rate, we find that the Parrots from Mauritius and from Rodriguez not only resemble each other in the proportions of the bones of their hinder extremities, but also in the

enormous development of their jaws, a feature which makes them unlike any other Parrots. Moreover, these considerations enable us to discuss with some amount of certainty, or at least probability, the only other bone of a Parrot which has been found in the Mare aux Songes: to wit, the sternum.

The sternum is preserved only in its anterior part. The large spina externa agrees in shape and direction exactly with that of *N. rodericanus*, and excludes any possibility of this sternum belonging to any other bird but a Parrot. The ventral margin of part of the keel is broken off, but the line of the m. subclavius is well marked; the whole of the anterior margin and the articulating facets for several ribs are likewise uninjured. This sternum appears at the first glance undoubtedly far too small for *L. mauritianus*, but if we measure its width in level of the first pair of ribs, the height of the keel, the distance from the middle of the anterior margin of the sternum (at the place where the spina interna would be if it existed in these Parrots) to the highest curve of the keel, or to the muscular ridge at the point (Plate XXXIII. fig. 7, *S*), we find that this fragmentary sternum by all its dimensions indicates that it belonged to a larger bird than *N. rodericanus*. In fact, the size of this sternum would fit one of the smaller specimens of *L. mauritianus*; and this is corroborated by the following calculation, which gives a result which we should not have expected:—Average of total length of hind limb of *N. rodericanus* (130): width of its sternum (20)=Length of hind limb of smallest *L. mauritianus* (181): width of its sternum would be 27·8, while our single sternum from Mauritius actually measures 27·5 mm. across!

There can be no doubt that the extinct Mauritian Parrot was a larger but otherwise nearly allied form of the Parrot from Rodriguez; it is, however, questionable whether both might not be included in the same genus *Necropsittacus*, for while we know from old drawings that the Mauritian form had a sort of ornamental crest, we know nothing to the contrary of *N. rodericanus*.

2. Astur alphonsi, sp. nov. (Plate XXXIII. figs. 9, 10.)

Amongst numerous Asturine remains a pair of tibiæ, a pair of metatarsals, and the metacarpals of the left side are probably referable to one individual bird of prey. The two metatarsals, with a length of 81 mm., agree perfectly with that figured by M. Milne-Edwards (plate 33. fig. 2). He rightly referred them to the genus *Astur*, and remarked that they belonged to a bird which was undescribed and unknown, unless it was identical with *A. melanoleucus* from the Cape of Good Hope. We have been able to measure the length of the tarso-metatarsus of an *A. melanoleucus*, and have found that it agrees in this respect with the two bones in question. It would therefore seem reasonable to assign these bones to *A. melanoleucus*, unless the absence of this South-African species from Madagascar, and the numerous instances of insular forms or species of Hawks, be deemed arguments sufficiently strong to distinguish the bird to which these bones belonged as *Astur alphonsi*.

The greatest length of the two tibiæ is 117 mm., which agrees proportionately with that of the two metatarsi, so as to justify us in connecting them with each other as those of the same Hawk, a view which is corroborated by the tibial and metatarsal articulating facets fitting well upon each other. The bony bridge for the m. flexor digitorum communis is very strong, the fibula reaches far down the tibia, the peroneal crest is straight and long, the cnemial crest slants gradually into the anterior inner edge of the shaft of the tibia.

It is of course impossible to state with certainty whether the metacarpal bones, the total length of which is 55 mm., belong to the same individual; that they belong to the same species is more than probable, and that they are those of a diurnal bird of prey of the size of *Astur melanoleucus* is unquestionable. All the facets, tendinous impressions and processes, and the sharp, blade-like, deeply scooped-out third metacarpal bone mark the specimen.

3. Strix sauzieri, sp. nov. (Plate XXXIII. figs. 11–18.)

The Owls are generally classified according to cranial, sternal, and various purely external characters. None of these points will serve our purpose, because the only bones of Owls in the present collection are those of the humerus, tibia, and metatarsus.

There is one character, namely the relative length of the tibia to that of the metatarsus, which is not only very constant but also very characteristic of the various families and even genera of Owls. From the quotient resulting from the division of the length of the tibia by that of the metatarsus we have come to the conclusion that the majority of the bones in question, namely four metatarsals, three tibiæ, and, by inference, two humeri, belonged to a member of the long-footed Owls, of which *Strix flammea* and its allies is the most pronounced type, while *Heliodilus soumagnii* from Madagascar closely approaches it, to the exclusion of *Carine murivora* from Rodriguez, *Scops*, *Sceloglaux novæ-zealandiæ*, *Spiloglaux*, *Gymnoscops*, *Asio*, and *Bubo* as examples of the several subfamilies and principal genera of the so-called *Bubonidæ*.

We have much pleasure in distinguishing this new Owl from Mauritius as *Strix sauzieri*, referring it to the genus *Strix*, and not to *Heliodilus*, on the strength of most of those very characters which induced M. A. Milne-Edwards to establish the new genus *Heliodilus*[1]. These characters are, first, the relative length of the tibia

[1] It will be convenient to mention here at least those characters which could be tested with the material at our disposal :—

"L'Héliodile est un Strigide à pattes robustes, à ailes plus courtes et à tête plus large que les Effraies (*Strix*). Le tibia est plus long et les proportions en sont différentes, car l'extrémité inférieure est plus robuste et le corps de l'os est aussi grêle; la crête péronnière est courte et le péroné ne se prolonge pas autant que chez les Chouettes et les Hiboux. Si l'os de la jambe est plus long que celui de l'Effraie, celui du pied est au contraire plus court; mais ses caractères sont à peu près les mêmes que dans ce dernier genre."—A. Milne-Edwards, Comptes Rendus (1878), vol. 85, p. 1282.

and metatarsus; secondly, the length of the "péroné" or fibula, which, at least in the two larger specimens, is continued far beyond the level of the tubercle of the hallux attachment, as far down as the epicondyle; thirdly, the relatively greater length of the peroneal crest, which in our specimens extends to the end of the upper third of the tibia, while in *Heliodilus* it ends a little below the upper fourth; the actual peroneal connexion, *i. e.* the ridge of the tibia which touches the fibula, is absolutely and relatively larger in our specimens than on the tibia figured by M. Milne-Edwards (Grandidier, Ois. de Madagascar, plate 36 *c*, fig. 8).

On the other hand, there are differences, notably the longer and higher cnemial process of the tibia and the shortness of the humerus, sufficient to justify the specific distinction of this Mauritian Owl from *Strix flammea*, with its numerous varieties.

	Humerus.	Tibia.	Metatarsus.	Quotient. $\frac{\text{Tibia.}}{\text{Metatarsus.}}$	
	mm.	mm.	mm.	mm.	
Strix sauzieri	71	90, 92, 93	63, 63, 64, 64, 66	1·42	Longest Metatarsus.
——, sp.	..	..	56 pair.		
—— flammea	84	85	60	1·42	
Heliodilus soumagnii	72	87	57–60	1·52	
Athene murivora	64–69	69–76	41–46	1·65–1·70	
Asio capensis	..	95	56	1·70	
Scops rutilus	47	50	28	1·80	
Sceloglaux novæ-zealandiæ	58	64	35	1·83	
Bubo virginianus	163	146	75	1·94	
—— madagascariensis	80	82	41	2·0	Shortest Metatarsus.

The pair of metatarsi measuring 56 mm. in length are at the same time much more slender than the other five metatarsi. We do not feel justified in explaining this considerable difference in size and strength by difference of age, because the bones are fully ossified and show all the characteristic markings in the same pronounced degree. Only the bony bridge over the tendon of the m. tibialis anticus is broken, and was moreover certainly incomplete in both of the smaller metatarsi. We naturally tried to fit the shortest tibia of 90 mm. length on to the metatarsus of the corresponding side, but the tibial condylar facets are a little too large. If they fitted, the quotient of this shortest tibia with the shortest metatarsus being 1·61 would indicate an Owl different from any of those which are mentioned in our list. *Asio capensis* cannot be thought of, because its metatarsus is several times stronger than the two in question, nor do we feel inclined to explain the shortness and slender shape of these two bones by sexual difference of *Strix sauzieri*. Unless we assume, what is unlikely, that the island of Mauritius possessed two different species of *Strix*, we have to conclude that the short pair of metatarsals belonged to a small individual of *Strix*

sauzieri, although it is rather improbable that this species, restricted to a small island, varied as much as British specimens of *Strix flammea*, of which latter the British Museum Catalogue records the length of the "tarsus" as 2·2 inches, *i. e.* 55 mm., while the measurements taken from an English specimen in the Cambridge Museum give the length of this bone as 60 mm.

4. Plotus nanus, sp. nov. (Plate XXXIV. figs. 1–5.)

The humerus, pelvis with sacrum, and tibia of the genus *Plotus* possess so many diagnostic characters that the three bones figured on Plate XXXIV. can easily be recognized as belonging to this genus of *Steganopodes*.

The *Humerus* shows the following characteristic points:—The sulcus transversus is very deep and strongly marked, extending from the tuberculum mediale halfway across the head of the humerus as a groove of equal width and depth. The crista superior is straight, and shows well-marked impressions of the insertions of the great pectoral muscle. The supracoracoidean or subclavian muscle has an inserting surface upon the corner where the caput humeri meets the proximal end of the crista superior. The tuberculum inferius s. medianum is a very prominent knob, serving on its dorsal and ventral surfaces for the attachments of the m. coraco-brachialis posterior and m. biceps humeri respectively. The pneumatic foramen lies at the bottom of a wide and deep recess. The dorsal lip of this recess is sharply marked by an oval impression from the tendon of the m. scapuli-humeralis posterior (m. infraspinatus, m. teres major, of other anatomists); from this impression the low but sharp ridge for the m. latissimus dorsi is continued down the middle of the ventral or inner surface of the humerus. The two grooves above and upon the ventral surface of the outer and inner condyles are produced by the origins of the pronator and short flexor muscles of the forearm. The m. brachialis inferior s. internus arises from a strongly marked impression on the dorsal or outer surface of the distal part of the shaft of the humerus.

The *Pelvis* and *Sacrum* are easily referred to the genus *Plotus* by the deeply notched or curved lateral margin of the pre-acetabular part of the ilium, the prominent and sharp antitrochanter, the sharp ventral ridge springing from the three anterior sacral vertebræ, and by the position of the single primary sacral vertebra closely behind the acetabular axis. The individual peculiarity of the specimen described is the lopsided position of the two halves of the pelvis with reference to the sacrum.

The *Tibia* is much flattened anteriorly; its anterior or cnemial crests are high, but not anchylosed with the patella; the peroneal crest for the attachment of the fibula is long and straight. The condylar portion of the tibia is turned considerably inwards, and the bridged-over groove for the passage of the tendon of the m. extensor digitorum communis is very deep and placed obliquely.

There remains the question of the specific differences of the bones before us. They all belong, to judge from their appearance, to one adult individual, but their small

size excludes at once the possibility of their being referable to any of the species hitherto known, as the following measurements will show. We distinguish it, on account of its small size, as *Plotus nanus*.

	Plotus nanus.	*P. anhinga.*	*P. melanogaster.*	*P. nov.-holland.*
	mm.	mm.	mm.	mm.
Left humerus	89	112	132	120
Left tibia	61	77	86	78–95
Distance from acetabular axis to anterior end of sacrum	30	35		
Distance between ventral inner margins of the acetabula	14·5	15		

5. Podicepes, sp. inc.

The proof of the former existence of Grebes in the Mare aux Songes rests upon one single bone only, the right ulna; but the latter agrees in all the essential points with the corresponding bone of the genus *Podicepes*, notably the configuration of the proximal and the distal articulations, and the existence of a sharply marked groove at the upper outer distal condyle for the passage of the tendons of the extensor muscles, and differs in all these characters from the corresponding bones of any other birds which might otherwise possibly be taken into consideration, that doubts are excluded. The total length of this ulna is 82 mm. It is consequently far too long and strong for *P. pelzelni*, *P. minor*, or *P. philippensis*. On the other hand, it is much too short for *P. cristatus* and by 10 mm. shorter than that of *P. ruficollis*. It is, however, slightly longer than the ulna of either *P. cornutus* or *P. auritus*, so that it probably belonged to an insular form of one of these last-named species.

6. Butorides mauritianus, sp. nov. (Plate XXXIV. figs. 6–8.)

It is surprising that of all the Ardeine bones, referable to at least twelve individuals of five different species, none belong to *Ardea* (*Butorides*) *nigricollis*, the only species of Heron at present existing in Mauritius, while a pair of ulnæ, one radius, four metatarsi, and one coracoid must be considered as belonging to a species of short-footed Heron hitherto unknown. The bones in question are all considerably shorter than the corresponding bones of *A.* (*Nycticorax*) *megacephala*. The metatarsi agree otherwise in every detail with those of the latter species; this relative stoutness indicates that they belonged to a Night-Heron or Bittern like *A. megacephala*. The two ulnæ cannot, unfortunately, be compared with those of *A. megacephala*; their length, 110 mm., compared with the length of the humerus of *A. megacephala*, 119 mm., shows, however, likewise that they were those of a considerably smaller bird.

The single left coracoid agrees in all the features of its dorsal or scapular half with *A. megacephala*, but its ventral or sternal half differs considerably, first by the much more strongly marked ridge of the linea intermuscularis on its ventral surface, secondly by the almost straight instead of inwardly curved margin between the processus lateralis and the lateral distal corner of the sternal articulation, thirdly by a very low but very distinct and sharp ridge which arises from the median margin of the coracoid a little above its median articulating corner. This roughness or prominent ridge is entirely absent in *A. megacephala* and in all other Herons which we have been able to examine, but at least a slight indication of it occurs in an individually varying degree in *Nycticorax* and in *Botaurus*. That this coracoid bone belonged, however, to an Ardeine bird is clearly indicated by its whole configuration, notably by the shape and position of the precoracoid process, the various articulating facets at the dorsal end, and the prominent lip on the visceral or internal surface of the median portion of the sternal articulating facet.

	Butorides mauritianus.	*Nycticorax megacephala.*
	mm.	mm.
Length of ulna	111–112	..
Length of metatarsus	81–87	96
Length of coracoid	48	55

7. Sarcidiornis mauritianus, sp. nov. (Plate XXXIV. figs. 9, 10.)

The most tangible proof of the former existence of this form in the island of Mauritius rests at present upon one specimen of left metacarpal bones. However, this solitary specimen is sufficiently well preserved to show its affinities by various well-marked characters. It agrees in size with the corresponding combination of bones of *Bernicla brenta*, while it is considerably smaller than those of the common domesticated *Anser cinereus*, and too large for the Madagascar and East-African *Sarcidiornis africanus* and the Indian *S. melanonotus*.

The genèrically diagnostic feature of the bones of the middle hand of *Sarcidiornis* is the very prominent process which arises from the side of the first metacarpal, proximally from the articulating facet of the pollex. The apex of this process is covered in *Sarcidiornis* by a skin, which, although thickened and bare of feathers, is not transformed into a horny callosity or spur. The same peculiar feature exists in the bone before us; the apex is rough and irregularly shaped, and since this part of the process never serves for the origin or insertion of muscles or tendons, its roughness plainly indicates the same purpose as that of the Madagascar species of *Sarcidiornis*, namely its use as a fighting knuckle, although in an either arrested or incipient state. Such a weapon, furnished with a sharp and long horny spur with bony core, carried by the first metacarpal bone, is fully developed in *Chauna*. This American genus

can of course not be compared with the bird from Mauritius except by analogy. The only truly "spurred Goose" of the Ethiopian region is *Plectropterus*; but the spur is carried by the radial carpal bone and therefore is at once removed from comparison with our specimen, which belonged to a rather large-sized species of *Sarcidiornis*, and, having probably been restricted to the island of Mauritius, may be distinguished as *S. mauritianus*.

Another part of this bird consists of the somewhat incomplete left half of the pelvis; it agrees in size with that of *Bernicla brenta*, consequently by inference with *Sarcidiornis*, measuring 70 mm. from the anterior brim of the acetabulum to the posterior end of the os ischii. The few characters which are preserved in this portion of a pelvis agree with those of *Anas* and *Anser* and other Lamellirostres.

8. Anas theodori, sp. nov. (Plate XXXIV. figs. 11–17.)

The fragment of a sternum, a pair of coracoids, eight humeri, and a pair of metatarsi are referable to a Duck which was considerably larger than *Nettapus auritus*, *Anas bernieri*, and *Dendrocygna*, but smaller than *Anas melleri*, of which we have a skin and breast-bone with shoulder-girdle for comparison.

Of the sternum only the anterior portion is preserved, which is, however, sufficient to show its affinities. Its width between the two lateral muscular ridges of the sternum is 28 mm., *i. e.* slightly less than in *Anas melleri* and agreeing with *Dendrocygna arcuata*; the sternum differs, however, from that of *Dendrocygna* by its well-developed, although broken-off spina externa, by its lower keel, and lastly by the much smaller and shallower entrance to the pneumatic foramen; it differs also from that of *A. melleri* by the lesser height of the keel, moreover by the shape and direction of the anterior margin of the latter.

The single left coracoid is in a perfect state of preservation and fits well into the sternal fragment, so that it might belong to the same species, although certainly not to the same individual. This coracoid differs from that of *Dendrocygna* by its greater length, by the shape of its sternal end, and by its very smooth, almost plain ventral surface. *Nettapus* and *Anas bernieri* are to be excluded on account of their much smaller and shorter coracoids. The coracoid in question is much shorter than that of *A. melleri*, but it agrees closely with the latter by its shape, and especially by the almost plain ridgeless ventral surface of the shaft.

The seven humeri are much like each other, but vary from 70 to 78 mm. in their greatest length; they are exactly of the same shape and size as those of different specimens of *Anas punctata*, *i. e.* of a much smaller Duck than *A. melleri*.

The two metatarsi are in a bad condition; the right one measures 42 mm. in length, indicating a bird much more short-footed than *A. melleri*.

	A. theodori.	*A. melleri.*
	mm.	mm.
Width between pectoral ridges	28	30
Distance from spina interna to top of crest	20	25
Length of coracoid	42	52
Length of humerus	70–78	89
Length of metatarsus	42	41

The result of our investigations is that the bones figured (Plate XXXIV. figs. 11–17) belong to a Duck which differs from any of those found in Madagascar, while it agrees more closely with *A. melleri* but for its dimensions, which are so much smaller that they cannot well be accounted for by individual variation. It is moreover the only Duck of which remains have hitherto been found in Mauritius; we distinguish it therefore as *Anas theodori*, in honour of Mr. Théodore Sauzier.

9. Fulica newtoni. (Plate XXXV. figs. 1–11.)

The remains of this large Coot are numerous. The femur, sternum, humerus, and four cervical vertebræ are new and hitherto not described, while the whole pelvis and sacrum, the tibia, and the metatarsus have been described by M. Milne-Edwards. The bones belonged to at least 24 different individuals, and show accordingly a considerable amount of variation in their dimensions.

The smallest thigh-bone is 76, the longest 90 mm. long. The latter is larger in all its dimensions, otherwise alike the others. The outer or superior trochanteric crest is high and curved inwards; the two principal arms of the tendinous loop for the m. biceps cruris have left two very distinct impressions on the lateral surface of the distal end of the shaft and near the popliteal region. The external condyle has a deep and smooth notch for the reception of the head of the fibula.

The pelvis agrees with that of *Fulica* proper and with that of *Tribonyx* because of the peculiar dip of the dorsal margin of the pre-acetabular ilium, which does not reach up to the level of the dorsal spinous processes, leaving a long groove through which passed the tendons of the usually obliterated dorsal spinal muscles. In the possession of this groove and in its elongated and laterally contracted shape this pelvis agrees with that of a typical *Fulica*, and it differs much from that of *Aphanapteryx* and *Ocydromus*, while the pelvis of *Porphyrio melanonotus* and that of *Tribonyx* are less contracted than in *Fulica* and *Gallinula*.

The sternum of *F. newtoni* resembles in several points that of *Aphanapteryx*, *Erythromachus*, and *Ocydromus*, and differs from *Tribonyx*, *Fulica* proper, and *Porphyrio*, first in the configuration of the whole anterior margin of the sternum, especially in the double or basally divided spina externa, which is moreover broad and flat, while in the other genera this spine is single and furnished with a ventral longitudinal sharp ridge; secondly, by the receding and broad anterior margin of the keel, which, however, is well developed, although less than in *Tribonyx* and *Fulica atra*, but the tendency towards a reduction of the keel is apparent.

The shortest humerus is 8·5, the longest 92 mm. in length. They all differ from that of *Aphanapteryx* by being far less curved, stronger throughout, and furnished with a large pneumatic foramen; the sulcus transversus upon the head of the humerus is deeper, but the tuberculum medium is lower.

The cervical vertebræ of the Rallidæ can be easily recognized by their shape and by the numerous articulating facets, processes, and median crests. On the whole, these vertebræ of *F. newtoni* resemble more closely those of *Porphyrio* and *Ocydromus* than those of *Fulica* proper. Dorsal spinous processes are absent in the 9th and 10th vertebræ, they are rather low in the 6th and 5th, sharp and high in the 4th. Ventral median processes are absent in the 10th to 5th, high in the 4th and 3rd. The latter two vertebræ are marked by a deep round notch on each side, this notch being often turned into a complete foramen. Most of the lower and middle vertebræ of the neck are very broad in comparison with their length.

In conclusion, we feel inclined to think that the *Fulica newtoni* combines important characters of the true genus *Fulica* with those of *Porphyrio*, *Tribonyx*, and *Ocydromus*, and that on the whole it more resembles these last three than the true Waterhens.

10. Aphanapteryx broecki. (Plate XXXV. figs. 12–20.)

Only the tibia, tarso-metatarsus, and underjaw were hitherto known, described and figured by M. Milne-Edwards. Besides the tibiæ and tarso-metatarsi of many individuals, we have now before us the pelvis with sacrum, femora, and humeri; one sternum, one third cervical vertebra, and one nearly complete premaxilla, together with fragments of the upper and lower jaws. It has been comparatively easy to determine most of these new bones because of their close resemblance to the corresponding parts of *Erythromachus*.

The pelvis, with the sacrum, of one specimen is extremely well preserved. It is much more compact, stouter, shorter, and broader than that of *Fulica newtoni*; the dorsal margin of the pre-acetabular part of the ilium reaches up to the dorsal spinous crest of the anchylosed presacral vertebræ, as is also the case in *Ocydromus* and *Porphyrio*. In their general configuration the pelvis and sacrum of *Aphanapteryx* agree with *Erythromachus*.

The femur, essentially similar to that of *Fulica*, *Porphyrio*, and other allied Rails, can be distinguished from that of *Fulica newtoni* by its smaller dimensions.

The tibia and metatarsus, having been described and figured previously, need not be commented upon, beyond stating that they, especially the metatarsus, are relatively stouter than those of *Fulica*.

The sternum and humerus are of particular interest, because of their small size, and because of the absence of any large pneumatic foramina, indicating that this bird was devoid of the power of flight. The sternum is not complete, its posterior portion being absent. Its width across the level of the first rib behind the anterior lateral process is only 25 mm.; the keel is very much suppressed, with its anterior margin broadened

out and deeply grooved, as in *Erythromachus*. There is no trace of a spina interna; the feet of the coracoids, as indicated by their facets, were separated from each other by a smooth groove of 9 mm. in length. The spina externa is represented by two projections from the ventral lips of the median corner of the coracoid articulation. In this respect *Aphanapteryx* agrees with *Erythromachus*, and also with *Fulica newtoni*.

The humerus is very short and slender for so large a bird; its typically Ralline characters are, however, obvious enough to recognize it as belonging to *Aphanapteryx*, while it differs by its far greater length and strength from the humerus of *Gallinula*, and by its much smaller dimensions from that of *Fulica*. A very interesting feature is the absence of the usually wide and deep pneumatic foramen, which is indicated only by a shallow depression which is smaller than even in *Gallinula chloropus*.

The third cervical vertebra could easily be recognized as such by its numerous Ralline characters, which in these birds are strongly pronounced; its dimensions remove it from either *Fulica* or *Gallinula*, *i. e.* from the only other Ralline birds hitherto known to have occurred in Mauritius.

The premaxilla fits well upon the several fragments of underjaws, and still better upon the underjaw figured by M. Milne-Edwards. The great length and the shape of these bones closely resemble those of *Erythromachus* (Phil. Trans. vol. 168, pl. xliii. fig. A). The Mauritian bird is, in fact, nothing but a larger species of the same genus.

A number of measurements are given in the subjoined Table in order to aid the comparison of the Mauritian Ralline birds with each other and with some of their allies.

	Fulica newtoni.	*Aphanapteryx broecki.*	*Porphyrio melanonotus.*	*Ocydromus australis.*
	mm.	mm.	mm.	mm.
Length of pelvis	80	60		
Distance between pectineal processes	23·0	28·5		
Distance across lat. dorsal iliac process	28	44		
Distance across antitrochanters	32	38		
Length of femur	76, 78, 81, 90	69, 70, 71	83	82
Length of tibia	120, 127, 130, 133	98, 102, 108, 112, 115	140	111
Length of tarso-metatarsus	82–84	79	98	62
Length of humerus	85, 88, 90, 92	60–66	88	57
Length of ulna	74			
Total length of sternum	70	incomplete	68	55
Width of sternum from *a* to *a*	29·5–30	25	22	20
Distance between coracoids at sternal articulation	5	9	2·5	
Greatest length of 9th cervical vertebra	17–21			
Greatest width of 3rd cervical vertebra	15	9·5		
Greatest length of 3rd cervical vertebra	16	12·5		

11. Trocaza meyeri.

Five fractured breastbones can easily be recognized as Columbine by the combination of the following characters:—The very high and at the same time slender or thin crista; the presence of a well-developed spina interna, which is broad at its base, ending anteriorly obtuse and slightly bifurcated, while the spina externa is by far less developed; lastly, the deep and regular grooves for the articulation with the coracoids, which do not meet each other, but are separated by a smooth, scarcely prominent, median ridge.

In order to determine the species we have compared the bones with those of *Turtur picturatus*, *Vinago australis*, *Funingus madagascariensis*, and *Trocaza meyeri*. The bones of the first three are figured by M. Milne-Edwards, of the last two the Cambridge Museum possesses skeletons. The result of this comparison showed that four breastbones belong to *Trocaza meyeri*.

In this species there exists a small but distinctly prominent tubercle on the labium internum of the anterior margin of the sternum, midway between the anterior end of the spina interna and the base of the lateral anterior process of the sternum; it serves for the attachment of the inner accessory sterno-coracoidal ligament. This tubercle is well developed in the four breastbones, as in *Trocaza*, very small in *Funingus*, and absent in *Turtur* and *Vinago*.

A second specific character is afforded by the spina externa of the sternum, which is well developed in *Trocaza* and *Vinago*, small in *Turtur*, absent in *Funingus*.

The measurements on the following page show, moreover, additional characters, which led to the determination of the species to which the breastbones belong.

Three tarso-metatarsal bones likewise are referable to *Trocaza meyeri*, because of their length and the configuration of the bony ridges and furrows on the posterior side of the proximal end of the tarso-metatarsus, serving for the passage of the various long flexor muscles of the toes. In this respect *Trocaza* agrees, but for the length of the bones, with *Turtur*, and differs considerably from *Funingus*.

12. Funingus, sp. inc.

One sternum, unfortunately very incomplete, consisting only of the anterior end, with the anterior margin of the sternum and the anterior margin of the keel, may possibly belong to *Funingus*, chiefly on account of the absence of the lateral tubercles of the spina interna, and because of several of its dimensions as given in the following Table, in which this specimen is marked M.S.=Mare aux Songes, while E.N. indicates obtained in the flesh by Sir Edward Newton, and M.E. that the specimen has been figured by M. Milne-Edwards.

	Vinago.	*Turtur.*	*Funingus.*			*Trocaza.*					
	M.E.	M.E.	E.N.	M.E.	M.S.	E.N. ♀	M.S.				
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Distance *a b* from anterior end of spina interna to pneumatic foramen	7·5	8·0	8	10·5	10·0	8	11	10·5	10	9	9
Distance *c c* across the sternum in level of the 2nd thoracic ribs	20·5	18	18	20	broken	21	26	26	25	incomplete	
Distance *a f* from anterior end of spina interna to anterior ventral curve of crista sterni	..	..	22	..	29	28	31	34	31	28·5	incomplete
Length of tarso-metatarsus	23	26·5	..	24	..	..	34	34	..	28·5	

There are also five ulnæ of a Pigeon, which could not, however, be further determined except that they belong to either *Trocaza* or *Funingus*.

13. Didus ineptus. (Plates XXXVI., XXXVII.)

The new material of bones of the Dodo has enabled us to add to the restoration of the skeleton the following parts which have hitherto not been known :—

1. The median distal portion of the *furcula* appears to be devoid of an "apophyse médiane" or hypocleidium, this region being rounded off. This may, however, be a case of individual variation, considering that in the male specimen of the Cambridge *Pezophaps* there is likewise no apophysis, while there is one, although small, in the female specimen. Hence, Professor Owen's restored drawing of this part in the British Museum specimen of *Didus* cannot be pronounced to be incorrect.

2. Metacarpal bones of the right and left side, and the first phalanx of the second finger. These bones present no remarkable features, and agree in their small size with the much reduced state of the other bones of the wings. There is, moreover, no evidence of the existence of those peculiar exostoses on the distal end of the radius and on the first metacarpal that are so characteristic of the male Solitaire, which probably used them as fighting-knuckles.

3. The distal third of the pubic bones.

4. Phalanges of the toes (hitherto known from the Oxford specimen only).

5. The atlas or first cervical vertebra.

The most interesting result of the examination of the bones entrusted to us by Mr. Sauzier is the determination of the number of vertebræ and ribs which belong to the various regions of the skeletal axis.

Hitherto our knowledge of these parts has rested upon the mounted specimen in the

British Museum (and the restored drawings by Professor Owen in the Trans. Zool. Soc. vi. and vii.), which is faulty, and upon the Cambridge skeleton, which was incomplete. Hence all the references to the number of vertebræ and ribs are also at fault (*cf.* Fuerbringer's ' Untersuchungen für Morphologie und Systematik der Vögel,' tabb. xxi. & xxii. pp. 778–781 ; and Bronn's 'Thier-Reich, Vögel,' p. 950).

The vertebræ examined by us belong to an unknown number of individuals. Moreover, it is not possible to pick out a complete series from the atlas to the pelvis, which without doubt belonged to one and the same individual. Lastly, it is a curious mishap that only a single specimen has been found of that vertebra which fits into the gap between the last of the three anchylosed thoracic vertebræ and the first vertebra which is overlapped by and fused with the pelvis.

The determination of the number of vertebræ composing the various regions of the vertebral column has consequently to rest upon circumstantial evidence. An unbiased collection of facts from other Pigeons reveals certain correlations of number and shape of vertebræ and ribs, and the results thus gained can be applied to the restoration of the Dodo's skeleton with a considerable amount of probability.

It seems to be the rule in normal (not domesticated) Pigeons that :—

1. The 15th, 16th, and 17th vertebræ are anchylosed together.

2. The 18th vertebra is free, articulating in front with the 17th, and behind with the 19th vertebra, which latter in all cases is overlapped by, and partly fused with, the pelvis. For the sake of convenience the 18th may be called the intermediate vertebra.

3. The 14th and 13th vertebræ each possess a spinous process which is hook-shaped.

4. Complete ribs, *i. e.* such as articulate with the sternum, vary from 3 to 4 in number, and are restricted to the 15th to 19th vertebræ, while the 16th to 18th always carry complete sternal ribs.

5. Cervico-dorsal vertebræ are those which carry movable short ribs ; the dorsal portion of such a rib articulates by a typical capitulum and tuberculum with one vertebra, while the ventral or distal half of the rib is lost. As a rule, at least, the last of these short ribs carries an uncinate process. The number of cervico-dorsal vertebræ is two, rarely three.

6. The other neck-vertebræ are true cervical vertebræ ; with the exception of the atlas and the epistropheus, they all possess a transverse foramen and immovable rib-rudiments.

7. In recent Pigeons the last or hindmost pair of complete sternal ribs is frequently followed by one pair of ribs which, attached to the 19th, or 1st pelvic, vertebra, almost reaches the sternum : in rare cases there is present even a second, although much shorter pair, which then belongs to the 2nd pelvic or 20th vertebra.

The following Table will show these modifications :—

C indicates the last true cervical vertebra.
h „ a hooked spinous process.
r „ a short rib.
st indicates a sternal rib.
u „ an uncinate process (not mentioned on the sternal ribs).

Serial number of vertebræ	12	13	14	15	16	17 (anchylosed)	18 intermediate.	19 1st pelvic.	20 2nd pelvic.
Columba livia	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	*st*	almost sternal	no rib
Phaps chalcoptera	C	*h*, *r*	*h*, *r*, *u*	*st*	*st*	*st*	*st*	„	long rib
Didunculus strigirostris	C	*h*, *r*	*h*, *r*	*st*	*st*	*st*	*st*	„	no rib
Treron olax	..	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	„	
Carpophaga pacifica	..	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	„	no rib
Goura coronata	..	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	„	
Pezophaps solitaria, ♂	..	C, *h*	*h*, *r*, *u*	*r*, *u*	*st*	*st*	*st*	*st*	short rib
—— ——, ♀	..	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	*st*	„
Didus ineptus, properly restored, Cambridge and Mauritius Museums	..	C, *h*	*h*, *r*	*r*, *u*?	*st*	*st*	*st*	*st*	no rib
Didus, British Museum, figured by Sir Richard Owen, Trans. Zool. Soc.	C	*r*	*r*, *u*	*st*	*st*	*st*	*st*	*st*	almost sternal

Didus agrees with *Pezophaps* in possessing 13 cervical vertebræ, 2 short ribs, 4 sternal ribs, the last being carried by the first pelvic vertebra.

Treron, *Carpophaga*, and *Goura* agree with each other in having 13 true cervical vertebræ, 2 short, 2 sternal, and 1 almost sternal pairs of ribs. They differ from *Didus* and *Pezophaps* in the latter pair of ribs being withdrawn from the articulation with the sternum.

Columba, *Phaps*, and *Didunculus* differ from the others in having only 12 true cervical vertebræ, 2 short, 4 sternal, and 1 almost sternal pair of ribs, because their 15th or first anchylosed vertebra (instead of the 16th or 2nd anchylosed vertebra) carries the first pair of sternal ribs.

The restoration in the Trans. Zool. Soc. vi. pl. 15 contains one pair of sternal ribs and one vertebra (the 15th in the figure) too many.

In conclusion we wish to say that, beside the Birds' bones here described, the explorations of Mr. Sauzier have produced very many bones of Reptiles, which will be treated of by one of us in a subsequent paper, together with a considerable number of shells of Mollusks, portions of Crustacean integument, and a few pieces of Coral. The presence of these marine forms in the soil of the Mare aux Songes may be, it is believed, attributed to the action of Land-Crabs, for there is no reason to think that

the sea has ever had access to the lake, from which it is separated by a ridge of some height, while it is known to be the habit of those creatures to convey animal remains a long distance inland from the shore. Nevertheless it may be as well to name the shells as determined by Mr. A. H. Cooke, Honorary Curator of Conchology in the Cambridge Museum. They are as follows:—LAND MOLLUSCA, *Gibbulina sulcata*, Lam., *Pachystyla inversicolor*, Fér., *Cyclostoma carinatum*, Lam. : MARINE MOLLUSCA, *Cypræa caput-serpentis*, L., *Nerita polita*, L., *Turbo sp. incert.* (fragment). In addition to the foregoing the seeds of several plants have also been found, but these appear not to need enumeration ; nor do the specimens of the soil collected by Mr. Sauzier (though all are carefully preserved in the Museum) seem to call for any particular remark on the present occasion.

EXPLANATION OF THE PLATES.

PLATE XXXIII.

Figs. 1–8. *Lophopsittacus mauritianus* (p. 283).

Fig. 1. Left tibia, front view. *l*, attachments of the transverse ligament across the long extensor tendons.

Fig. 2. Right femur, posterior view.

Fig. 3. Left metatarsus, plantar surface.

Fig. 4. Left metatarsus, dorsal surface. *g*, groove for the tendon of the musc. extensor digitorum ; *i*, insertion of the tendon of the m. tibialis anticus.

Fig. 5. Dorsal view of the underjaw. *p*, posterior angle ; *f*, facet for the quadrate ; *fi*, additional facet for the jugal process of the quadrate.

Fig. 6. Lateral view of the right jaw.

Fig. 7. Ventral view of sternum. *Sp.e.*, spina externa sterni ; *p.l.a.*, anterior lateral process ; *S*, lateral line of m. subclavius.

Fig. 8. Right lateral view of sternum. *Sp.i.*, spina externa sterni ; *S*, median line of m. subclavius.

Figs. 9 and 10. *Astur alphonsi* (p. 285).

Fig. 9. Left tibia, front view. *f*, rest of fibula ; *b*, bony bridge over the tendon of the m. extensor digitorum ; *p*, peroneal crest.

Fig. 10. Left metacarpals, lateral view. *p*, articular facet of the pollex ; m_3, metacarpale III.

Figs. 11–18. *Strix sauzieri* (p. 286).

Figs. 11, 12. Inner and outer views of humerus. *f*, pneumatic foramen.

Fig. 13. Left tibia, front view. *p*, peroneal crest ; *f*, distal portion of fibula ; *l*, attachment of transverse ligament.

Figs. 14, 15. Posterior and anterior views of right tarso-metatarsus. *b*, bony bridge across the tendon of the m. tibialis anticus; *h*, facet for the hallux's metatarsal; *i*, insertion of the m. tibialis anticus.

Fig. 16. Proximal end of the tarsus.

Figs. 17, 18. Posterior and anterior views of the small pair of tarso-metatarsals.

PLATE XXXIV.

Figs. 1–5. *Plotus nanus* (p. 288).

Figs. 1, 2. Dorsal and ventral views of pelvis. *I*, first vertebra fused with sacrum; *T.1*, primary sacral vertebra; *pb*, os pubis; *at*, antitrochanter.

Fig. 3. Inner or median view of left humerus.

Fig. 4. Outer or lateral view of left humerus. *C.s*, crista superior; *S.t*, sulcus for the humero-coracoid ligament; *T.s*, tuberculum superius s. externum; *s.a.l*, sulcus anconæi lateralis; *s.a.m*, sulcus anconæi medialis; *b.i*, origin of the m. brachialis inferior.

Fig. 5. Anterior view of left tibia. *p*, peroneal crest; *l.c*, lateral cnemial crest.

Figs. 6–8. *Butorides mauritianus* (p. 289).

Figs. 6, 7. Dorsal and ventral views of left coracoid. *l.i*, linea intermuscularis; *p.l*, prominent lip; *pr*, precoracoid process; *r*, rough ridge.

Fig. 8. Posterior plantar view of right tarso-metatarsus. *h*, attachment of metatarsale I.

Figs. 9 and 10. *Sarcidiornis mauritianus* (p. 290).

Fig. 9. Lateral view of metacarpals of left wing.

Fig. 10. Median or ventral view. *M.1*, rough knob of first metacarpal; *P*, articulation of pollex; *f*, facet for the os carpale ulnare.

Figs. 11–17. *Anas theodori* (p. 291).

Fig. 11. Left lateral view of sternum. *Sp.e*, spina externa; *l*, lateral line of m. subclavius.

Fig. 12. Anterior margin of sternum. *K*, keel.

Fig. 13. Ventral view of left coracoid.

Figs. 14, 15. Right humerus. *s*, sulcus for ligament. humero-scapulare; *C.s*, crista superior; *b.i*, origin of m. brachialis inferior.

Fig. 16. Posterior or plantar view of right tarso-metatarsus.

Fig. 17. Proximal end of the same.

PLATE XXXV.

Figs. 1–11. *Fulica newtoni* (p. 292).

Fig. 1. Dorsal view of premaxilla.
Fig. 2. Dorsal view of third cervical vertebra.
Fig. 3. Dorsal view of either ninth or tenth cervical vertebra.
Fig. 4. Ventral view of either ninth or tenth cervical vertebra.
Fig. 5. Sternum from the right side. *p.l.a*, anterior lateral process; *Sp.e*, spina externa; *s*, ridge of m. subclavius.
Fig. 6. Sternum from the ventral side. *a a*, distance of 30 mm.
Fig. 7. Sternum from the dorsal side. *C.s*, attachment of ligament between sternum and coracoid.
Fig. 8. Lateral view of left humerus. *S.t*, sulcus transversus.
Fig. 9. Median view of left humerus. *C.s*, crista superior; *t.m*, tuberculum medium.
Figs. 10, 11. Anterior and posterior views of left femur. *B*, attachment of sling of biceps muscle; *F*, facet for the fibula.

Figs. 12–20. *Aphanapteryx broecki* (p. 293).

Fig. 12. Premaxilla and mandible; lateral view.
Fig. 13. Dorsal and ventral views of third cervical vertebra. *p.t*, posterior zygapophysis.
Figs. 14, 15, 16. Ventral, dorsal, and lateral views of sternum. *T*, tubercle for attachment of sterno-coracoid ligament; *K*, anterior end of keel.
Fig. 17. Lateral view of left humerus. *t.m*, tuberculum medium, much higher than in *Fulica*.
Fig. 18. Median view of left humerus.
Fig. 19. Ventral view of pelvis and sacrum. *p.p*, pectineal process; S_1, primary sacral vertebra.
Fig. 20. Right lateral view of pelvis. *A*, antitrochanter; *p.i*, posterior lateral dorsal process of ilium; *P*, os pubis.

PLATE XXXVI.

Didus ineptus (p. 296).

Fig. 1. The first correctly restored and properly mounted skeleton of the Dodo. The specimen belongs to the Government Museum of Mauritius. The left wing and ribs have not been drawn, in order to keep the drawing clearer. The 18th vertebra has been cross-shaded, because it was still unknown when the skeleton was restored.

Figs. 2, 3, 4. Anterior, posterior, and lateral views of the atlas. Nat. size.

Fig. 5. Dorsal and ventral views of the metacarpals and of the first phalanx of the index.

PLATE XXXVII.

Didus ineptus (p. 296).

Figs. 1 A, B. Dorsal and lateral views of the posterior portion of the pelvis. Nat. size.

Figs. 2 A, B, C. Lateral, anterior, and posterior views of the 18th vertebra. Nat. size. Only one single specimen of this 18th vertebra was found amongst the hundreds of other vertebræ of the Dodo which have passed through our hands. This specimen is unique. The corresponding vertebra of the mounted skeleton in the British Museum is a cleverly executed artificial substitute.

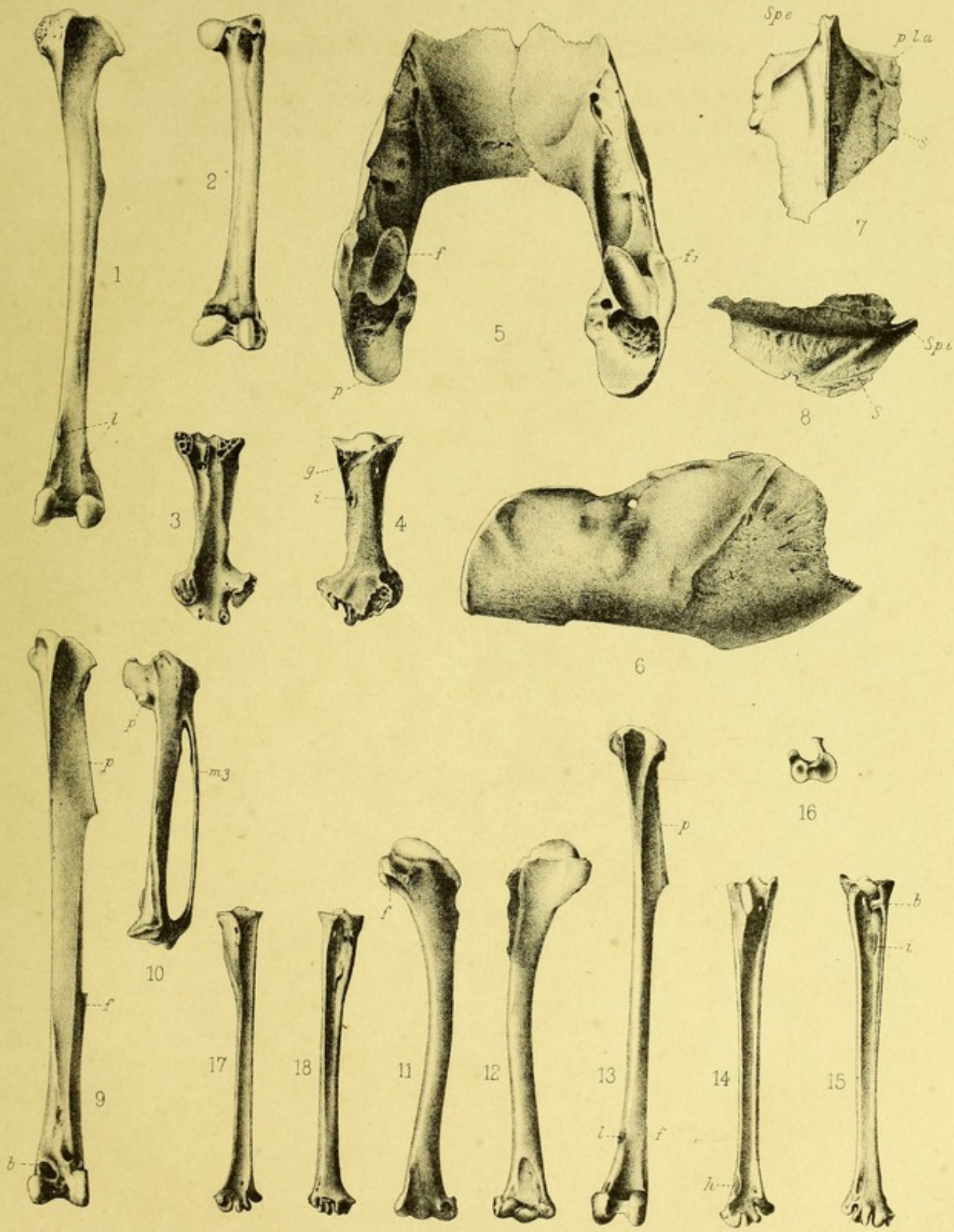

FIG 1-8 LOPHOPSITTACUS MAURITIANUS. FIG 9-10 ASTUR ALPHONSI.
FIG 11-18 STRIX SAUZIERI.

Cambridge Engraving Company.

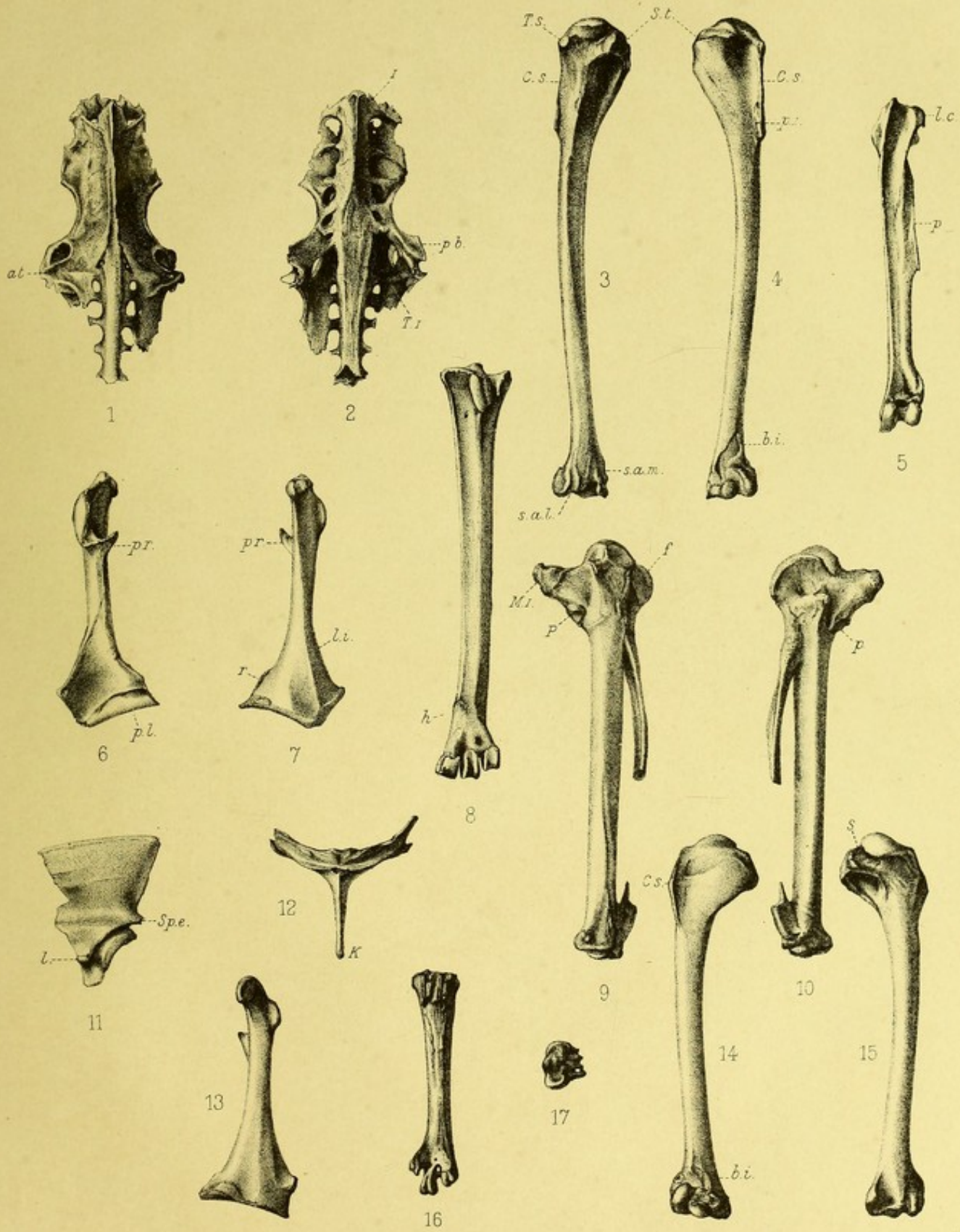

FIG. 1-5 PLOTUS NANUS. FIG. 6-8 BUTORIDES MAURITIANUS. FIG. 9-10 SARCIDIORNIS MAURITIANA.
FIG. 11-17 ANAS THEODORI.

Cambridge Engraving Company.

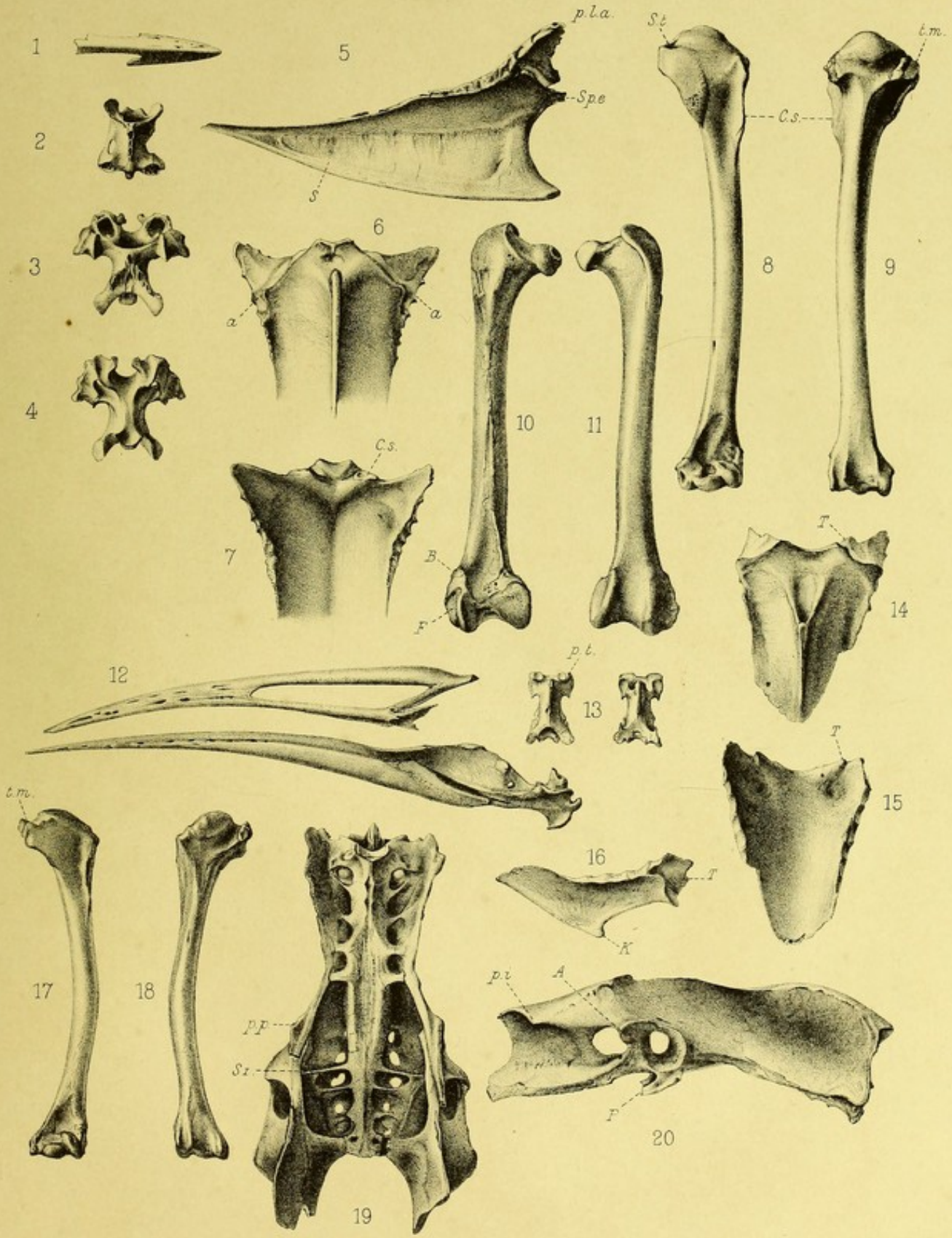

FIG 1-11 FULICA NEWTONI. FIG 12-20 APHANAPTERYX BROEKEI.

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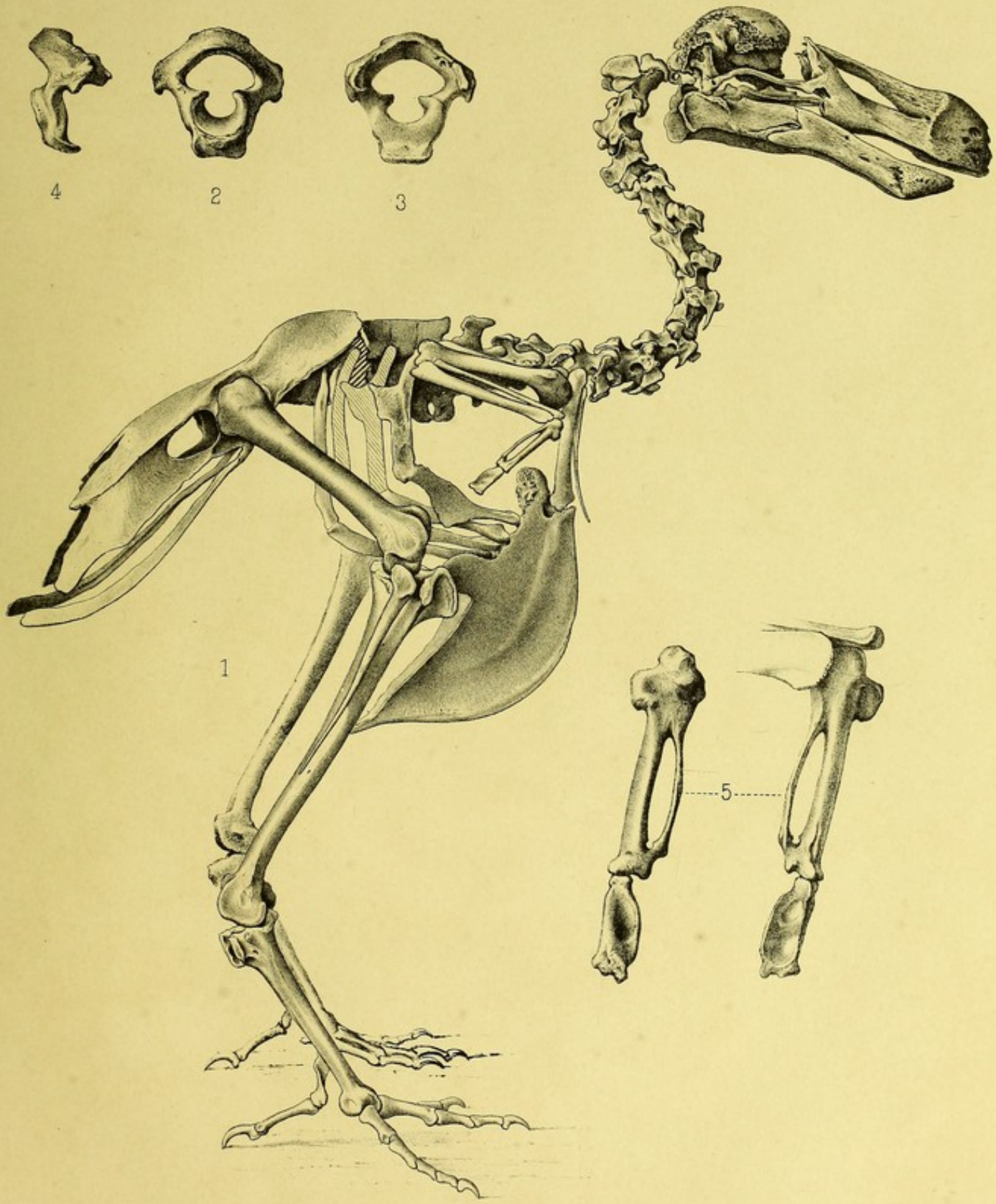
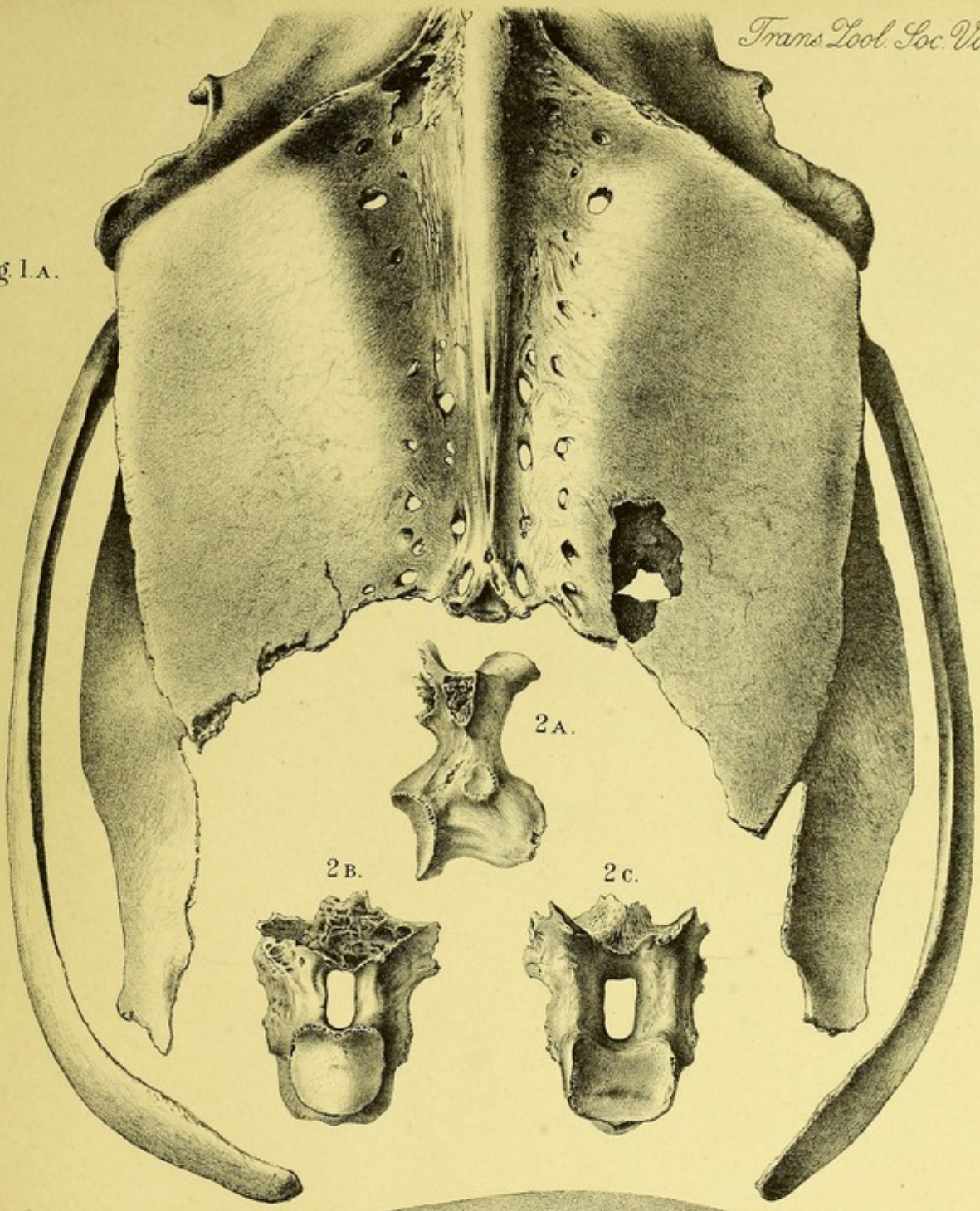


FIG. 1-5 DIDUS INEPTUS

Cambridge Engraving Company.

Fig. 1.A.

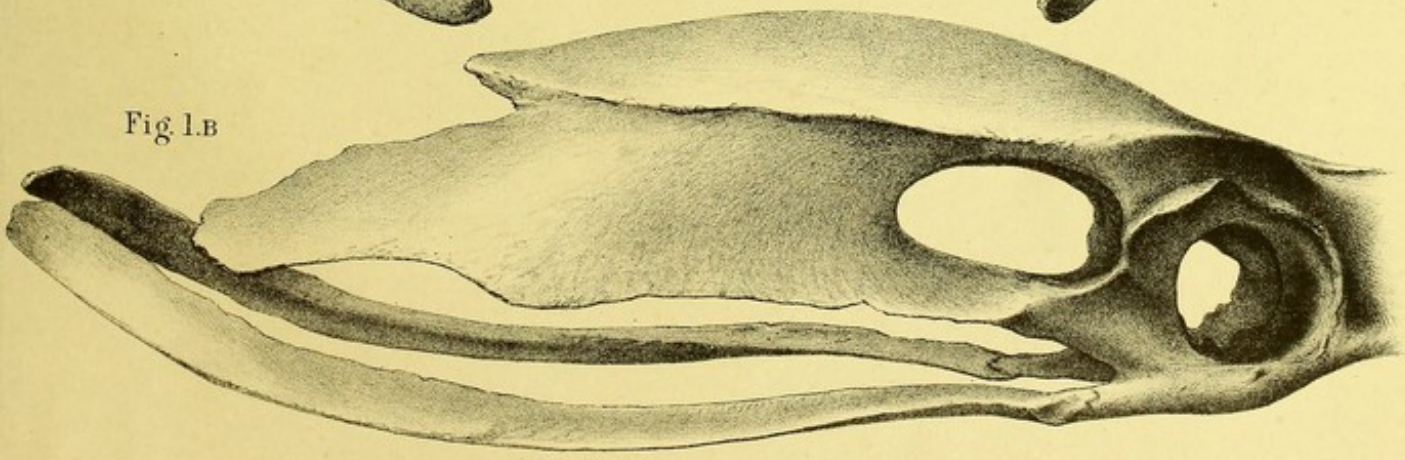


2A.

2B.

2C.

Fig. 1.B



Cambridge Engraving Company.

DIDUS INEPTUS.

X. *Description of a remarkable new Sea-urchin of the Genus* Cidaris *from Mauritius.*

By F. Jeffrey Bell, *M.A., Sec.R.M.S., Professor of Comparative Anatomy and Zoology in King's College.*

Received September 12th, 1892, read November 1st, 1892.

[Plate XXXVIII.]

A FEW months since the Trustees of the British Museum obtained from M. de Robillard, of Mauritius, another of those rarities in the collection of which he has so much distinguished himself [1]. The specimen is unique, and its general facies would be so much altered by the removal of a fifth of the spinulation that I propose, on this occasion, to limit myself to a description of the external appearance of the most remarkable *Cidaris* it has ever been my good fortune to see. In the hope that further examples might be discovered I have delayed, longer perhaps than I should, the publication of a notice of this extraordinary specimen.

The primary spines are exceedingly long, some of them being more than 150 millim. in length, or about three times the diameter of the test. They are, however, most remarkable for being curved, slightly indeed, but yet distinctly curved in an upward direction. The base of the spine is flattened on its lower side; there are two sharp edges, and the upper side is formed of two halves set at a wide angle to each other, and ending in a distinct ridge. This ridge may be dentate and ornamented with a few minute tubercles. At a distance of about 20 millim. from its base the upper ridge disappears, and the spine becomes flat above as well as below. At about this point most of the spines become completely altered in colour (in the dry specimen), for while the basal part is creamy yellow, the rest of the large spine is of a reddish-brown colour. In many, near the tip, there are a few bands of brown and pale yellow. Where the brown colour begins a distinct striation also commences, and there are ten striæ on both the upper and the lower surfaces. The spine is widest at its base, and as it narrows very regularly the whole has the form of a greatly elongated triangle. Gradually and almost imperceptibly, the form of the spines in cross section alters, and instead of being depressed and flattened it becomes almost regularly circular.

The spines just described are arranged very regularly in pairs in each inter-ambulacrum; only one or two are more than 150 millim. long; in each inter-ambulacrum there are seven or eight primary spines, and the shortest are, as usual,

[1] I cannot let pass this opportunity of putting on record the regret with which all who are interested in marine zoology have heard of the recent death of this distinguished collector.

those nearest the mouth. It is usual for all to have the form and coloration already described; but those nearest the mouth are more spatulate in form than the rest.

The secondary spines are crowded in great quantities round the bases of the primaries and in the ambulacral areas; they are sharply pointed, and creamy or yellowish in colour. The apical area is very extensive and about half the diameter of the corona.

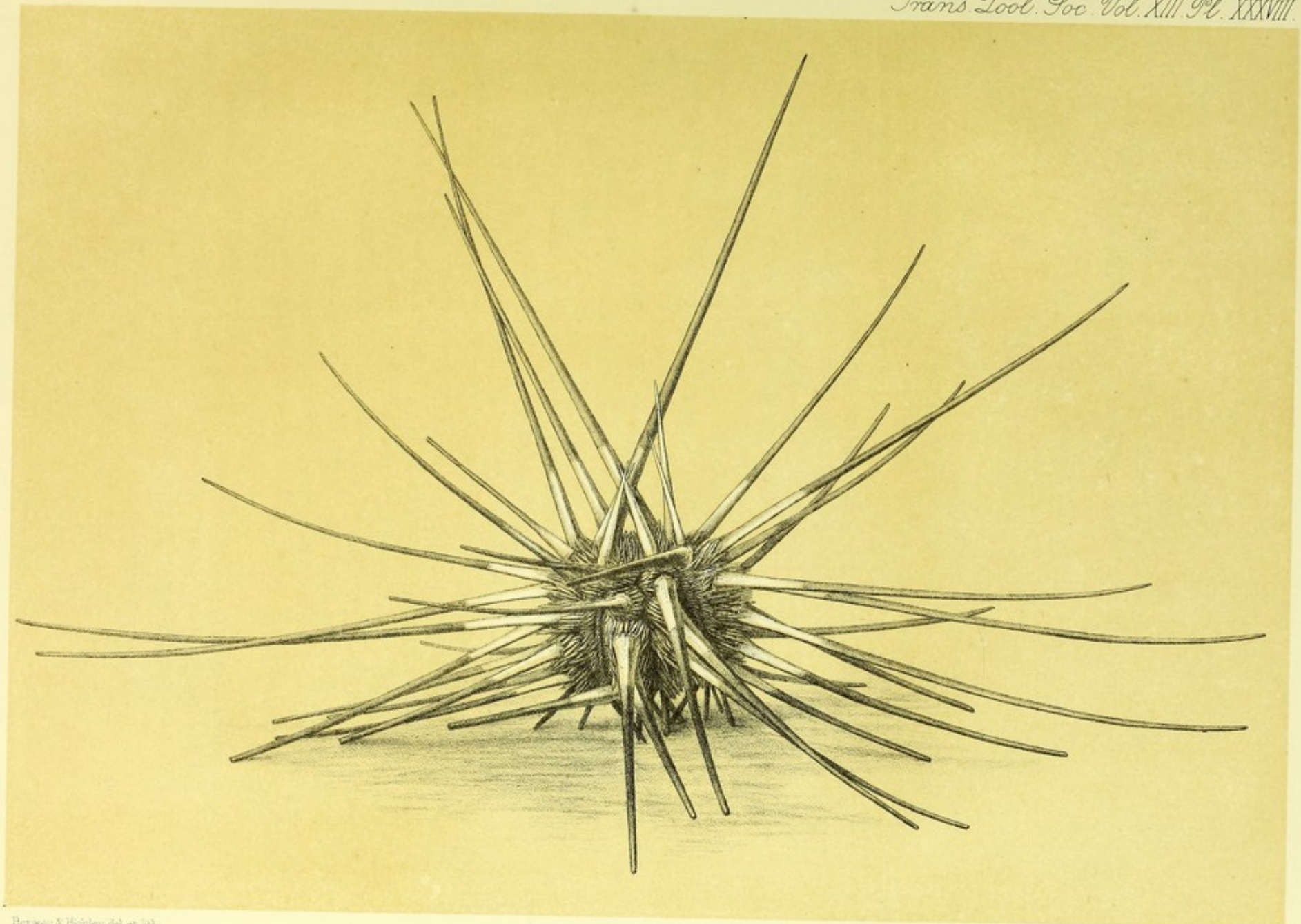
With regard to the affinities of this species it is not possible to say much. The amount of ostracum seen in transverse sections of the spines is slight, and there are no swellings, transverse crowns, or ridges, and no parasitic deposits. The long simple spines with striæ appear to be most like those members of the genus which have been distinguished as *Dorocidaris*.

A number of, as I think, very unnecessary genera have been founded for various examples of *Cidaris*[1]. To *Cidaris* in a wide sense there is no doubt that the present specimen belongs, and I do not expect that the investigation of the denuded test will lead to the establishment of any new generic division for it. From the characteristic shape of the spines I propose to call it *Cidaris curvatispinis*.

EXPLANATION OF PLATE XXXVIII.

Cidaris curvatispinis, from a photograph, reduced to two-thirds of the natural size.

[1] *Cf.* Catal. Brit. Echinoderms Brit. Mus. (1892), p. 139.



Percy Sect. & Highley del. et lith.

Hanhart imp.

CIDARIS CURVATISPINIS.

⅔ nat.

XI. *On Remains of an Extinct Gigantic Tortoise from Madagascar* (Testudo grandidieri, *Vaillant*).

By G. A. Boulenger.

Received October 25th, 1892, read November 15th, 1892.

[Plates XXXIX.–XLI.]

On the 14th December, 1868, Prof. H. Milne-Edwards announced to the French Academy of Sciences[1] the discovery by M. Grandidier of remains of some gigantic Tortoises in Madagascar, contemporaries of *Æpyornis* and *Hippopotamus lemerlii*. These bones were referred to two species, named *Testudo abrupta* and *Emys gigantea* by Grandidier, without, however, any descriptions being given by means of which some idea could be obtained of their affinities. So matters stood until 1885, when Prof. L. Vaillant published some notes on these remains[2], which had in the meantime been restored for exhibition in the Palæontological Gallery of the Paris Museum, at the same time showing that both species belong to the genus *Testudo*. The name *gigantea* being twice preoccupied in that genus, Grandidier's *Emys gigantea* was renamed *Testudo grandidieri*. It is, however, not impossible that Grandidier's tortoise will ultimately have to be regarded as a form of the true *Testudo gigantea* of Schweigger. To *T. grandidieri* belong the remains the description of which has been kindly entrusted to me by Dr. H. Woodward. They consist of two nearly perfect shells, skilfully restored by Mr. Barlow, fragments of others, an imperfect skull, and numerous bones belonging to several individuals, found by Mr. Last in South-west Madagascar, and now preserved in the Geological Department of the British Museum.

Mr. Last writes, from Nossi Vey, as follows about the specimens:—"They were found in large caves in the rocks some two miles from the beach. These caves were formed by the sea long ago, when either the sea was higher or the land lower than it is at present. The Tortoises are found in pairs partly bedded in the fine loose sand of the caves, and, owing to the fact that they are only partly buried, many of the small bones get lost, the natives making use of these caves as hiding-places for themselves in time of war, and for their goods in time of peace. In one case, where the shell of one animal was completely underground, though broken all to pieces, I have sifted the soil and found nearly all the small bones and a head, which seems to me very small for so large an animal."

Unfortunately, Mr. Last did not keep apart the bones which he secured in connexion with the shell, but sent them home mixed up with those of several other individuals. This has necessitated considerable labour on my part in identifying them, and in several

[1] Comptes Rendus, lxvii. 1868 p. 1165.

[2] Comptes Rendus c. 1885, p. 874.

cases caused some uncertainty; in dealing with the smaller carpal and tarsal bones and phalanges I had to give up the attempt at sorting out the bones according to specimens. The material, though thus inadequate for the complete restoration of any single specimen, yet affords information on almost every portion of the skeleton, and is therefore of the greatest value in fixing the characters of this extinct tortoise, our knowledge of which was still very imperfect.

1. *Shell.*—In addition to fragmentary remains of several specimens, we have two nearly perfect shells, referable to male and female. The former measures 116 centim. in a straight line and 150 over the curve, thus agreeing very closely in size with the type specimen in Paris, which measures 121 and 152. In the characteristic flatness of the vertebral region, together with the sinuous protuberances and the deep grooves separating the epidermal scutes, it agrees entirely with the original, as I am informed by Prof. Vaillant, to whom I showed the specimens during a recent visit he made to the Natural History Museum. The figures (Plate XXXIX.) appended to this paper relieve me from giving a description of the shape of the carapace, which, after all, differs but slightly from that of the existing Aldabra forms, *Testudo elephantina* and allies. Its width is 85 centim. and its height 49. The anterior margin is feebly notched in the middle and turned outwards on the sides, with notches between the marginal scutes; the posterior sides are likewise expanded, and the pygal incurved. The nuchal shield is very small, as long as broad; the vertebral shields are broader than long, a little broader than the costals; the supracaudal is single.

The plastron agrees with that of *T. gigantea* and *T. hololissa*. Its length is 92 centim.; its front lobe 27 long and 33 broad at the base, 12 at the apex, which is truncate. The bridge measures 44. The hind lobe is rounded, without anal notch, 19 centim. long and 47 broad. The gular shield is divided; the suture between the humerals three and a half times as long as that between the gulars; pectorals very short; abdominals as long as pectorals; femorals three-fifths of pectorals; anals as long as gulars.

The second specimen, which is a female, differs from the preceding in its less deeply excavated plastron, its greater thickness, the dorsal plates being about $1\frac{1}{4}$ inch thick, whereas in the larger male their thickness is only $\frac{3}{4}$ to 1 inch; the anterior and posterior borders are not spread out nor notched; the sutures between the bones are almost obsolete; and the nuchal is larger and a little longer than broad. The carapace measures 97 centim. in a straight line, 120 over curve; width 73; height 44. The plastron is imperfect, wanting the anterior lobe. The bridge measures 40 centim.

In the characters of its shell, *T. grandidieri* clearly pertains to the section known as "Aldabra Tortoises"[1]. Aldabra being a group of small islands north-west of Madagascar, this section of the genus would, with our present extended knowledge of its distribution, more properly be termed the "Madagascar Gigantic Tortoises." On referring to the synopsis of the species as given by me[2], it will be seen that an analysis of the characters

[1] Günther, 'Gigantic Land-Tortoises,' p. 10.

[2] Cat. Chelon. &c. p. 153.

of the carapace and plastron in the tortoise now described leads to *T. hololissa*, which differs from *T. elephantina* in the smaller plastron not notched behind; from *T. gigantea* in the undivided supracaudal shield; and from *T. daudini* in the wider plastral bridge. *T. grandidieri* may be distinguished from *T. elephantina*, *hololissa*, and *gigantea* by the greater depression of the carapace.

2. *Skull.*—The remains on which *Testudo grandidieri* was established did not include any portion of the skull. It is therefore highly gratifying to find among the bones secured by Mr. Last a nearly complete skull, 15 centim. long (to the extremity of the supraoccipital crest), wanting merely the zygomatic arch and the right quadrate. This skull was associated with the female shell noticed above. The mandible of this specimen is also present, together with a symphysial fragment of another.

The structure of the skull fully confirms the conclusion arrived at by Prof. Vaillant, from the study of the shell, as to the close affinity of *T. grandidieri* to the Aldabra Tortoises. The differences, in fact, are rather slight and, in some respects, show an exaggeration of the features which differentiate the Aldabra forms from their congeners.

The naso-frontal region is moderately convex, with the nasal fossa extremely large and produced to between the anterior portion of the orbits, sloping obliquely downwards, and longer than broad. When the skull is viewed from above, the anterior portions of the choanæ, separated by a narrow septum, are visible through the nasal fossa, whilst the præmaxillaries terminate on a line with the anterior borders of the orbits. The interorbital region is formed entirely by the præfrontal bones, the upper surface of which is much more developed than that of the frontals. The postorbital arch is slender and the parietal bones narrow. The præfrontals form a broad suture with the postfrontals, and the frontals are enclosed between these two elements and the parietals. The præfrontals are longer than broad, and their median suture measures two-fifths that between the frontals; the latter are very slightly longer than broad, and measure half the greatest length of the parietals. The diameter of the tympanic cavity equals that of the orbit.

The lower aspect of the skull presents this peculiarity, that the pterygoids do not meet on the middle line, being separated by the basisphenoid, as I have recently described in *T. microtympanum*[1]. The vomer is produced posteriorly far beyond the line of the postorbital arch, and its length equals nearly four times that of the choanæ; it bears a feeble median keel, which is continued on the anterior half of the basisphenoid; the palatines extend but little beyond the vomer. The suture between the præmaxillaries and the vomer falls a considerable distance behind the inner angle of the alveolar edges of the maxillaries. The alveolar surface of the maxillary is broad, with a strong denticulate median ridge, which is equally distant from the likewise denticulate inner and outer margins. The occipital condyle is tripartite, and the posterior margin of the opisthotic is not excised.

[1] Proc. Zool. Soc. 1891, p. 5, figs. 1, 2, 3.

The mandible has a double denticulate ridge, between which the alveolar surface is deeply concave; its outer surface slopes outwards and is concave; the symphysis is short and without a backward dilatation of the lower margin.

3. *Cervical Vertebræ.*—Among the remains mentioned by Vaillant was a third biconvex cervical vertebra, thus affording a valuable diagnostic character confirming the deductions arrived at from the examination of other bones. Our material is, unfortunately, very scanty, consisting merely of two second vertebræ, one sixth, one seventh, and three eighth, one of the latter being reduced to the arch. I have therefore no special remarks to offer on this part of the skeleton.

4. *Sacral and Caudal Vertebræ.*—A great number of vertebræ were collected, which I have been able to sort out and refer to three specimens, as follows:—

A. The largest specimen: 7 vertebræ, referable to the 3rd, 4th, 6th, 10th, 11th, 12th, and 13th caudals. In all these the arch is anchylosed to the centrum, and so are the costoids to the vertebræ. I regard this specimen as a male.

B. A smaller specimen, with centrum and arch and costoids likewise anchylosed, but the arch less elevated and less produced posteriorly; the series consists of a sacral and 11 caudal vertebræ, viz. 1st and 2nd, 4th and 5th, and 7th to 13th. I regard this specimen as a female, probably the same as yielded the shell and skull which were found associated.

C. This specimen, which agrees nearly is size with the preceding, differs in having the centra thicker and joined by suture to the arches, which in some of the vertebræ have even become detached; the costoids were also loosely attached and have been lost. These vertebræ form a complete series from the 2nd to the 18th.

The bones in specimens A and B agree so well with those of *T. elephantina*, male and female respectively, that I have no doubt they belong to the same form as yielded the skull described above. As regards specimen C, there are, on the other hand, several differences, so that I have to consider whether they are referable to the same species. These differences consist chiefly in the greater vertical diameter of the centrum, the lesser excavation of the articular cavity, the persistent suture between arch and centrum in the anterior vertebræ, 8th inclusive, and the autogenous costoids throughout.

Owing to the fact that the vertebræ are nearly equal in size in specimens B and C it would seem, at first, that age cannot be made to account for the differences. However, we must bear in mind that the tail differs so much in size according to the sexes in these Tortoises that it may be as large in a half-grown male as in a full-grown female of the same species; and how great the differences in the shape of the bones are may be gathered from a perusal of Günther's descriptions on pp. 29 and 37 of his memoir, which deal with what I regard as male and female of one and the same species. I have therefore carefully compared the caudal vertebræ of the adult male *T. elephantina* with those of the female of the same species (I regret to have no half-grown or young male

skeleton with which to compare), and have come to the conclusion that the differences between specimens B and C may, provisionally at least, be ascribed to both age and sex. On comparing the caudal vertebræ of a young Galapagos tortoise (*T. elephantopus*) with those of an adult of a closely allied form (*T. vicina*) I find the articular facets to be nearly plane in the former, whereas the cup-and-ball system is strongly developed in the latter. As to the anchylosis or non-anchylosis of the costoids, I think the examination of more material would reveal a great amount of individual differences on this point, irrespective of age or sex. Both specimens of *T. elephantina* show no trace of suture, but I find a great amount of individual variation in other species. In the adult specimen of *T. vicina* most of the costoids show a distinct suture with the centrum, whilst those of the 6th vertebra, the right one of the 10th, the left of the 16th and 17th, and the right of the 18th and 19th are more or less completely united with the centrum.

After describing the tail of the adult male *T. elephantina*, Dr. Günther adds:— "Nearly always the animal carries it [the tail] bent sidewards under the carapace, generally towards the left side; and therefore I anticipated to find a want of symmetry in some portion of the root of the tail; however, nothing of the kind can be observed." This statement is not quite correct. Since the above lines were written, Dr. G. Smets[1] has pointed out that the basal caudal vertebræ of *T. sulcata* and other Land-Tortoises are characterized by a remarkable asymmetry, especially with regard to the zygapophyses, and I find his statement borne out by the gigantic species as well. Smets remarks of *T. sulcata* that the right postzygapophysis of the first sacral vertebra is obliterated, whilst the left is well developed; on the second sacral the left zygapophysis is more developed than the right; likewise on the first caudal. On the second caudal the right postzygapophysis is slightly more massive than the left, but its articular facet is smaller; in the 3rd, 4th, and 5th the right postzygapophysis is more developed than the left, whilst in the 6th to 8th it is the reverse. The first and second caudal vertebræ have the diapophyses more developed than the left; on the third vertebra the left diapophysis is less massive but a little longer than the right; fourth and fifth with the left, seventh with the right, diapophysis longest. From the ninth vertebra any striking asymmetry ceases.

In the large male specimen described by Günther[2] the second sacral vertebra has but one prezygapophysis, the left; the facet of the right postzygapophysis of the first caudal is much larger than that of the left, but little larger in the second; in the third vertebra the left postzygapophysis is the largest, and in the fourth it is the right. In the female specimen the asymmetry is much less marked.

In the 3rd and 4th vertebræ of specimen A of *T. grandidieri* the right postzygapophysis is more developed than the left, in the 6th the left.

In specimen B the left postzygapophysial facet of the second sacral is much higher

[1] Muséon, 1887, p. 394. [2] *Op. cit.* p. 29.

up than the right; the right postzygapophysis of the first caudal vertebra is abortive, its facet being sessile and directed upwards; that of the second vertebra is less developed than the left; the other vertebræ being nearly symmetrical.

In specimen C the right postzygapophysis is the more developed on the second caudal vertebra, the left on the third and fourth.

It is therefore clear that in these Tortoises the asymmetry of the caudal vertebræ is subject to much individual variation, and that the identification of single vertebræ cannot be attempted by means of this character.

5. *Pectoral arch.*—The complete pectoral arch of a specimen which, judging from the size of the bones, must be the one of which Mr. Last states he found most of the bones, that is to say, the female previously noticed, is preserved. The coracoid is free from the scapula, which measures (from the proximal extremity of the suture with the coracoid) 17½ centim., the acromial process (so-called precoracoid) measuring (likewise from the suture with the coracoid) 9 centim. Length of coracoid 11 centim., greatest width 9. These proportions agree very closely with those of *T. elephantina*.

Besides these bones, a smaller right coracoid is preserved.

6. *Pelvis.*—This is represented by the ischia of a large specimen, and the ilia and left pubis and ischium of a smaller specimen, no doubt the female of which shell and bones were found associated. In general configuration, and especially in the narrow bridge, they agree with *T. elephantina*. The surface of the ilium which articulates with the sacrum is directed more upwards than inwards, thus differing from the specimen of *T. elephantina* with which I have compared it, and approaching the arrangement described by Vaillant.

7. *Limb-bones.*—Numerous carpal and tarsal bones and phalangeals and long bones belonging to at least six specimens:—

A. The largest (femur measuring 20 centim.): left femur, right tibia, and left fibula.

B. A smaller specimen, probably the female (femur 16½ centim.): right humerus, right and left radius, and right ulna; right and left femur and right tibia and fibula.

C–F. Right radius; two right tibiæ; four left tibiæ; one right and one left fibula.

There are also a few bones, apparently dermal ossifications from the limbs, which I am unable to determine with precision, having been unsuccessful in finding anything similar with which to compare them.

Now that most of the bones have been identified, it will perhaps be possible to mount the skeleton of the female specimen found undisturbed by Mr. Last, and to exhibit it in that condition in the Geological Galleries of the British Museum. The neck will, however, have to be omitted.

EXPLANATION OF THE PLATES.

PLATE XXXIX.

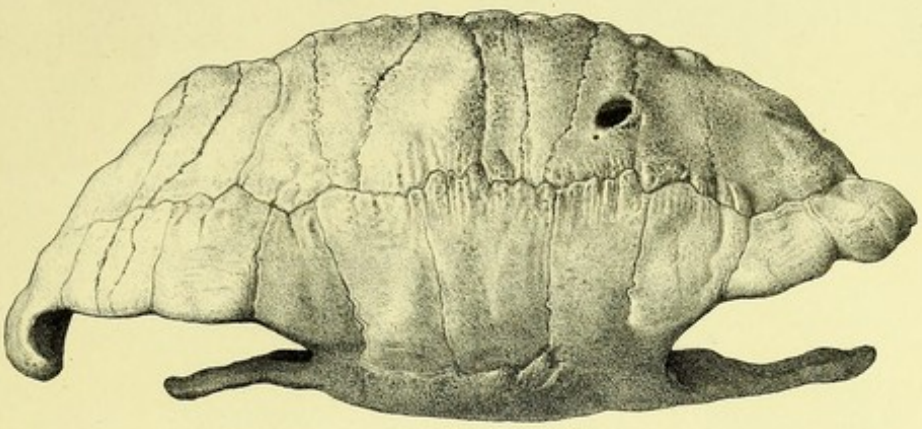
Shell of male (*Testudo grandidieri*), $\frac{1}{9}$ nat. size. Upper, lower, and side views.

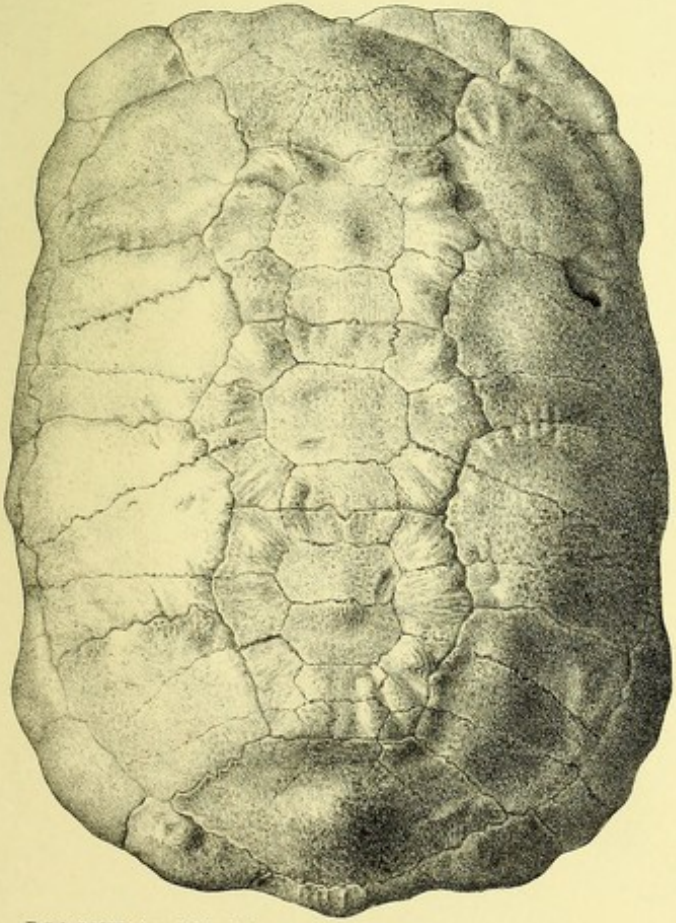
PLATE XL.

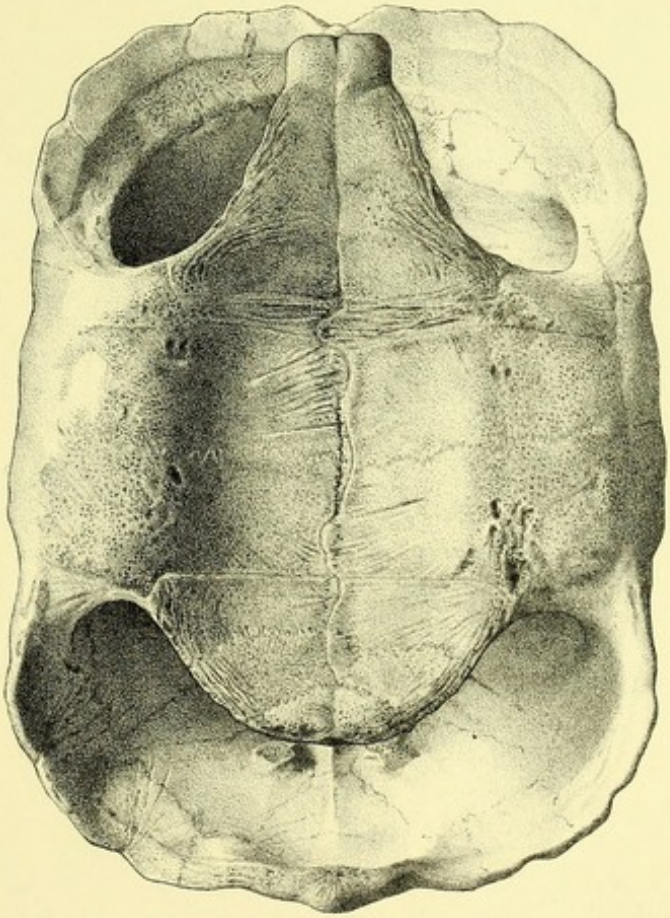
Shell of female, $\frac{1}{8}$ nat. size. Upper, lower, and side views.

PLATE XLI.

Skull of female, nat. size. Upper, lower, and side views, and upper view of symphysial portion of mandible.



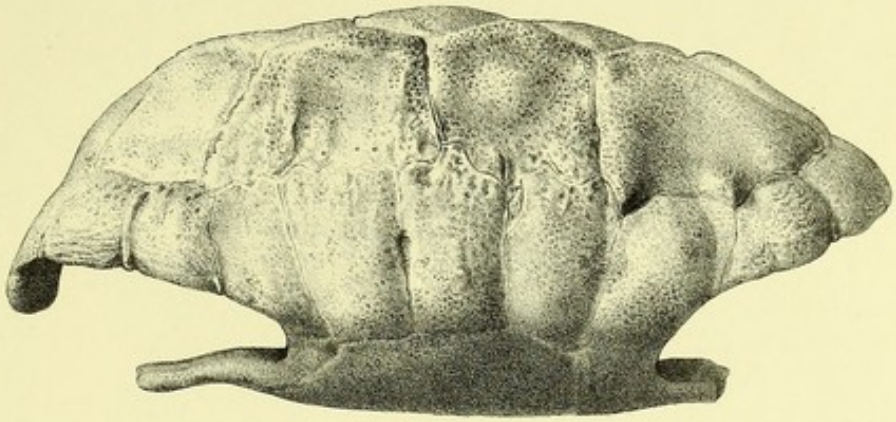


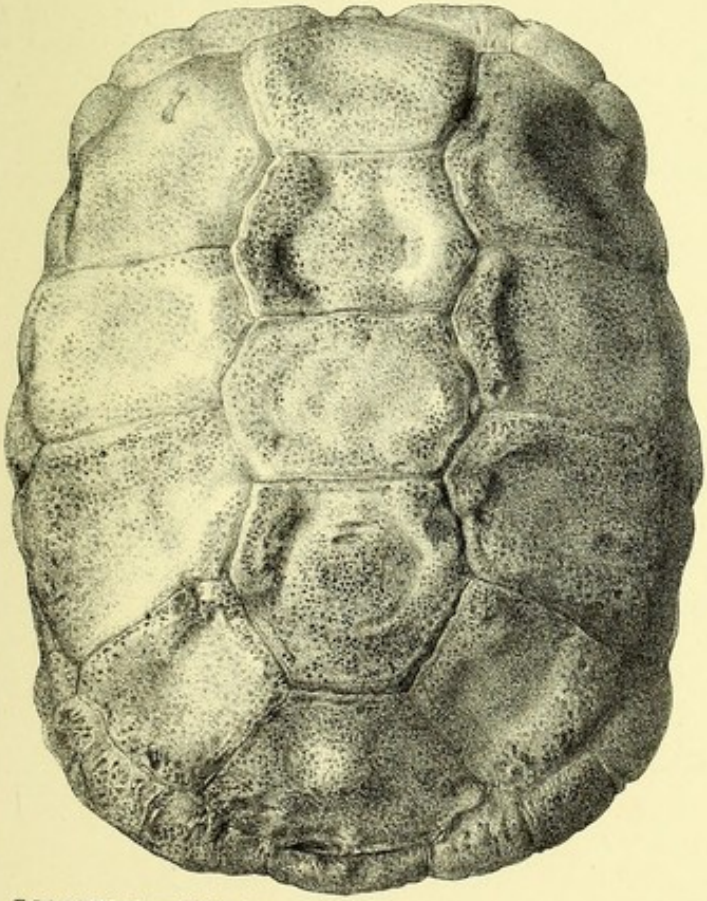


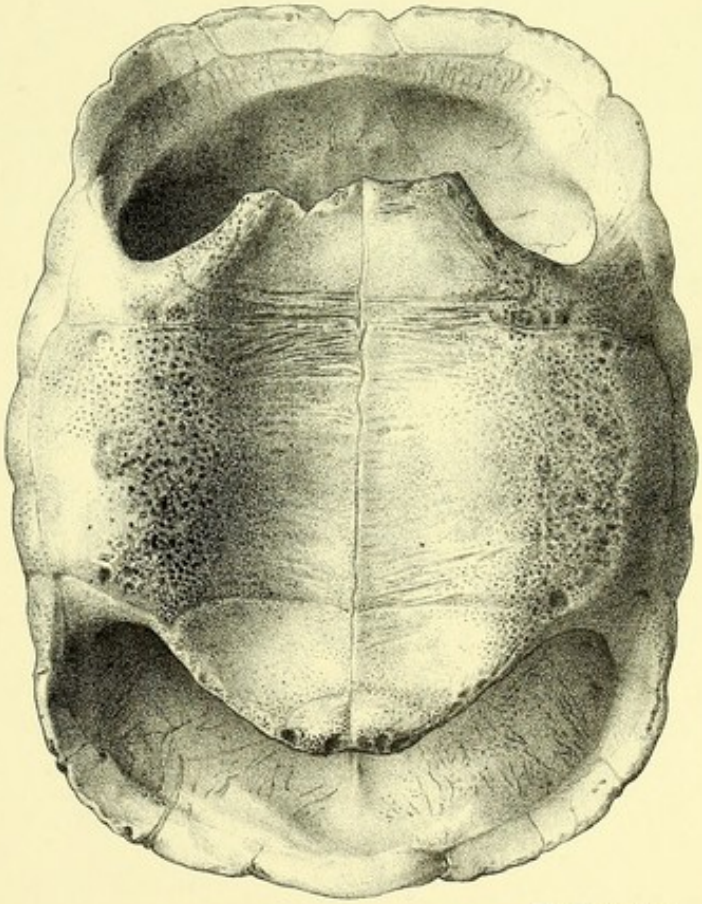
E.C. & G.M. Woodward del et lith.

West, Newman imp.

TESTUDO GRANDIDIERI.







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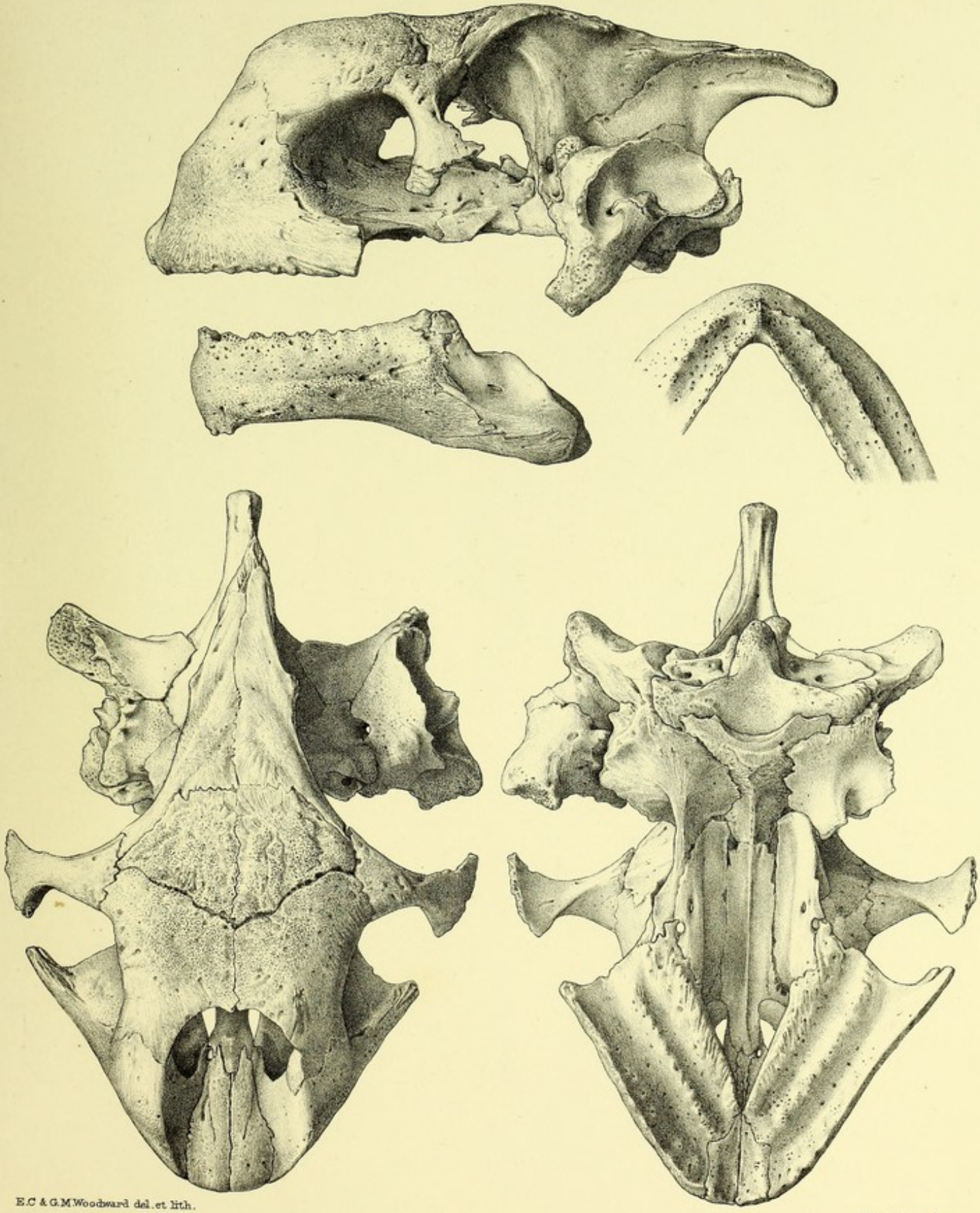


E.C & G.M. Woodward del. et lith.

West, Newman. imp.

TESTUDO GRANDIDIERI.

XII. *On the Remains of some Gigantic Land-Tortoises, and of an extinct Lizard, recently discovered in Mauritius.* *By* HANS GADOW, *Ph.D., M.A., F.R.S., Lecturer on Advanced Morphology of Vertebrata, and Strickland Curator, University of Cambridge.*

Received November 29th, 1892, read December 20th, 1892.

[PLATES XLII.–XLIV.]

THE collection of bones of birds from the Mare aux Songes, in Mauritius (described in Trans. Zool. Soc. vol. xiii. (1893) p. 281), was accompanied by an equally interesting collection of reptilian remains from the same locality. Mr. Théodore Sauzier, as President of the Commission des Souvenirs Historiques, made the stipulation that a typical selection of these bones should be given to the University Museum of Zoology, provided the whole of the material was worked out in Cambridge. This task has been entrusted to me, and I now take the opportunity of thanking Mr. Sauzier for his generous liberality.

Considering that a great portion of the collection has to be returned to Mauritius, it is necessary to figure most of the important specimens.

Dr. Günther's Monograph, 'The Gigantic Land-Tortoises, living and extinct,' London, 1877, naturally forms the basis of the following descriptions. By having distinguished several species, notably *Testudo triserrata* and *T. inepta*, when studying previous collections from the Mare aux Songes, and by having, moreover, assigned names to the numerous disconnected skulls, carapaces, plastra, pelves, and shoulder-girdles, he has established a case of precedence which naturally has to be acknowledged as potentially correct, until at some future time complete specimens, with all their bones associated, shall be found, and either corroborate or correct his identifications.

I follow his plan of distinguishing by different names at least some of the most obviously differing carapaces and plastra, referring, however, to many of the other bones by letters and numbers only. The same letters and numbers, with references to this paper, having been attached to all the specimens, recognition has been secured.

There remains the question of the specific value of these names. It is immaterial to the descriptive purpose of this paper, whether they be considered as indicating species, subspecies, varieties, or races. So long as we knew that Mauritius was inhabited at the utmost by three species, namely *T. triserrata* and *T. inepta*—*T. indica* s. *perraulti* being only supposed to have come from Mauritius, and since the name *T. leptocnemis* was suggested only on account of the femur, pelvis, and scapula—this

view was to be accepted as possible, considering that the island of Aldabra has yielded, according to Dr. Günther, five living species, which Mr. Boulenger has reduced to four.

But now, through this last collection, there have come to light so many different forms of Tortoises that, proceeding upon the old lines, at least the following forms have to be distinguished :—

T. INDICA, provided carapace No. V. belongs to this form.

T. TRISERRATA.

T. INEPTA.

T. SAUZIERI.

T. SUMEIREI, *i. e.* the name given by Mr. Sauzier to the specimen which is still living in the court of the Artillery Barracks at Port Louis.

Lastly, T. LEPTOCNEMIS, if need be.

This makes five or six different forms, and to suppose that these represent as many species reduces the idea of a species to absurdity, unless the very presence of these Tortoises on this little island (and the same applies to Aldabra) be explained by the thrilling assumption that during the supposed process of subsidence of the surrounding country—now the Indian Ocean—the Tortoises fled to the highest districts, now the islands of Madagascar, Aldabra, Mascarenes, &c. This assumption implies the supposition, equally gratuitous, that South-western "Lemuria" was inhabited by at least 11 to 14 different species of gigantic Tortoises, namely 5 or 6 now in Mauritius, 4 or 5 now in Aldabra, 1 in Rodriguez, and 1 or 2 in Madagascar, not counting the species which possibly never reached these islands.

How these islands ever received their Tortoises is a mystery, but this is quite another question.

The five or six forms of Galapagos Tortoises were, or are, to a certain extent peculiar to different islands, and this isolation is in favour of their specific value, but five of the Mauritian forms were all found in the same swamp [1]. With plenty of food, a congenial climate, and without formidable enemies, they grew to a gigantic size, could interbreed to their hearts' content, for all we know to the contrary, and variation within harmless bounds received no check from natural selection. The very thinness of the shells of some of these gigantic Tortoises, especially *T. vosmaeri* of Rodriguez and several Galapagos forms, seems to indicate that strength of the dermal armour was no longer required in these Elysia of Tortoises.

[1] I do not suggest that different genera, and even different species of one genus, do not inhabit the same locality. In the marismas of Andalucia I have found, in the Laguna de los Patos, *Emys europæa* and *Clemmys sigris* s. *leprosa* in equal numbers, a somewhat unexpected fact, because *Emys* is the almost exclusive Tortoise in North Portugal, while *Clemmys* is extremely abundant in the Alemtejo, where *Emys* is very rare.

The Carapaces. (Plate XLII.)

Carapace No. I.—*Testudo sauzieri.* The whole shell, together with the plastron, is complete, with the exception of the second, third, and fourth vertebral plates. The dorsal profile differs from that of the typical *T. inepta* by the shape of the hump of the fifth vertebral plate, the much steeper hump of the fourth plate, and the apparently much steeper hump of the first vertebral.

The marginals are likewise different; the first is in broad contact with the first costal, even more so than in *T. triserrata*, while in *T. inepta* the first marginal and first costal do not touch each other. The last marginal or caudal is much thicker than in *T. inepta*, measuring 10 by 3·3 cm., with a thickness of 2·3 cm.; instead of being concave ventrally, it is decidedly convex.

The total length of carapace no. I. is 51·5 cm.; its greatest breadth across the inguinal region is 36 cm.

The plastron, 36 cm. long, resembles that of *T. triserrata* (that of *T. inepta* is still unknown), but the pectorals are wider than in the plastron figured by Dr. Günther, while the markings of the shields in the axillary region agree with it. However, there is another male plastron in the Cambridge Museum, determined by Dr. Günther as belonging to *T. triserrata*, in which the pectorals are just as wide as in *T. sauzieri*, while the axillary impressions are different.

The whole shell is rather thick, like that of *T. inepta*; the sides are steep and as decidedly convex as in *T. inepta*.

Carapace No. II.—*T. inepta.* Fragment of posterior two-thirds, typical *T. inepta.*

Carapace No. III.—*T. triserrata.* Fragment, consisting of the posterior six marginals, with portions of the adjoining right and left fourth costals, and the fifth vertebral plates.

Carapace No. IV.—*T. triserrata.* Fragment, a little more complete than no. III.

Both specimens are easily recognized as belonging to the typical *T. triserrata*, because of the large, ventrally concave caudal plate, which is thin, strongly curved, and measures 17·5 cm. in greatest width, 10 cm. in height.

Carapace No. V.—*T. indica.* This fragment consists of the complete first, second, third, and portion of the fourth vertebral plates; portions of the right and left first marginals, portions of the right and left first, second, and third costals. Greatest length of fragment 43 cm.

Its dorsal longitudinal profile is almost a straight line, only with a slight concavity across the middle of the first vertebral plate. All the vertebrals are nearly flat, and there is no indication of a swelling or hump on the fourth plate.

The first marginals are likewise in the same flat dorsal level. Apparently the first marginal scutes did not touch the costal plates.

The anterior margin of this carapace is very peculiar (*cf.* Pl. XLII. fig. 10).

1st. The two marginals form a straight line, instead of being curved as in *T. inepta*, *T. triserrata*, and *T. sauzieri*.

2nd. The median notch is very slight dorsally; absolutely wanting on the ventral margin.

3rd. Ventrally the two marginals are strongly concave, forming a sharp and very prominent ridge.

Dr. Günther, Monograph, p. 43, remarks that "a carapace with so straight a vertebral profile as that delineated and described of *T. perraulti* is not represented among the specimens collected by Messrs. Bouton and Newton." Moreover, none of the species described in his Monograph possess such a flat carapace. Our carapace no. V., in its flatness and almost straight profile, agrees rather well with the figure given by Perrault of his male Grande Tortue des Indes ('Mémoires pour servir à l'Histoire des Animaux et des Plantes,' Amsterdam, 1736, p. 395), but the anterior marginals are very different. This may, however, be due to the inexactness of the drawing, which also exhibits the curious anomaly of showing only four instead of the usual five vertebral plates.

Perrault remarks that the length of the shell was 3 feet, the tail 14 inches long, and ending in a point "garni d'un bout semblable à une corne de bœuf." The length of this horny spur is not mentioned; judging from the figure, it would scarcely amount to half an inch.

Duméril et Bibron, 'Erpétologie Générale,' vol. ii. p. 126, mention among other points "la suscaudale simple, très élargie; la dernière de la rangée vertébrale bombée." If this implies that only the last vertebral plate possesses a hump, then this specimen differs from both *T. triserrata* and *T. inepta*, because in the former all the vertebrals are humped and in the latter the fourth and fifth; on the other hand, *T. indica* s. *perraulti* agrees by the large caudal plate with *T. triserrata*, and differs from *T. inepta* and *T. sauzieri*.

It is very probable that carapace no. V. belongs to a *T. indica*, and in this case there can be no longer any doubt that Perrault's specimen came from Mauritius, a corroboration of Dr. Günther's surmise.

The Plastra. (Plate XLII.)

Plastron A.—Intermediate between *T. triserrata* and *T. sauzieri*. This plastron is complete. Its greatest length is 39 cm., its greatest breadth 35·5 cm., indicating a much broader Tortoise than *T. sauzieri*. It agrees in its ventral impressions with that of *T. sauzieri*, but differs from the latter as follows:—

1. The markings or shield-impressions in the inguinal region are more like those of *T. triserrata*.

2. The posterior margin of the plastron is decidedly and sharply curved upwards, instead of showing a slight triangular swelling; more like *T. triserrata*.

3. The fourth to seventh marginals, which connected the plastron with the three middle costal plates, are very much steeper, and almost flat vertically instead of being convex.

Plastron B. *T. triserrata.* Typical. Represented by the two disconnected anterior and posterior two-fifths of a male specimen.

Plastron C. *T. triserrata.* The anterior half of a large male plastron; greatest width of fragment 42 cm.

Plastra D, E, F, G. *T. sumeirei.* When Dr. Günther wrote his Monograph he could state categorically :—

1. That the specimens with a nuchal plate, and with a double gular, came from Aldabra.

2. That the specimens without nuchal, and with a single gular, came from the Mascarenes.

3. That the specimens without nuchal, and with a double gular, are Galapagos Tortoises.

Now this statement cannot be upheld any longer, because among the materials brought by Mr. Sauzier from the Mare aux Songes are the anterior portions of four very large plastra, which differ from all the others previously received from Mauritius and Rodriguez in the following points[1] :—

1. The anterior lobe of the plastron is very much elongated.

2. It ends in a fork instead of being rounded off.

3. There were two gular shields, a right and a left, as indicated by the deep impressions left upon the bones.

Another difference is exhibited by the posterior portion of the plastron (Pl. XLII. fig. 8), which, from its size, thickness, and colour, I suppose to belong to the same Tortoise as the anterior portion of the plastron (fig. 6).

The posterior margin of this specimen ends ventrally in a much swollen and rugose tuberosity; dorsally it possesses a somewhat triangular, very strong tuberosity, which seems to have fitted upon the ischiadic symphysial tuberosity of the pelvis, and which, to judge from its roughness, seems partly to have been anchylosed with the pelvis. None of the Mauritian specimens, hitherto known, show any such tuberosities; but they exist in some of the Aldabran forms, namely in *T. elephantina*, *T. daudini*, and *T. hololissa*, not, however, in *T. ponderosa*, which latter has, by the way, been recognized by Boulenger as the female of *T. elephantina*.

In the configuration of the pectoral impressions, and in the whole shape of the anterior lobe, the plastra D, E, F, G agree mostly with *T. daudini*.

[1] There are also five precisely similar specimens of anterior plastral portions in the Cambridge Museum, which had probably been received together with those Tortoise-remains from Mauritius which Professor Haddon has catalogued and described in Trans. Linn. Soc. ser. ii., Zoology, vol. ii. (1879) pp. 155–163, pl. 13. They have, however, remained undetermined and do not seem to have been mentioned.

All these specimens are extremely thick and heavy, in every respect different from the plastra of *T. triserrata* and *T. sauzieri*. The greatest width of fragment E is 38 cm.

The fact that they have been found in the Mare aux Songes, together with the other Tortoise material, excludes the possibility of their having been introduced by Man.

Tabular Comparison of the Forked Plastra D, E, F, G of Mauritius with Plastra of Aldabra Tortoises. (+ means agreement, — means difference.)

	T. elephantina.	*T. ponderosa.*	*T. daudini.*	*T. hololissa.*
Anterior end of plastron	+	+, most.	—	—
Double gulars	+	+	+	+
Pectoral impressions	+	+, most.	—	—
Posterior plastral tuberosity ..	+	—	+	+

T. sumeirei (Pl. XLIV.).—The indigenous existence in Mauritius of Tortoises with a double gular and with a long forked plastron having been proved, it is quite within the range of probability that the solitary specimen which is still living in that island is a native and not an imported creature.

Mr. Sauzier has given a description, with photographic views, of this specimen in 'La Nature,' no. 1016, 19 novembre, 1892, pp. 395–398, and he has distinguished it as *Testudo sumeirei*, in honour of M. Camille Sumeire, of Mauritius. Mr. Sauzier has presented to us several of the original photographs of this Tortoise, accompanied by the following notes :—

"Lors de la conquête de l'Ile de France (Maurice), le 3 décembre 1810, il existait dans la cour des casernes de l'Artillerie, à Port Louis, une gigantesque tortue de terre, qui a fait partie du matériel laissé aux Anglais.

"Cette bête vit encore dans cette même cour, dont les bâtiments ont été convertis en mess pour les officiers.

"Il est facile de voir, par son aspect général, qu'elle doit être d'un grand âge. Si, en 1810, d'après les plus anciens habitants, elle avait attenue sa taille actuelle, ou peu après, elle aurait pour moins deux siècles—ce qui ne l'empêche pas, bien qu'aveugle depuis quelques années, de porter avec aisance sur sa carapace deux hommes représentants ensemble le poids de 150 kilos.

"Il est à regretter que l'absence d'échelle [in the side-view photograph], ou mieux encore, d'un objet de comparaison, dans la photographie, ne permette pas d'apprécier exactement la taille de cette gigantesque tortue, dont on ne connaît pas le lieu d'origine."

When walking this Tortoise stands 63·5 cm. high, leaving 15·5 cm. between the ground and the plastron; its carapace is grey and measures in its "grande circonférence" 259 cm. = 8 feet 6 inches, and 213 cm. "de circonférence en largeur." The

fore legs are 45, the hind legs 30 cm. long; neck and head 39·5 cm., tail 30·5 cm. in length.

The back view shows a very large, broad, and sharply-curved caudal shield, which strongly resembles that of *T. triserrata*, and differs from that of any Aldabran or Galapagos specimens. Front and side views show that there is no nuchal shield whatever.

The under view shows a slightly forked projection of the anterior end of the plastron, with two gular shields, indicating two gular bony plates as in the forked plastra D, E, F, G.

The first marginal shield is very large and in broad contact with the first costal, agreeing in this respect with Aldabran specimens.

The profile of the carapace, the scarcely serrated marginals, and the markings of the vertebral and costal shields most resemble the corresponding parts of *T. ponderosa* = female of *T. elephantina*.

The anterior portion of the plastron, which is well shown in the photograph, agrees in length, narrowness, and forked termination with *T. daudini*.

According to Boulenger's Key, pp. 153–154, Cat. Chelonians, British Museum, this specimen would come nearest to *T. nigrita* and *T. nigra* s. *elephantopus* (nuchal absent, gulars distinct, shields of carapace concentrically striated in the adult, profile of carapace declivous in front). But *T. nigrita* differs considerably in the shape of the anterior end of the plastron, the profile of the distinctly humped vertebral shields, and the serrated marginals. *T. elephantopus* differs likewise in the shape of its plastron. Both *T. elephantopus* and *T. nigrita*, moreover, differ in the shape of their much smaller caudal shield, and above all in the shape of the head. The head of the photographed specimen, *T. sumeirei*, agrees much more with that of the Aldabran type, while *T. triserrata* and *T. inepta* appear to have resembled the Galapagos types.

There remains the question whether the forked plastra D, E, F, G belong to the same race of Tortoises as *T. sumeirei*.

This question is difficult to settle; we do not know the carapaces which belonged to the plastra D, E, F, G.

However, this much is certain—(1) that the plastra D, E, F, G cannot have belonged to Galapagos Tortoises, because of the double gulars and because of their locality; (2) that the type of *T. sumeirei* cannot be a specimen introduced from the Galapagos Islands, because of the shape of its head, plastron, and double gulars; (3) that *T. sumeirei* cannot be one of the true Aldabran species, because it has no nuchal shield and because of its different caudal shield; (4) *T. sumeirei* exhibits quite a new combination of characters, namely double gulars, without nuchal, and is indigenous in Mauritius. At any rate, we have here a Mauritian Tortoise which is fundamentally of the Aldabran type, but combines with Aldabran features several

peculiarities which are characteristic of the Mauritian *T. indica*, *T. triserrata*, and *T. inepta*, and also resembling in several points some of the Galapagos species [1].

Complexes of terminal Caudal Vertebræ (Plate XLIII. figs. 1, 2, 3).—Until proof to the contrary is forthcoming, I assign two completely preserved specimens of anchylosed terminal vertebræ to the species which possesses the cleft or forked plastron, namely *T. sumeirei*. The largest of these curious specimens measures 12 cm. in length, with an anterior concave, almost saddle-shaped, articulating facet of 5·3 cm. in width. The anterior half of this vertebral complex consists clearly of three or four anchylosed vertebræ, while the posterior half, strongly curved downwards and tapering to a blunt point, shows by its surface-mouldings that it was covered with a horny sheath which completely surrounded the terminal half like a spur. The length of this spur was at least 6 cm., to which, of course, the probably considerable thickness of the horn itself has to be added.

Dr. Günther says in his description of *T. elephantina* (Monograph, p. 30) that "the last seven vertebræ are quite rudimentary and coalesced into a single bone." The total number of caudal vertebræ of *T. elephantina* is 25, *i. e.* 18 free vertebræ besides the coalesced complex; the shell of the large stuffed male specimen in the Natural History Museum is not less than 49 inches long, but the caudal complex is far less completely anchylosed, and its anterior articulating facet is one third smaller than is the case with the two specimens in Mr. Sauzier's collection. They either belonged to a Tortoise of gigantic dimensions (as indicated by the large plastron E), or the caudal spurred complex is relatively larger than in any of the Aldabran races. According to Perrault's description, *T. indica* likewise possessed a distinct horny spur. Dr. Günther continues as follows:—"In individuals of the male sex the tail plays a very important part as an external prehensile or, rather, steadying organ, which also differs externally from that of the female in its greater length and by being provided with a large terminal claw. Nearly always the animal carries it bent sidewards under the carapace, generally towards the left side, and therefore I anticipated to find a want of symmetry in some portion of the root of the tail; however, nothing of the kind can be observed."

I have much pleasure in corroborating the sagacious anticipation of Dr. Günther concerning an asymmetrical development, not, however, of the root of the tail, but of the terminal half of the anchylosed complex, which shows a distinct deviation towards the left side (see figure of dorsal view, Plate XLIII.).

Among gigantic Land-Tortoises such an anchylosis has hitherto been observed only in specimens from Aldabra, Mauritius, and, to a lesser extent, from the Galapagos. In one specimen of *T. elephantopus* the vertebræ are, according to Günther, "irregular, and asymmetrically confluent towards the end of the tail."

[1] Should the post-mortem of the solitary surviving type of *T. sumeirei* reveal that it differs in its plastron from those referred to as D, E, F, G, I herewith reserve to myself the claim of distinguishing these forked plastra as belonging to a *Testudo guentheri*.

Adult specimens of *Chelone midas* have a similar, although much smaller, caudal claw; in a large male specimen in the Cambridge Museum the horny claw or spur is about 2 cm. in length, and covers about three vertebræ, two anchylosed and one free.

None of the textbooks of zoology, comparative anatomy, and herpetology written since 1877 have as yet condescended to mention this important instance of an anchylosed terminal caudal vertebral complex in the class of Reptiles.

Cervical Vertebræ (Pl. XLIV. figs. 20–25).—Three atlas vertebræ, representing two different types, one with slightly joined neural arches and with a ring-shaped perforated body, the others with a completely solid unperforated body—differences which cannot be explained away by age. Although the atlas of the various families of Tortoises exhibits many modifications, the specimen A, with the solid body, is peculiar; its body does not contain the odontoid process, because the latter has left the three typical articulating facets or impressions upon the body of the atlas. Specimens B and C agree more with the atlas vertebræ figured by Dr. Günther.

Pelves.—Five nearly complete specimens, numbered I. to V. (Pl. XLIII. figs. 4 & 5).

Pelvis No. I. has to be assigned to *T. triserrata* according to Dr. Günther's definition. It is the largest known, measuring 23 cm. in height and 23 cm. in width. The bridge between the obturator foramina is very broad, namely 3·8 cm. Unfortunately, the tuberosity of the ischiadic symphysis, resting upon the plastron, is lost. The ventral ridge of the ischiadic symphysis is very prominent.

Pelvis No. II. belongs to a smaller specimen, its measurements being 17 and 15·5 cm. The obturator foramina are wide, the bridge consequently narrow, resembling that of Aldabran Tortoises. The lateral ridge or crest of the shaft of the ilium is very prominent, more so than in *T. triserrata*. This pelvis differs markedly in two peculiarities from those which have been determined as belonging to *T. triserrata* and *T. inepta*. First, the longitudinal ridge on the ventral side of the ischiadic symphysis is very low, instead of being very prominent. Secondly, the ischiadic tuberosity has a deep cavity on its ventral surface, and is rough instead of being smooth, suggesting that it fitted upon and was partly fused with a corresponding tuberosity of the posterior end of the plastron. Such a plastron is that which I have distinguished as belonging to *T. sumeirei*.

Pelves III., IV., and V. resemble each other, and those of *T. inepta* more than other species; but it has to be noted that they exhibit a certain amount of variation in the extent of the lateral iliac ridge—in fact, that they are intermediate between the typical specimens of *T. triserrata* and *T. inepta*. They may belong to *T. leptocnemis*, the pelvis of which is diagnosed as resembling that of *T. triserrata*, but with a narrower ilium.

Scapulæ and Coracoids.—The four specimens are all different. Two are more like those of *T. inepta*; one more like that of *T. triserrata*; the fourth has a very flat scapular shaft, resembling in its transverse configuration that of *T. triserrata* and still

more in general the Aldabran species. I feel inclined to associate this specimen with the other remains of *T. sumeirei*.

It has to be borne in mind, however, that the bones of the shoulder-girdle of all these extinct Tortoises are subject to a very great amount of variation in size and shape [1]. It would not be difficult to select out of the extensive material at our disposal at least half a dozen different types, provided the intermediate forms were neglected or suppressed.

Phalanges.—Three large terminal and seven middle and proximal phalanges.

Skulls (Pl. XLIII. figs. 6 *a*–8).—Mr. Sauzier's collection contains 19 skulls and two mandibles. Two of these skulls and one pair of underjaws belong to *T. triserrata* according to Dr. Günther's definition. Six skulls and the other pair of underjaws agree with those of *T. inepta*. The remaining eleven skulls differ from those of *T. triserrata* and *T. inepta* chiefly in the shape of the ventral surface of the long supra-occipital crest. This surface is broad, triangular, and concave, while it is narrow and ridge-like in *T. inepta*, narrow and doubly ridged (or, in other words, with a narrow longitudinal groove) in *T. triserrata*.

However, all these skulls exhibit a considerable amount of individual variation in their general aspect, slope and size of the crest, relative strength of the various parts of the skull, naso-frontal profile, &c. Most of them approach to a slight extent the Aldabran skulls by the convexity of their frontal region, and, according to Dr. Günther, the "posterior margin of the paroccipital crest is deeply excised" in *T. daudini*. Whether these variations are due to age or sex, or are of specific or subspecific value, cannot be determined. It has to be borne in mind that we have no criterion whatever by which we can associate any of these numerous skulls with any particular form of carapace, plastron, or limb-girdle. It is quite possible that the typical skulls of *T. triserrata* belong to the carapaces which have been distinguished as those of *T. inepta*, or to *T. sumeirei*, or *vice versâ*, and the same remark applies with equal force to the various sorts of pelves.

Unfortunately, this uncertainty is inevitable, because, owing to the circumstance that many of the bones from the Mare aux Songes had to be fished out of a morass just as the labourers happened to come across them, no record of the juxtaposition of the various bones could be, or at any rate has been, made. Until, by happy chance or by a much more careful and extensive mode of research, all the principal parts of one unquestionable individual are found, the association of these bones will be a matter of speculation without any valid basis.

> "Habt alle die Theile in der Hand,
> Fehlt leider nur das geistige Band."

[1] See A. C. Haddon, Trans. Linn. Soc. ser. ii., Zoology, vol. ii. (1879) pp. 156–158.

DIDOSAURUS MAURITIANUS. (Plate XLIV. figs. 1–16.)

A short fragment, with three teeth, of the maxilla, five fragments of the mandible, seven more or less perfect femora, and portions of three humeri have been described and figured (with the exception of the maxillary fragment) by Dr. Günther in the 'Journal of the Linnean Society,' Zoology, vol. xiii. (1878) pp. 322–324. All these bones had been collected in the Mare aux Songes.

Mr. Sauzier has obtained many more specimens in the same locality:—4 complete left mandibles; 4 complete right mandibles; 10 right and 9 left mandibular dentals: 14 right and 14 left proximal halves of mandibles; 3 complete frontals, of two large specimens and one small; 3 bases cranii; 1 atlas vertebra; 3 thoracic vertebræ, two of which are successive and belong to one individual; 4 lumbal vertebræ of a smaller specimen; 1 lumbal rib; 1 sacrum; 2 fused vertebræ; 4 post-sacral vertebræ (first, second, third ?, and fourth ?); 4 right humeri; 4 left humeri; 4 ulnæ; 3 right femora; 7 left femora; and 3 left ossa innominata or pelvic halves, one of which indicates a small specimen.

The largest of the complete underjaws measures 76 mm. in length.

As was to be expected, the number of teeth is variable, namely 22, 23, 24, 24, 25 in the five most complete left dentals, and 20, 22, 23, 26 in the right dentals.

The shape and proportions of the underjaws, of the frontal bone, and of the basis cranii indicate that in the shape of the skull *Didosaurus* resembled the genus *Cyclodus*.

The largest humerus measures 42 mm. in length, the smallest 35 mm.; all the specimens possess a distinct entepicondylar foramen.

The ulnæ vary from 30·5 to 32 mm. in length.

The largest femur measures 49 mm., the shortest 43 mm.

P.S.—Since this paper was read, Mr. Sauzier has published a memoir, which contains not only numerous historical accounts, but also several excellent woodcuts, representing side and back views of the large Tortoise living at St. Louis. It is entitled 'Les Tortues de terre gigantesques des Mascareignes et de certaines autres iles de la mer des Indes.' 8vo. Paris, 1893. 32 pp.

EXPLANATION OF THE PLATES.

PLATE XLII.

Fig. 1. Type of *Testudo sauzieri*. Carapace No. 1.
Fig. 2. Carapace No. I.; posterior view.
Fig. 3. Longitudinal vertical section through type-specimen of *T. sauzieri*.
Fig. 4. *T. sauzieri*; ventral view.
Fig. 5. Plastron A.
Fig. 6. Plastron F. Dorsal view, posterior portion, *T. sumeirei*.
Fig. 7. Plastron F. Profile section through posterior portion.
Fig. 8. Plastron F. Ventral view, posterior portion, *T. sumeirei*.
Fig. 9. Carapace No. V. Probably *T. indica* of Perrault.

Fig. 10. Profile section through the anterior portion of carapace no. V., in level of the arrow.
Fig. 11. Profile section through corresponding part of *T. triserrata*.
Fig. 12. Plastron E. Dorsal view. *T. sumeirei*.
Fig. 13. Plastron E. Ventral view. *T. sumeirei*.

PLATE XLIII.

Figs. 1–3. Dorsal, anterior, and ventral views of complex of terminal caudal vertebræ, referred to *Testudo sumeirei*. Nat. size.
Fig. 4. Pelvis No. II. Ventral view. Probably *T. sumeirei*.
Fig. 5. Pelvis No. II. Dorsal and anterior view.
Fig. 6 *a*. Cranium of *Testudo*, sp. ?
Fig. 6 *b*. View of the "posterior margin of the paroccipital crest."
Fig. 7. Cranium and posterior view of paroccipital crest of *T. inepta*.
Fig. 8. „ „ „ „ *T. triserrata*.
(Figs. 6, 7, 8 are drawn to the same scale, namely about $\frac{6}{10}$ nat. size. The paroccipital crests are drawn of the natural size.)

PLATE XLIV.

Figs. 1–16. *Didosaurus mauritianus*. Nat. size.
Figs. 1, 2. Inner and outer view of left mandible.
Fig. 3. Dorsal view of frontal bone.
Fig. 4. Ventral view of basis cranii.
Fig. 5. Upper figure: dorsal view of atlas.
Fig. 5. Lower figure: side view of a thoracic vertebra.
Figs. 6 & 7. Dorsal and ventral views of two successive thoracic vertebræ.
Fig. 8. Dorsal and ventral views of sacrum.
Fig. 9. Dorsal view of first post-sacral vertebra.
Fig. 10. Dorsal view of second post-sacral vertebra.
Fig. 11. Dorsal view of third ? or fourth ? post-sacral vertebra.
Fig. 12. Left outer view of pelvis.
Fig. 13. Posterior view of femur.
Figs. 14 & 15. Anterior and posterior view of humerus.
Fig. 16. Left ulna.
Fig. 17. *Testudo sumeirei*; the type specimen living at Port Louis, Mauritius.
Fig. 18. Ventral view of plastron of the same specimen.
Fig. 19. Side view of the same specimen.
(Figs. 17–19 after photographs procured through the kindness of Mr. Th. Sauzier.)
Figs. 20, 21, 22. Lateral, anterior, and posterior views of atlas A. Nat. size.
Figs. 23, 24, 25. Anterior, lateral, and posterior views of atlas B. Nat. size.

Fig. 1. I

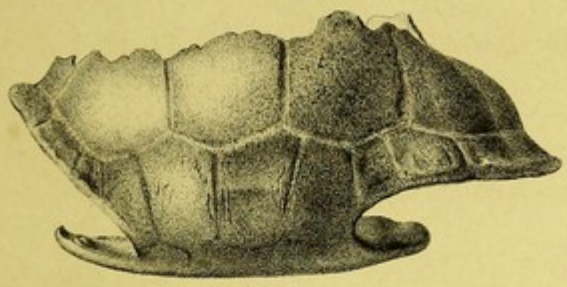


Fig. 2. I

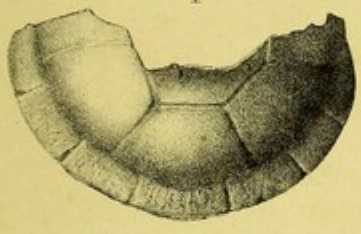
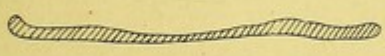
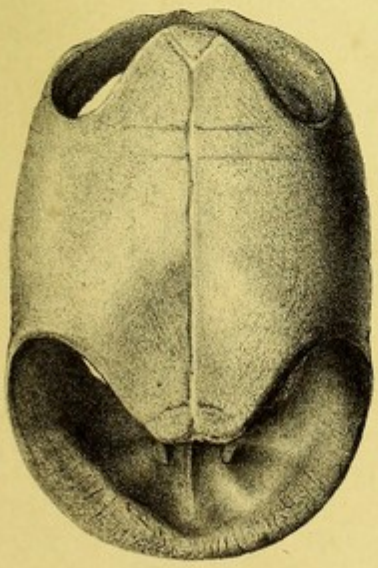


Fig. 3

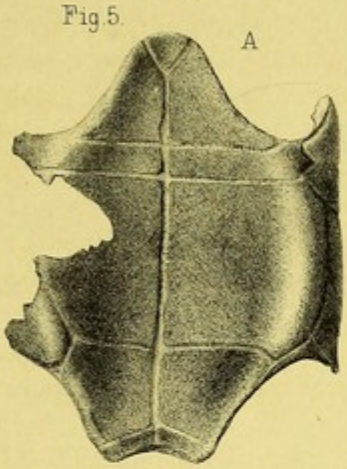




I

Fig. 4.

Fig. 5. A



F

Fig. 6.

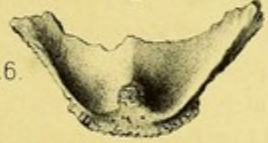


Fig. 7.

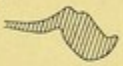


Fig. 8. F

V

Fig. 9.

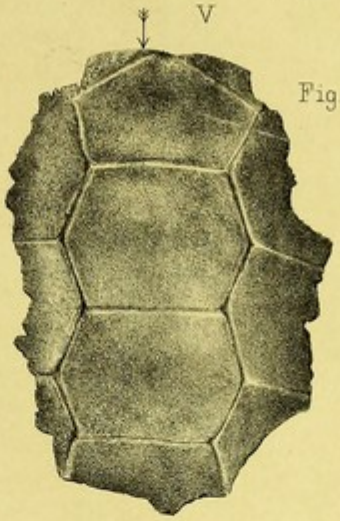


Fig. 10

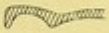
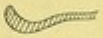


Fig. 11.



E

Fig. 12.

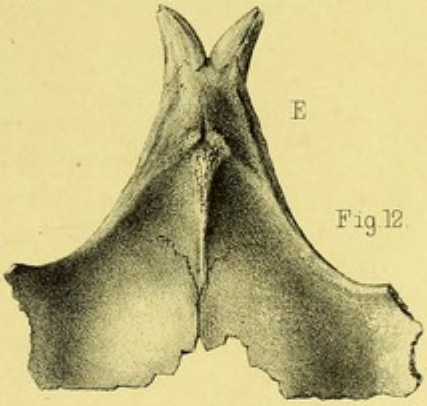


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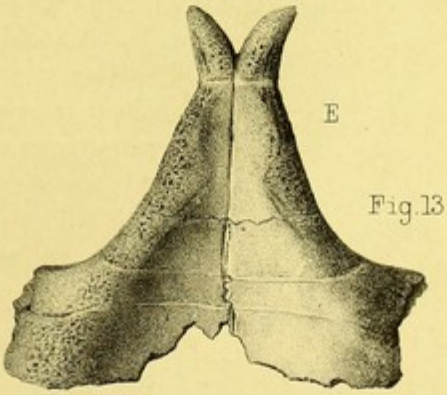
Fig. 13.



MAURITIAN LAND-TORTOISES.

Edwin Wilson Cambridge

Fig 2.

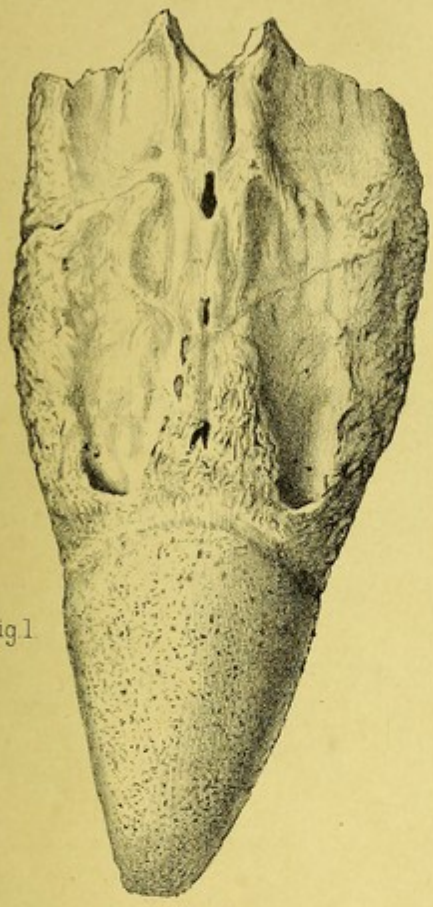
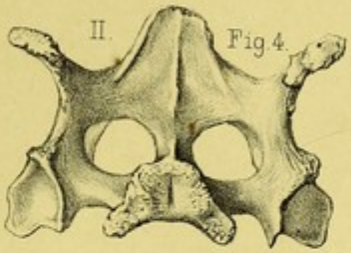


Fig 1.

II.

Fig 4.



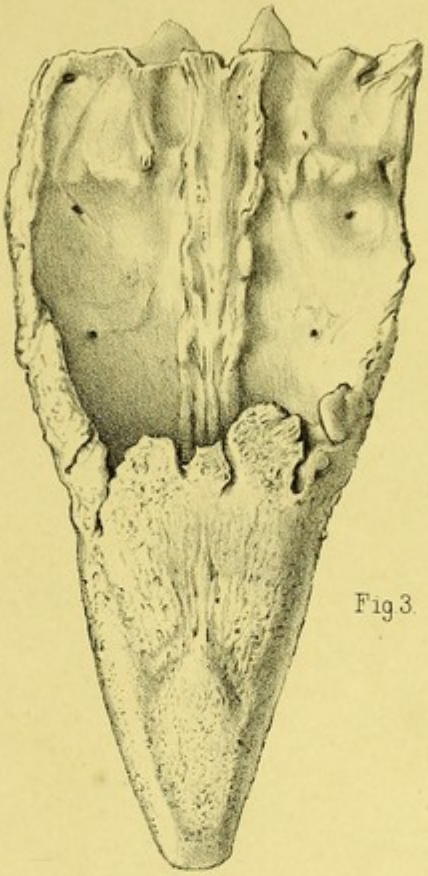
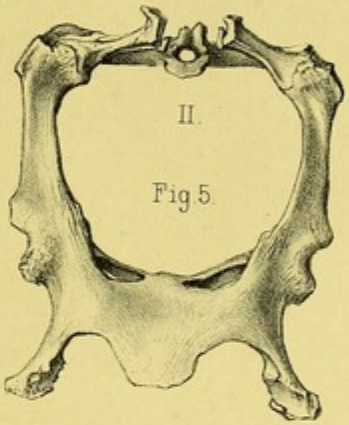


Fig 3.



II.

Fig 5.

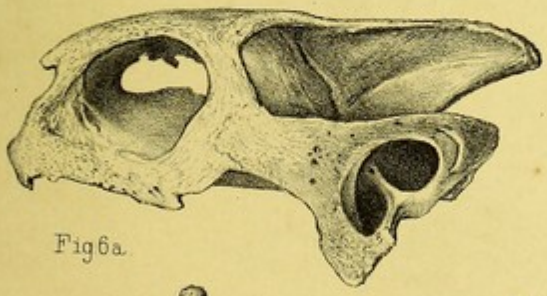
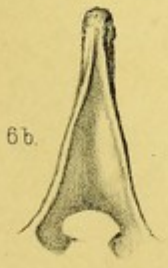


Fig 6a.



6b.

Fig 7.

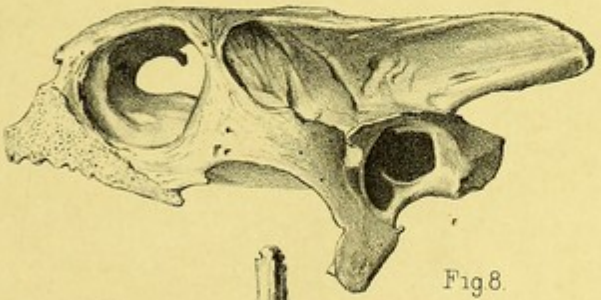
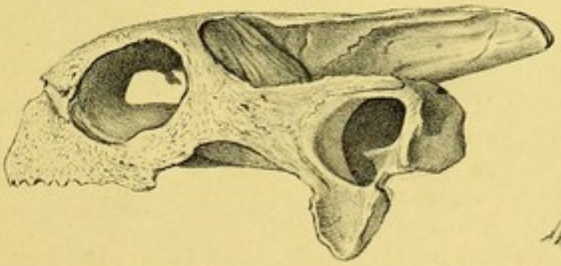


Fig 8.



MAURITIAN LAND-TORTOISES.

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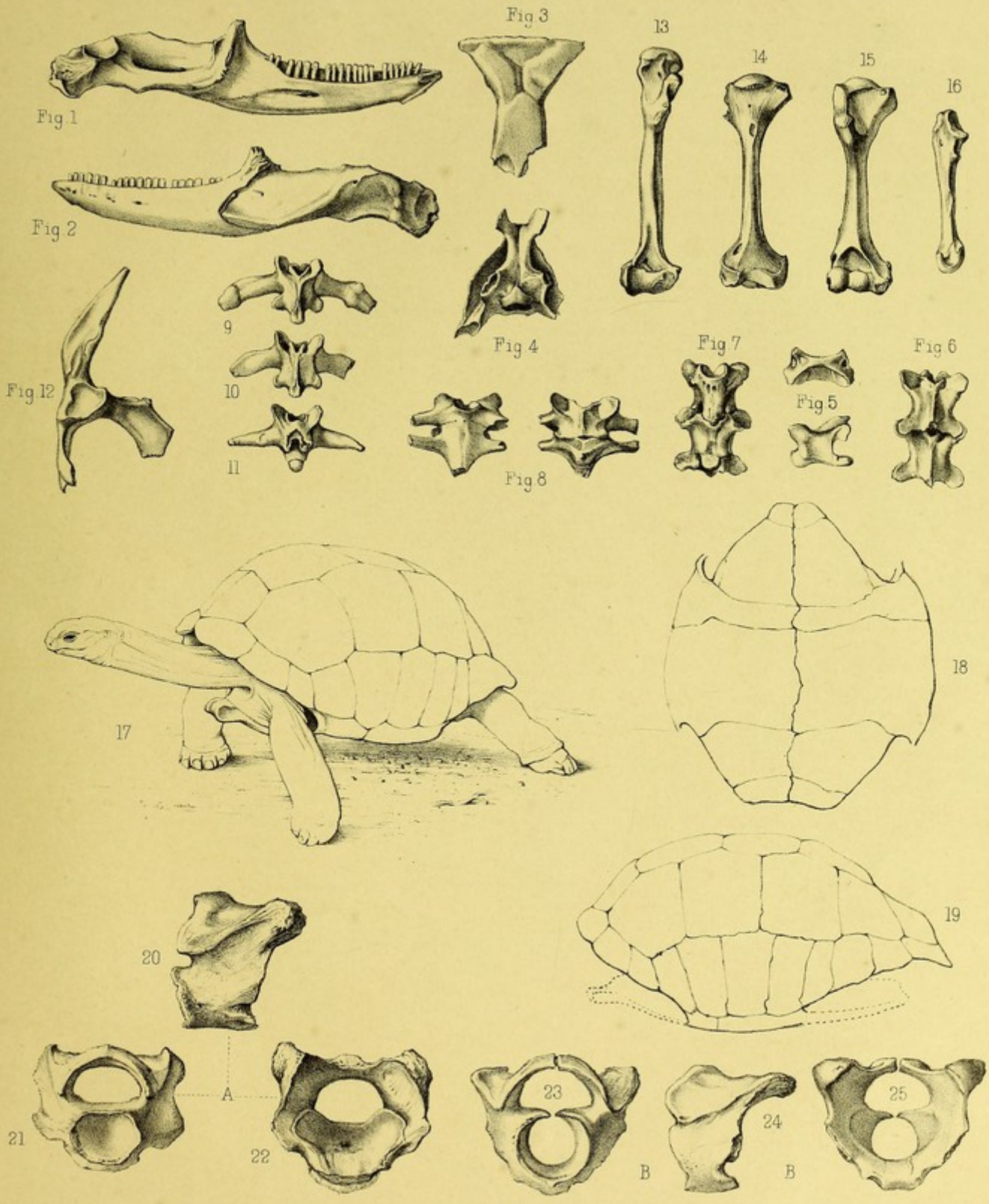

FIG. 1-16 DIDOSAURUS MAURITIANUS.
FIG. 17-19 TESTUDO SUMEIREI.
FIG. 20-25 „ SP. ATLAS A AND B.

Edwin Wilson Cambridge

XIII. *A Revision of the Genera of the Alcyonaria Stolonifera, with a Description of one new Genus and several new Species.*

By Sydney J. Hickson, *M.A. Cantab., D.Sc. Lond., F.Z.S., Fellow of Downing College, Cambridge.*

Received October 13th, 1892, read December 6th, 1892.

[Plates XLV.–L.]

In a communication made to the Royal Society in 1883 (8) I pointed out the advisability of separating those Alcyonarians in which the polypes spring independently from a basal stolon into a special suborder, for which I proposed the term Stolonifera. As my suggestions have not been very generally accepted by continental writers on this group, it is necessary to preface my remarks by a short defence of the position I now take in retaining this suborder.

No very serious argument has yet been brought forward against the retention of the Stolonifera. Von Koch (19), in his monograph of the Gorgonidæ of Naples, refers to my paper in a footnote only, and does not attempt either to describe or criticize my classification. I cannot allow this opportunity to pass without reference to the extraordinary and perfectly unjustifiable attack that he has made upon me in this footnote.

He says, in the first place, that I have quite falsely quoted his paper on the "Skelet der Alcyonarien." The sentence to which he probably objects will be found on page 699. It runs as follows:—"Recently von Koch has suggested a classification that is based on the varieties of the skeleton, but it seems to me that the Pennatulidæ and Gorgonidæ are not so closely related as to justify their position in the same division of the same group (Axifera)." The word Axifera, it is true, at the end of this sentence was allowed to remain in this position in the text by an oversight, and for that I apologize; but the general statement is perfectly true, for on p. 474, in describing his third "Hauptgruppe," he says "Zu der letzten Abtheilung gehören die beiden Familien der Pennatuliden (VII.) . . . . . und die der Axifera (VIII.)" (*i. e.* the true Gorgonidæ).

In the second place, he says that I did not investigate a single true Gorgonid (Axifera); but, as a matter of fact, I not only did make and examine several series of sections through the polypes of *Primnoa*, which von Koch himself includes in his family Gorgonidæ, but I actually gave and described a careful drawing of one of these sections. I was induced to make the statement that the siphonoglyphe is probably absent in the Gorgonidæ, partly because I could find no such structure in the two forms I investigated myself, and partly because von Koch himself did not describe any

such structure in any of the numerous Gorgonidæ he had examined (*Isis*, *Gorgonia*, *Sclerogorgia*, &c.); but I was wrong in placing too much reliance on von Koch's work, as he failed to note in a monograph on the anatomy of the genus the well-marked siphonoglyphe of *Tubipora*. Ever since the publication of my paper in the 'Philosophical Transactions' von Koch has not brought forward one word of criticism upon my system of classification that requires an answer, and I can only say now that I am exceedingly sorry that he should have thought it necessary to make such a personal attack upon me.

Viguier (35), in a valuable paper on a very remarkable Alcyonarian, *Fascicularia edwardsi*, in which a number of small *Alcyonium*-like colonies are connected together by expansions of the cœnenchym, remarks:—"Je ne parlerai pas, au cours de cette discussion, de la classification proposée par Hickson, dans le mémoire cité plus haut. En voulant séparer d'une manière aussi absolue les types où la multiplication se fait par bourgeons naissant directement sur les polypes, de ceux où elle se fait par l'intermédiaire de stolons, cette classification, justement critiquée par Koch à un autre point de vue, avait déjà, au moment où elle a été proposée, l'inconvénient de laisser en dehors le Paralcyonium, où les deux modes se trouvent réunis."

Viguier's argument would be perfectly conclusive if my group Stolonifera were based entirely on the mode of origin of the young polypes. I was probably wrong in assuming that there was sufficient evidence to lead us to believe that in the *majority* of Alcyonaria they are formed by budding directly from the first-formed polypes; in fact, it seems to be more probable now that in all the Alcyonaria, except, perhaps, the Pennatulida, the buds are formed in the cœnosarcal canals, which connect the cœlentera of the older polypes. The essential feature of the Stolonifera, a feature in which the genera of the group differ from all the other Alcyonaria, is that the polypes arise independently from a creeping basal stolon or (in *Tubipora*, in *Clavularia viridis*, and the fossil *Syringopora*) also from horizontal platforms or connecting-tubes; and their walls never become fused or cemented together by a growth of the mesoderm during the whole life of the colony.

The growth of the colony of a Stoloniferan usually takes place at the periphery of the stolon, that is to say it increases in size horizontally; the only exceptions to this rule being found in the forms just mentioned, where there is a very considerable vertical growth, and new polypes are formed above the plane of the stolon. In all the other Alcyonaria there is, after the youngest stages, very little basal horizontal growth, but a very considerable distal vertical growth and multiplication by gemmation from peripheral canals.

The important differences of the mode of growth of the five suborders of the Alcyonaria may be seen at a glance by reference to the diagrammatic figures here given.

It was naturally expected that the authors of the volume on the Alcyonaria of the 'Challenger' expedition (30) would take the trouble to consider and discuss the

Fig. 1.

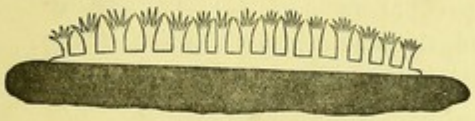

Fig. 2.

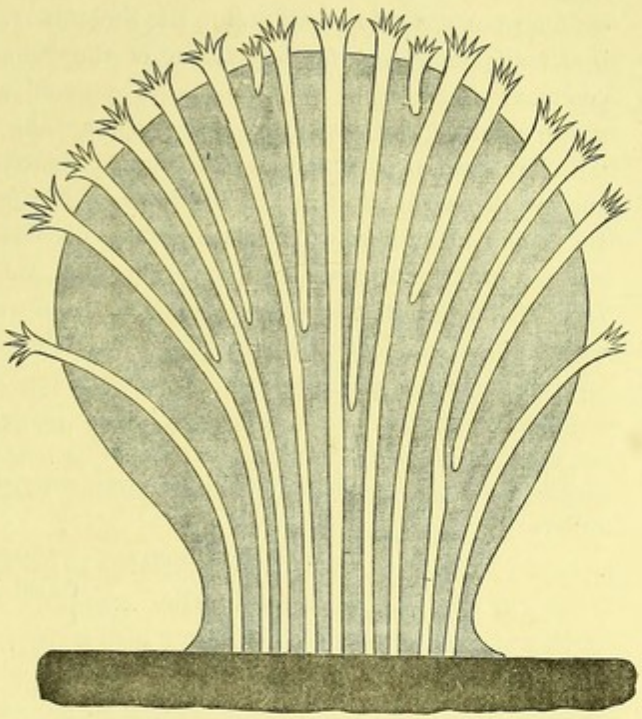

Fig. 3.

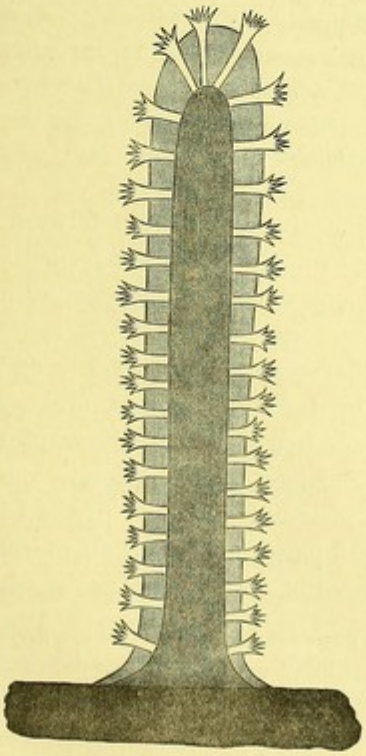

Fig. 4.

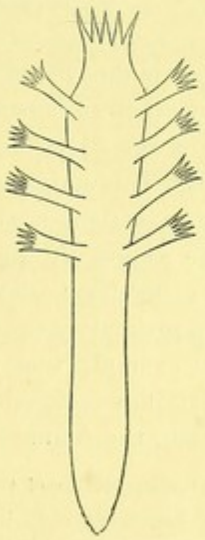

Fig. 1. Schematic section through a Stoloniferan.
Fig. 2. Schematic section through an Alcyonid.

Fig. 3. Schematic section through a Gorgonid.
Fig. 4. Schematic section through a Pennatulid.

value of classifications that have been seriously put forward in easily accessible publications; but not only is my group, the Stolonifera, passed over in silence, but the name is actually employed for a division of the genus *Clavularia*, without one word of comment or apology. Anyone who is not well acquainted with the literature of the group might quite easily infer, on reading the 'Challenger' report, that the term "Stolonifera" is used for the first time by these authors. It is quite in keeping with such work as this that no attempt is made in the volume cited to discuss the value of the genera of the family Cornulariidæ (Clavulariidæ), which have recently been proposed without sufficient reason or description; that the peculiar mode of budding of *Clavularia viridis* is not referred to[1]; and that, in a word, the whole group remains in the same state of confusion that it was in before the publication of that colossal memoir.

Classification of the Alcyonaria.

The Order Alcyonaria may be conveniently divided into the following five Suborders:—

1. Protoalcyonaria . *Haimeia, Hartea.*
2. Stolonifera ..... { Fam. 1. *Clavulariidæ.* ,, 2. *Tubiporidæ.*
3. Alcyonacea..... { Fam. 1. *Alcyonidæ.* ,, 2. *Helioporidæ.* etc. etc.
4. Gorgonacea..... { Section I. *Scleraxonia.* ,, II. *Holaxonia.*
5. Pennatulacea ..... Fam. *Pennatulidæ.*

The principal points by which this classification differs from those put forward in recent times by other authors are the separation of the Protoalcyonaria and Stolonifera from the rest of the Alcyonaria as separate suborders, and the grouping together into one suborder the Tubiporidæ and the Clavulariidæ.

The value of a system of classification rests upon the correctness of the conception of the relative values of the characters presented by the animals that are being classified. A good classification is not necessarily the one in which the different groups contain an approximately equal number of families or genera. It is generally recognized now, for example, that it is not reasonable to include *Amphioxus* in the Class Pisces, but that it is reasonable and far more correct to place this remarkable form in a group by itself, the Acrania, which is to be considered of equal value to the whole

[1] To illustrate the importance of this point, I may be allowed to quote some remarks of the late Professor Moseley (10):—"The existence of transverse communicating canals in *Clavularia*, extending between the vertical tubes at successive heights above the stolon-tubes, as in *Syringopora*, is apparently a new fact, and one of great interest."

of the Chordata, with the exception of the Tunicata—the Craniata. Now the genera *Haimeia*, *Hartea*, and *Monoxenia* differ from all the other Alcyonaria in the remarkable character that they remain solitary—they do not, in fact, form compound colonies by gemmation.

This feature surely, by itself, is quite sufficient to justify their separation into a suborder. It is true there are many points in their anatomy and life-history that require further investigation, but it is only misleading to group them, even temporarily, with the Alcyonidæ, Helioporidæ, and other families with complicated growth and gemmation.

The Stolonifera, again, must be placed in a separate suborder, because in their mode of budding and in their general anatomy they differ widely from the other Alcyonaria. Anyone with the smallest experience of the group could distinguish almost at a glance one of the Stolonifera. He could recognize it as such as easily as he could recognize an Alcyonian, a Pennatulid, or a Gorgonian. There are, of course, in all these suborders some genera that present difficulties, but the majority of them may be quite easily located.

I have very little to add to the remarks I made in two former papers in favour of my proposition to classify *Tubipora* with the Stolonifera. I was not by any means the first to point out the relations between this genus and *Clavularia* and *Cornularia*. In 1834, de Blainville (1) placed these three genera together in one family, "Les tubipores;" and von Koch many years ago regarded *Tubipora* as a very primitive form, closely related to the Cornulariidæ. The formation of new buds in *Clavularia viridis*, from tubes connecting the polypes, similar to the condition which existed in the fossil *Syringopora*, is a point which brings the genus *Clavularia* closer to *Tubipora*, and this may be used as an additional argument in favour of my method of classification.

The Stolonifera.

The Suborder Stolonifera may be defined as follows:—Colonial Alcyonaria, with a membranous or ribbon-like stolon. Mesoglœa poorly developed. Polypes either entirely free from one another, excepting at their bases, or connected by horizontal platforms (*Tubipora*) or connecting-tubes (*Clavularia viridis*). Skeleton composed of calcareous spicules, which may be joined together to form firm tubes (*Tubipora*), free from one another, or absent. In some cases the body-wall supported by a horny secretion.

The Stolonifera contain two families, the Tubiporidæ and the Clavulariidæ. To the former belongs the genus *Tubipora* alone, distinguished from all the other Stolonifera by the fact that the spicules join together to form a firm skeleton, and by the presence of horizontal connecting platforms. To the latter belong four living genera, namely *Clavularia*, *Cornularia*, *Stereosoma*, and *Sympodium*, and probably the fossil genus *Syringopora*.

The family Clavulariidæ is practically the same as the Cornulariidæ of other writers, but there are very good reasons for changing the name and adopting the one that I have proposed.

The genus *Cornularia* is distinguished from the other genera by the absence of spicules and the presence of a considerable horny secretion on the polype-walls and stolon. If this genus contained a large number of species, and it were at all a common thing for the species of the other genera to have horny walls and be devoid of spicules, *Cornularia* might be taken as the type of the family. But it is not so. *Clavularia* is the genus with the largest number of species, and the absence of spicules and the presence of a horny substance strengthening the walls of the polypes are phenomena not very frequently met with in the family. It is better, then, to take *Clavularia* as the typical genus.

At the time of the appearance of the famous 'Histoire Naturelle des Coralliaires,' by MM. Milne-Edwards and Haime, seven genera were recognized, and they were arranged as follows:—

- Cornulariés
  - Simples, à polypiéroïde tubulaire et à polype rétractile ..... *Haimeia.*
  - Agrégées, portées sur
    - des stolons radiciformes.
      - Polypiéroïdes
        - tubuliformes.
          - Polypes
            - rétractiles.
              - Murailles
                - ni costulées ni spiculifères: *Cornularia.*
                - costulées et spiculifères: *Clavularia.*
            - non rétractiles. — *Rhizoxenia.*
        - verruciformes ..... *Sarcodictyon.*
    - une expansion membraniforme.
      - Polypes
        - rétractiles .. *Sympodium.*
        - non rétractiles *Anthelia.*

If subsequent naturalists had followed closely the characters here given by the French naturalists, we might have been preserved from the extraordinary state of confusion into which the group has now fallen; but new species have been included in the old genera without reference to the characters here given, new genera have been created without any reason, adequate or otherwise, given in the text, and the figures, in some cases, have been hopelessly at variance with the descriptions. To give here just one example of the many I have come across:—The genus *Rhizoxenia* was established by Ehrenberg (5) to include a species that he found in the Red Sea, characterized by the fact that the polypes are not retractile, and Milne-Edwards and Haime rely upon this as the one and only character separating this genus from *Clavularia* and *Cornularia*. "Genre IV. Rhizoxenia. Polypiéroïdes comme dans les genres précédents, mais polypes non rétractiles."

Notwithstanding this fact, Sars (26) described a new species as *Rhizoxenia filiformis* with completely retractile polypes, and von Koch (17), in describing Dana's old species, *Rhizoxenia rosea*, says the polypes are extraordinarily contractile.

Without giving more examples illustrating the fearful state of confusion of the group at the present time, I will merely express my opinion that all the old classifications must now be definitely abandoned, and a new one be formed to take their place. In order to do this it is necessary to criticize the genera as they now stand.

Since the publication of the 'Histoire Naturelle des Coralliaires,' several genera have been added, so that we have now thirteen genera in all (omitting the non-colonial forms *Haimeia*, *Hartea*, and *Monoxenia*).

The Genera of the Stolonifera.

In the report on the Alcyonaria of H.M.S. 'Challenger,' Studer and Perceval Wright (30) include the following sixteen genera in the family Cornulariidæ:—

1. *Cornularia*, Lamarck.
2. *Rhizoxenia*, Ehrenberg.
3. *Clavularia*, Quoy & Gaimard.
4. *Sarcodictyon*, Forbes.
5. *Anthelia*, Savigny.
6. *Gymnosarca*, Saville Kent.
7. *Cornulariella*, Verrill.
8. *Telesto*, Lamouroux.
9. *Cœlogorgia*, Milne-Edwards.
10. *Cyathopodium*, Verrill.
11. *Scleranthelia*, Studer.
12. *Anthopodium*, Verrill.
13. *Sympodium*, Ehrenberg.
14. *Erythropodium*, Kölliker.
15. *Callipodium*, Verrill.
16. *Pseudogorgia*, Kölliker.

These sixteen genera fall into three groups:—

(1) Those that have been thoroughly well described and figured, and can be readily identified as separate genera belonging to the Stolonifera, namely: *Cornularia*, *Clavularia*, and *Sympodium*.

(2) Those that have been only imperfectly described, and had better be incorporated in the other genera: *Rhizoxenia*, *Sarcodictyon*, *Anthelia*, *Gymnosarca*, *Cornulariella*, and *Cyathopodium*.

(3) Those that do not come within the limits of my definition of the Stolonifera, and should be placed in other suborders: *Telesto*, *Cœlogorgia*, *Scleranthelia*, *Erythropodium*, *Pseudogorgia*, *Anthopodium*, and *Callipodium*.

The three genera *Rhizoxenia*, *Sarcodictyon*, and *Anthelia* have been established for many years, and I feel some hesitation in proposing that they should now be abolished. Increased knowledge of the varieties of the species of *Clavularia*, however, shows that it is a matter of impossibility to draw any hard-and-fast lines between the forms described under these generic names and some of the species of *Clavularia*.

The genus *Rhizoxenia* was established by Ehrenberg (5) in 1834 for those forms allied to *Cornularia* and *Clavularia*, but differing from them in the non-retractility of

their polypes. Since Ehrenberg's time new species have been named *Rhizoxenia* with perfectly retractile polypes, so that the original character of the genus has been lost. Thus von Koch (17) in a recent paper says that *Rhizoxenia rosea* (von Koch) differs from *Clavularia* in the fact that the tentacles are partially invaginated in retraction as in *Corallium rubrum*; but this is not a character that can be raised to the value of a specific distinction. I have myself noticed in some species of *Clavularia* that the base of the tentacle is, to a certain extent, invaginated, and I have always considered that this feature depends upon the presence or absence of a dense deposit of spicules at the basal part of the tentacles. In those Clavularias with very thick-walled polypes there is no invagination of the tentacles—they are simply withdrawn; but in those whose polypes are thin-walled a partial invagination takes place. Even if there were any value in this character it is not one, I think, that should be very readily adopted, as it is not very easy to determine the mode of retraction of the tentacles with certainty without making a series of sections through a large number of polypes, and it would consequently be a character of great inconvenience to the systematic zoologist. Until some other character has been described, the genus *Rhizoxenia* must go, and consequently

Rhizoxenia rosea, Dana (3), becomes *Clavularia danæ*.[1]
Rhizoxenia primula, Dana (3), becomes *Clavularia primula*.
Rhizoxenia thalassantha, Ehrenberg (5), becomes *Clavularia thalassantha*.
Rhizoxenia filiformis, Sars (26), becomes *Clavularia filiformis*.

The genus *Sarcodictyon* was established by Forbes (12) for a delicate little form with very thin-walled polypes, which may be completely withdrawn into a thin ramifying stolon of ribbon-like bands.

There can be no doubt that the *Rhizoxenia filiformis* of Sars is closely related to *Sarcodictyon catenata* of Forbes; but it was hardly fair of Sars to criticize Forbes's action in not including it in the genus *Rhizoxenia*. Surely it was Sars who was at fault in placing his species with perfectly retractile polypes in a genus whose main character was that the polypes were not retractile!

However, I agree with Sars that *Sarcodictyon* must be given up, and consequently

Sarcodictyon catenata of Forbes becomes *Clavularia catenata*.

It is difficult, too, to find any very definite character by which to distinguish the genus *Anthelia* from *Clavularia*. The stolon is a membranous expansion, the polypes are not retractile as a whole, though their tentacles are, and there are numerous spicules. All of these characters are to be seen in some Clavularias.

Dana says, "The *Antheliæ* cover the rocks or any solid support at hand with thin fleshy plates, which consist of an aggregation of polypes united by their bases. They differ from the *Xeniæ* in budding only at the base, which gradually spreads outward by the process, producing finally the encrusting plate."

[1] The name *Clavularia rosea* has been given to a species from Kerguelen by Studer (28).

Anthelia glauca, Savigny, = *Clavularia glauca*.
Anthelia strumosa, Dana (3), = *Clavularia strumosa*.
Anthelia purpurascens, Dana (3), = *Clavularia purpurascens*.
Anthelia desjardiniana, Templeton, = *Clavularia desjardiniana*.
Anthelia capensis, Studer (28), = *Clavularia capensis*.
Anthelia filippii, Kölliker (20), = *Clavularia filippii*.

The name *Gymnosarca* was given by Saville Kent (13) to a form that exhibits numerous creeping stolon-like thick expansions, which anastomose and give rise to *free cylindrical stolons* on which the polypes are found. It may be that *Gymnosarca* should more correctly be placed with *Telesto* among the Alcyonida, but the determination of this point must rest upon some future microscopic examination of the "free cylindrical stolons." If they are really "stolons" (that is to say, if they are not mainly composed of the fused body-walls of the polypes), there is no reason for separating this form from the genus *Clavularia*. Whatever view we take, *Gymnosarca* as a separate genus must disappear from the Clavulariidæ.

The genus *Cornulariella* was described by Verrill (31) in 1874 in a footnote to a list of specimens caught in a dredging-expedition on the coast of New England.

The chief point of importance in this form is the presence of large fusiform spicules with sharp conical projections, which thicken and stiffen the walls of the polype-bodies. The actual size of these spicules is not given.

It seems to me to be a mistake to place a species in a separate genus on the character of the spicules alone. The spicules vary enormously in size, in number, and in distribution in the various species of *Clavularia*. Sometimes they are very large, as in *Clavularia viridis* (Plate L. fig. 16), sometimes very small, as in *C. garciæ*, and sometimes altogether absent, as in one variety of *C. australiensis*, *C. celebensis*, &c.

If there were any other distinctive character of this form, it might be well to consider it a separate genus; but it seems to me, from the very meagre description that is given (without any figure), that it is nothing more than a species of *Clavularia* with large and peculiar spicules. In what respects it is allied to "*Cornularia* and *Telesto*" we have no information.

It seems to me, then, that *Cornulariella modesta* should become *Clavularia modesta*.

The name *Cyathopodium* was given by Verrill (33) to a species formerly described by Dana as *Aulopora tenuis*. (It is obvious that in Verrill's paper *Allopora* is a misprint for *Aulopora*.) Verrill says, "It is, in fact, a *Tubipora*-like polyp with short cup-shaped cells, connected by narrow calcareous stolons, which correspond to the transverse plates of *Tubipora*, and from which the polyps spring."

I must confess that I fail to see that we have any evidence for supposing that this form is allied to *Tubipora*. We have no figure nor description of the polypes, and we have no figure nor description of the microscopic appearance of the calcareous stolon.

Moreover, the narrow calcareous stolons of *Cyathopodium* do not correspond in any way with the transverse plates of *Tubipora*. They are homologous with the stolons of *Tubipora*, and there is nothing like the horizontal platforms in this form. From the beautiful drawing given by Dana (3) it appears to be very similar macroscopically to Forbes's *Sarcodictyon*, a genus which, as I have pointed out, must now be abandoned.

Aulopora tenuis (Dana) = *Cyathopodium tenue* (Verrill) = *Clavularia tenuis*.

The genera *Telesto*, *Cœlogorgia*, *Scleranthelia*, and *Pseudogorgia* seem to me to be very remotely allied to the Stolonifera, and I do not think it is necessary to discuss their relations here. They all belong to the Alcyonida.

The genus *Erythropodium* was established by Kölliker (20) for the *Xenia carybœorum* of Duchassaing and Michelotti (4). From the description and figures given by the Italian observers, and the very brief description of the species given by Kölliker, it is quite unreasonable to accept without further comment the genus *Erythropodium*. It seems to me to be highly probable that Duchassaing and Michelotti were perfectly correct in their identification of the specimen they examined as a *Xenia*.

The genus *Callipodium*, established by Verrill (32) in 1869, would probably be more correctly placed among the Alcyonidæ than the Clavulariidæ. "The polyps are rather large and situated at the tops or summits of round-topped verrucæ, which are more or less elevated above the surface of the cœnenchyma, and either distantly scattered or closely crowded together; in the latter case often united laterally nearly to their summits." These points seem to indicate, as Verrill remarks, that it is "more nearly allied to the Briareidæ than to the Cornularidæ (Clavulariidæ, mihi), and I am therefore inclined to regard it as an encrusting genus of the former family, since even the typical species of the genus *Briareum* is sometimes found growing in broad encrusting sheets on stones, or parasitically covering the dead axes of many species of Gorgonidæ.

The genus *Anthopodium*, also established by Verrill (34), seems to be closely related to *Callipodium* on the one hand, and *Telesto* on the other. There is no reason whatever for retaining it in the suborder Stolonifera.

Genus Cornularia, Lamarck (24).

Without spicules. Stolons with a simple cavity. The basal parts of the polypes and stolons protected by a horny secretion.

Cornularia cornucopiæ. Naples. von Koch (16) = *Tubularia cornucopiæ*, Pallas, Elenchus.
Cornularia aurantiaca. China. Stimpson (27).

The species given by Quoy and Gaimard, *Cornularia multipinnata* and *Cornularia subviridis*, belong properly to the genus *Xenia*.

A further and more detailed account of the anatomy of this genus is a desideratum.

Genus Clavularia, Quoy & Gaimard (25).

The definition of this genus given by the French naturalists runs as follows:—

"Animaux cylindriques à huit tentacules pinnés continus dans des claviformes, coriaces, striés, subpédicules fixes et agglomérés."

This definition holds good in its entirety for the one species *Clavularia viridis* only. The limits of the genus must be considerably expanded to include the species that have been described since the return of the 'Astrolabe.'

The genus *Clavularia* includes those Clavulariidæ that possess a membranous or retiform creeping stolon into which the polypes cannot be completely retracted. Spicules are usually present. No horny secretion of the ectoderm formed.

In order to render the task of identifying the species of *Clavularia* an easier one, it is necessary to give detailed lists of some of the principal characters of all the species that have now been described.

The species of *Clavularia* arranged approximately in the order in which they have been described.

Name of Species.	Locality and depth.	Length of polypes.	Authority.
Clavularia viridis	Vanikoro, shore (?).	50 mm. and over.	Quoy and Gaimard (25).
C. violacea	Vanikoro, shore (?).	Only a few lines.	Quoy and Gaimard (25).
C. rusei	St. Thomas.	?	Duchassaing and Michelotti (4).
C. rosea	Kerguelen, 120 fath.	9 mm.	Studer (28).
C. magelhænica	Straits of Magellan, 42 fath.	5 mm.	Studer (28).
C. ochracea	Mediterranean.	10 mm.	von Koch (15).
C. crassa = *Cornularia crassa* (M.-E. & H.)	Mediterranean, shallow water.	5 mm.	Marion and Kowalewsky (23).
C. petricola	Mediterranean, shallow water.	6 mm.	Marion and Kowalewsky (23).
C. arctica	Vadsö, 50–60 fath. [150 fath., Grieg (6)].	12–14 mm.	Koren and Danielssen (21).
C. borealis	Throndhjemsfjord.	10–12 mm.	Koren and Danielssen (21).
C. stormi	Throndhjemsfjord.	5 mm.	Koren and Danielssen (21).
C. frigida	Off Spitzbergen, 260 fath.	3 mm.	Koren and Danielssen (22).
C. tubaria	Sombrero, W. Indies, 450 fath.	18 mm.	Perceval Wright and Studer (30).
C. elongata	Off Azores, 1000 fath.	13 mm.	Perceval Wright and Studer (30).
C. cylindrica	Off Tristan da Cunha, 100–150 fath.	5 mm.	Perceval Wright and Studer (30).
C. marioni	Mediterranean.	10 mm.	von Koch (16).
C. concreta	46° N. lat., 49° E. long., 1267 fath.	.....	Studer (29).
C. australiensis	Port Jackson, Australia, shallow water.	About 3 mm.	Hickson, present monograph.
C. ramosa	Port Jackson, Australia, shallow water.	About 4 mm.	Hickson, present monograph.
C. flava	Port Jackson, Australia, shallow water.	About 8 mm.	Hickson, present monograph.
C. garciæ	Diego Garcia, shallow water.	9–10 mm.	Hickson, present monograph.
C. reptans	N. Celebes, 5–10 fath.	?	Hickson, present monograph.
C. celebensis	N. Celebes, 10 fath.	8 mm.	Hickson, present monograph.

To these must be added the species of those genera that I have shown can no longer be separated from *Clavularia* :—

Name of Species.	Locality and depth.	Length of polypes.	Authority.
Clavularia desjardiniana = *Anthelia desjardiniana.*	Ile de France.	?	Dana (3).
C. strumosa = *A. strumosa*	Red Sea.	1 inch.	Ehrenberg (5).
C. glauca = *A. glauca*	Red Sea.	?	Savigny's figure in de Blainville (1).
C. purpurascens = *A. purpurascens*	Red Sea.	?	Ehrenberg (5).
C. capensis = *A. capensis*	Cape of Good Hope, 50 fath.	9–10 mm.	Studer (28).
C. filippii = *A. filippii*	?	?	Kölliker (20).
C. danæ = *Rhizoxenia rosea*	Mediterranean.	2 lines.	Dana (3).
C. primula = *R. primula*	Fiji Islands.	4–5 lines.	Dana (3).
C. thalassantha = *R. thalassantha* .	Moluccas.	?	Ehrenberg (5).
C. filiformis = *R. filiformis*	Coasts of Norway, 30–40 fath.	?	Sars (26).
C. catenata = *Sarcodictyon catenata.*	British, deep water.	.....	Forbes (12).
C. colinabum = *S. colinabum*	Scotland.	?	Forbes (?).
C. bathybius = *Gymnosarca bathybius.*	Cezimbra, Portugal.	.....	Saville Kent (13).
C. modesta = *Cornulariella modesta.*	Gulf of St. Lawrence, 80–100 fath.	6–18 mm.	Verrill (31).

To these must be added two species, *Rhizoxenia alba* and *Sympodium margaritaceum*, described by James Grieg from the coasts of Norway, both of them being undoubtedly species of *Clavularia* :—

Name of Species.	Locality and depth.	Length of polypes.	Authority.
Clavularia alba = *Rhizoxenia alba*	68° N. long., 9° 44′ E. lat., 634 fath.	.....	Grieg (6).
C. margaritaceum = *Sympodium margaritaceum.*	63° N. long., 5° E. lat., 237 fath.		

The following species have been too imperfectly described to enter into any modern system :—*Anthelia rubra* of delle Chiaje, *Anthelia olivi* and *Anthelia domuncula* of de Blainville.

Genus Sympodium (Ehrenberg).

Some doubt has been thrown upon the stability of this genus by the recent investigations of von Koch (18) upon *Sympodium coralloides*, who has shown that this form is a true Alcyonid adapted to live on a *Gorgonia* stem, and proposes that its name should be changed to *Alcyonium coralloides*. It is possible that, when they are properly examined histologically, the other species attributed to *Sympodium* may turn out to be after all true Alcyonians with a modified habit. For the present, however, it may be allowed to stand provisionally, and the reader may be referred to the excellent account of the genus in the 'Challenger' volume for the species that have been hitherto described.

The genus includes those Clavulariidæ with a thick plate-like stolon into which the polypes may be completely retracted.

Description of a new Genus (Stereosoma), *and of new Species of* Clavularia.

Stereosoma, gen. nov.

Stereosoma celebense. (Plate XLV.)

The only specimen of this interesting new genus known to me is one that I found growing on the reefs of Talisse Island in North Celebes. It does not occur in great abundance on any of the reefs that I visited; in fact the only specimen I found after months of reef-wading in search of specimens was a small colony bearing five or six polypes attached to a piece of water-logged wood.

The genus can be at once recognized by two important characters, the first being that it shows no power of retracting either its body-wall or tentacles, and the second that the pinnæ of the tentacles are separated from one another by very considerable intervals.

The absence of contractility is a remarkable feature.

Many Alcyonaria are usually described as not contractile, but the description is seldom perfectly accurate.

Polypes that possess a great number of densely-packed spicules take a long time to contract, and they may be removed from their habitat, placed in ordinary spirit, and be preserved without showing very much contraction. Again, many Alcyonarians that do not exhibit any considerable power of contracting their body-walls may contract their tentacles.

Now *Stereosoma* possesses no spicules, and the tentacles show no more power of contracting than the body-wall.

The illustration given (Plate XLV.) is a faithful representation of the specimen as it reached England on my return from Celebes, the colour alone having been added from notes that I made at the time of its discovery.

On making a series of transverse sections through one of the polypes I found that the ectoderm is remarkably thick, and presents a very vacuolated appearance.

Between the vacuoles and the ectoderm covering the body there may be seen a number of isolated cells, islets of cells, and strings of cells (Plate L. fig. 1). These are undoubtedly derived from the ectoderm, and probably secrete the tough, vacuolated, homogeneous substance that surrounds them and lies between them and the mesoglœa. I have had no means of ascertaining what is the precise chemical nature of this substance, but it is undoubtedly of a horny consistency. It stains deeply in borax carmine, and can be readily distinguished from the true mesoglœa which lies below it. It is a point of some importance, in comparing this genus with *Cornularia*, that in

Stereosoma the horny substance that is formed lies inside the ectoderm, whereas in *Cornularia* it is outside it.

The mesenteries present well-marked muscle-ridges and muscular bands. The muscles are used for producing the graceful swaying and bending movements that I noticed in the living condition.

There is a small and not very well-defined siphonoglyphe (Plate L. fig. 2), and the walls of the stomodæum in preserved specimens are slightly folded.

There are no spicules in the body-walls, tentacles, or stolon.

The stolon is a moderately thick plate-like structure containing numerous ramifying canals.

The tentacles are long and delicate, and present the remarkable feature of possessing only a few small teat-like pinnæ, separated from one another by considerable intervals. In this feature *Stereosoma* presents a character that seems to separate it from all the other Stolonifera. In all the species of *Clavularia* that I have examined the pinnæ are exceedingly numerous and very closely set, so that the tentacle has a considerable resemblance to the vexillum of a feather. The tentacle of *Stereosoma* has no resemblance whatever to a feather.

The elongated slit-shape mouth is situated on the top of a prominent conical hypostome.

There are no external ridges or other markings on the body-walls.

The genus may be defined as follows:—

Clavulariidæ forming small colonies, consisting of stiff non-retractile polypes situated at considerable intervals from each other on a thick plate-like stolon. Tentacles non-retractile. Pinnæ few and widely separated. Spicules absent.

One species, *Stereosoma celebense*. Polypes 15 mm. long, 3 mm. in diameter; tentacles 10 mm. long, with from 5 to 10 pinnæ on each side. Colour pale brown.

Locality. Shore reefs on southern part of Talisse Island, North Celebes.

Genus Clavularia.

Clavularia australiensis, Hickson (11), Variety A. (Plate L. fig. 3.)

Specimen 1. Stolon thin and membranous, forming in some places sympodial plates, in others broad and narrow strands.

Polypes partially retracted into the stolon, forming protuberances on its surface, 0·5 mm. in diameter, 1·0 to 1·5 mm. in height, and about 2 mm. apart.

Spicules numerous, simple, multituberculate, 0·14 to 0·18 mm. long (Plate L. fig. 4).

Colour in spirit white.

The specimen sent to me is parasitic on a piece of sponge.

An interesting point in connection with this specimen is the enormous number of zooxanthellæ in the intermesenterial spaces (Plate L. fig. 5).

I am convinced, from an examination of a large number of specimens of Alcyonarians, that the number of the zooxanthellæ in the cœlenteron cannot be used for purposes of classification, since polypes of the same species, and even of the same colony, show very great variation in this respect. Generally speaking, shallow-water polypes possess more than those that live in deeper water, the zooxanthellæ being probably dependent for their growth and multiplication upon the intensity of the daylight. But whether this is the only cause or not does not seem certain. At any rate we can say that it is highly probable that the conditions favourable for the growth and multiplication of the zooxanthellæ are not precisely the same as those favourable for the growth and multiplication of the Alcyonarian colonies, and thus the variations in the number of these symbiotic algæ in the polypes may be accounted for.

Specimen 2. The stolon is somewhat thicker in the central part of its area than in Specimen 1. It is membranous, but becomes divided at the edges into broad and narrow strands. The polypes are densely crowded on the central parts of the stolon, but scattered at the edges.

The polypes are partially retracted, but not to such an extent as in Specimen 1, the adpressed tentacles remaining visible in more than fifty per cent. of the polypes.

The average height of the partially retracted polypes is 3 mm., and their diameter 1·5 mm.

The walls of the polypes are thicker than they are in the first specimen, with dark brown corrugated outer surfaces.

Spicules resemble those in Specimen 1, but the tubercles are slightly longer and less numerous. Average length 0·15 mm. (Plate L. fig. 6).

The colony is parastic on a piece of sponge.

Clavularia australiensis, Variety B. (Plate L. fig. 7.)

The three specimens that I have grouped together as Variety B of this species are distinguished from the others by the absence of spicules. This fact in itself might be considered by some naturalists to be sufficient reason for the establishment of a new species, or even a new genus, for their reception; but after a careful examination of the anatomy of the specimens, their mode of growth, structure of the tentacles, and general anatomy, I am convinced that we are not justified in separating into different species those forms that differ mainly in the presence or absence of spicules. I believe that it is quite possible that in some localities, where there is but little lime in the water and an abundance of sand, the *Clavularias* do not develop spicules. This is sufficient to constitute a separate local variety, but not a species.

Associated with the absence of spicules in this variety there may be noticed a difference in the character of the ectoderm from that of Variety A (Plate L. fig. 8).

The ectoderm of Variety A is over the great part of ts surface smooth and columnar, each cell being marked off from its neighbours by very definite cell-outlines. In

Variety B, on the other hand, the ectoderm is highly vacuolated and its surface irregular. The cells have branched processes which anastomose with one another, and it is impossible to determine, in most cases, where one cell ends or another begins. I believe that this vacuolated ectoderm is considerably stiffer or firmer than the simple columnar ectoderm of Variety A, and that it is formed for the support of the body-wall in the absence of spicules.

In Specimen 1 of this variety the stolon is thin and membranous, dividing into ribbon-like pieces at the edges. The polypes are partially retracted and densely crowded on the parts of the colony with a membranous stolon, but fully expanded and widely separated from one another at the edges.

The colour is brownish yellow, due to a considerable deposit of sand.

The colony is parasitic on an Ascidian test.

Specimens 2 and 3 are probably young examples of the above. The stolon is very thin and composed of a number of anastomosing bands or ribbons. Most of the polypes are fully expanded. They are both parasitic on mussel-shells.

Locality. Coast of Victoria, shallow water.

Clavularia ramosa, Hickson (11). (Plate L. figs. 9 & 10.)

Stolon composed of a number of thin branching strands clinging to the branches of a seaweed. The strands of the stolon are usually about $\frac{1}{2}$ mm. in breadth, but never exceed 1 mm.; they do not fuse to form membranous or plate-like expansions.

The polypes spring from the branches of the stolon singly at intervals of 3 mm. The youngest polypes are found at the ends of the youngest branches.

New polypes apparently never arise between the older polypes, but each polype is formed in succession at the end of the growing branch of the stolon.

The ramifications are formed by a simple bifurcation of the growing point of a branch, and they are produced quite independently of the position of the youngest polypes. Sometimes a polype may be seen springing from the angle of a bifurcation, but more frequently there is no polype in this position.

Judging from spirit-specimens only, the polypes are not capable of complete retraction into the branches of the stolon. In the retracted condition they are funnel-shaped. The broad rounded distal extremity, 1·5 mm. in diameter, contains the retracted calyx. The narrow proximal extremity at the point of attachment to the stolon is ·5 mm. in diameter.

The distal extremity is marked by eight deep furrows.

The spicules are numerous, both in the stolon and the polype-walls; they are double clubs 0·1 to 0·15 mm. long. In the tentacles there are a few elongated lancet-shaped spicules with irregular dentate projections (Plate L. fig. 11).

In spirit the specimens are dirty yellowish white in colour.

Locality. Coast of Victoria, shallow water.

CLAVULARIA FLAVA, Hickson (11). (Plate L. fig. 12.)

The stolon is thin and ribbon-like, not coalescing into membranous plates. There are comparatively few polypes situated on the stolon at intervals of 4 to 6 mm. At the edges of the stolon there are frequently to be seen considerable areas devoid of polypes.

The polypes have in all cases their crowns retracted, and the tracts of insertion of the mesenteries are not indicated externally by longitudinal grooves or lines. This feature, connected probably with the denseness of the mesoglœa and the great number of spicules, is quite sufficient in itself to distinguish this species from *C. australiensis*.

The length of the polypes, as they are seen in spirit with their tentacles retracted, is 4–6 mm., the diameter 1·5 mm.

The spicules are of a bright yellow colour, and form a dense armature for the polypes and stolon. On slicing off a piece of the body-wall and examining it with the microscope the spicules appear to be locked together to form a compact skeleton.

The spicules are 0·1 to 0·15 mm. in length, and are of three kinds:—(*a*) short and broad double cones with numerous blunt tubercles, found in great number in the mesoglœa of the body-walls of the polypes and the stolon; (*b*) elongated style-like spicules, with very few short and pointed tubercles, found principally in the tentacles; (*c*) a few spicules of irregular shape that I have never seen *in situ* (Plate L. fig. 13).

The colour of the specimens in spirit is orange. They are situated on fragments of an old lamellibranch (oyster?) shell.

Locality. Coast of Victoria, shallow water.

CLAVULARIA GARCIÆ, sp. nov. (Plate XLVI.)

The stolon is in the form of a thin membranous plate about 1 mm. in thickness.

The polypes are evenly distributed over the stolon, and separated from one another by short intervals. When looking down upon a spirit-specimen it appears as if the polypes were densely crowded, on account of the long tentacles and pinnæ, but on carefully separating the polypes with needles it is clear that there are considerable intervals between their bases.

The polypes have remarkably thin and transparent walls containing a number of very small scattered (not crowded) spicules; the mouth is very small and situated at the extremity of a teat-like papilla in the centre of the oral disk. Each polype is from 9–10 mm. in length.

The tentacles are about 5 mm. in length, very thin-walled, and bear on each side about 30 long hollow pinnæ. The great length and number of the pinnæ give the species a very fluffy or downy appearance quite peculiar to it.

Neither the polypes nor the tentacles show any signs in the spirit-specimens of a power of contraction.

Every polype is fully expanded. This is a noteworthy feature in a species with such thin-walled tentacles and polypes. It must be noted that it is highly improbable that in the natural condition the polypes can retract, for there are no spaces in the basal stolon that could contain them.

Another very remarkable feature of the species is the minuteness of the spicules. They are a great deal smaller than the spicules of any species of *Clavularia* I have yet examined (Plate L. fig. 15). They are all of one kind, namely, rhombic in shape, with the angles rounded off, and they show a number of extremely minute thorn-like projections. Each spicule measured 0·05 mm. in length and 0·003 mm. in breadth.

The specimen now in my possession was kindly given to me by Mr. G. C. Bourne, who found it in shallow water on the reefs of Diego Garcia, in the Chargos Archipelago.

Clavularia reptans, sp. nov. (Plate XLVII.)

This species of *Clavularia* is quite different in habit from any species yet described. The stolon consists of thin strands creeping over pieces of dead branched coral, in many cases stretching across the spaces between the branches, forming bridges on which polypes may arise. The important point about this form of stolon, and one upon which I was inclined to lay special stress, is the extraordinary area over which each colony extends, and the absence of any special point of concentration. When dredging off the coast of Talisse I often fished up bits of coral, much too large for my collecting-jars, that had this species of *Clavularia* growing over it in a form that reminded me of a very wide-meshed net. The whole colony grows, in fact, like a Canariensis creeper, clinging to any projecting branch that may be in its vicinity.

The breadth of the stolons averages 1 mm., the diameter of the contracted polypes 2 mm., and the length of the expanded polypes 7 to 10 mm.

It should be noted here that it is very rarely the case in *Clavularia* that the diameter of the retracted polype is actually greater than the average breadth of the stolon from which the polype springs. This character, then, is one which helps us to distinguish *Clavularia reptans* from other species of the genus.

The tentacles of this species are rather short and provided with numerous densely packed pinnæ, resembling somewhat the tentacles of *Clavularia garciæ*. Spicules absent.

Locality. I have only found this species at depths of 5 to 20 fathoms in the Banka Straits, North Celebes.

Clavularia celebensis, sp. nov. (Plate XLVIII.)

I have established this species for a small specimen of *Clavularia* I found off Talisse Island in 10 fathoms of water on an old water-worn branch of a madrepore.

In habit it is very similar to *Clavularia viridis*, but differs from it in several important points of structure.

The stolon is composed of thin strands varying from 1 to 3 mm. across, which coalesce at intervals to form small plate-like expansions. The polypes are of various sizes, the largest I have measured being 8 mm. long, with a maximum of 2·5 mm. in breadth. They have very thick walls, due to an extreme development of the mesoglœa. No grooves or lines of any kind mark externally the insertion of the mesenteries. The tentacles are long and pointed in life, and provided with numerous densely crowded pinnæ. The polypes are not capable of any very great contraction, but the crown of tentacles can be introverted into the anterior part of the polype-walls.

As I have had at my disposal such a small specimen I have not made as complete a study of the anatomy of this species as I should wish, but in the fragments of the stolon and polypes I have examined with the microscope I have not been able to find any trace of spicules. It is possible that they exist, for I find that it is never safe to state that there are no spicules in any species unless several polypes and a large piece of the stolon have been boiled in potash and the residue examined with the microscope.

The colour of the stolon and body-walls is the usual dull olive-brown, but the pinnæ of the tentacles are bright green.

When examined alive with the polypes expanded this species is one of the most beautiful, delicate, and graceful Alcyonarians I have ever seen.

Locality. Talisse Island, N. Celebes ; shallow water.

Clavularia viridis, Quoy & Gaimard. (Plate XLIX.)

I published, in the 'Proceedings' of the Royal Society, 1886 (10), a preliminary account of some observations on this species that I made when I was resident in Celebes. I then pointed out the existence of the remarkable tubes connecting the polypes, and the similarity of the expanded polypes, both in form and colour, to those of *Tubipora*.

Since my return to England I have made a few more observations upon its anatomy.

The species may be found in abundance on most of the coral-reefs of North Celebes, and probably occurs on the shores of nearly all the islands of the Malay Archipelago.

Quoy and Gaimard, who originally described the species, found it at Vanikoro, and Wallace obtained some specimens, which are now in the British Museum, from the Aru Islands.

Its usual habitat is, like *Tubipora*, on the shore side of the reef, where it is left exposed to the air at low water of spring tides. It occurs either in large clumps five or six inches in height and over a foot in diameter, or in small creeping colonies clinging to dead water-worn coral branches.

When dried in the sun it leaves a firm but brittle skeleton, composed of a plexus of irregular branching fibres, which fuse into a continuous sheath in the lower parts. This skeleton retains the original form of the contracted colony.

In colour the expanded polypes are either olive-brown or green, or any of the intermediate colours between the two.

The length of the polypes varies according to the size of the colony and the mode of growth. The longest tube I have measured is four inches, but the average length is not more than one or two inches.

When the tide goes down the crown and neck of the polypes are slowly but completely retracted within the firm walls of the lower part of the polype-tubes. In this firmly retracted condition they retain a considerable quantity of sea-water in their cœlentera, and they are able, in consequence, to withstand exposure to the air and sun for an hour or two.

The stolon consists of a network of tubes and strands clinging to the supporting coral blocks. In some places these strands are somewhat expanded, but I have never found any very extensive membranous plates in this species.

There are no spicules in the tentacles nor in the crown and neck, but in the lower parts of the body-walls of the polypes there are a few very large calcareous spicules. They are long spindles beset with numerous small spines and tubercles. Their average size is 2·3 mm. long by 0·14 mm. broad (Plate L. fig. 16).

A series of sections through the polypes shows that the muscular ridges on the mesenteries are very numerous and long (fig. 17); in fact the mesenterial muscles of *Clavularia viridis* are stronger than any I have met with in the Alcyonaria, excepting perhaps *Tubipora* (9).

The mesoglœa is very thick for a Stoloniferan, both in the tentacles and body-wall.

The spicules are situated in the mesoglœa, and in transverse sections of decalcified specimens empty spaces may be seen, indicating the places that they formerly occupied.

The horny skeleton is formed by some modification of the mesoglœa. It occurs in the form of a number of very dense fibres, which are figured in transverse sections in Plate L. fig. 18 *h.f.* They appear in the form of deeply stained cores situated in the centres of wide lacunæ in the homogeneous mesoglœa.

It is difficult to determine the exact chemical nature of this horny skeleton, but it is apparently closely related to keratin.

It is insoluble in weak and strong nitric and hydrochloric acid. It is partially soluble in strong hot sulphuric acid. It is not digested by pepsin and ·2 per cent. hydrochloric acid, nor by solution of pancreatin.

On burning it gives a pungent and somewhat aromatic odour.

In origin it differs from the horny skeleton of *Cornularia* and *Stereosoma* in being a product of the mesoglœa. There is nothing that resembles it in any other species of the genus.

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EXPLANATION OF THE PLATES.

PLATE XLV.

Stereosoma celebense, p. 337.

PLATE XLVI.

Clavularia garciæ, p. 341.

PLATE XLVII.

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PLATE XLVIII.

Clavularia celebensis, p. 342.

PLATE XLIX.

Clavularia viridis, p. 343.

PLATE L.

Structure of *Stereosoma* and *Clavularia*.

Fig. 1. Transverse section through a portion of the body-wall and one mesentery of *Stereosoma celebense*, showing the thick vacuolated ectoderm, consisting of an outer layer of cells and a subjacent dense homogeneous substance containing a number of isolated cells, rods of cells, and cell islets (*Ect.'*), as well as the vacuoles or lacunæ. The mesoglœa is sharply defined and is not vacuolated. A considerable number of zooxanthellæ may be seen adhering to the endoderm.

Fig. 2. Outline drawing of a transverse section through *Stereosoma celebense* in the region of the stomodæum, showing the small but prominent muscular ridges and the siphonoglyphe.

Fig. 3. A small specimen of *Clavularia australiensis*, Variety A.

Fig. 4. Two forms of the spicules of *Clavularia australiensis*, Variety A.

Fig. 5. Transverse section through a polype of *Clavularia australiensis*, Variety A, showing the enormous number of zooxanthellæ adhering to the endoderm, and the simple columnar form of the ectoderm.

Fig. 6. Two forms of spicules found in another specimen of *Clavularia australiensis*, Variety A.

Fig. 7. A specimen of *Clavularia australiensis*, Variety B, showing the ribbon-like character of the stolon at the edges. One of the polypes is fully expanded, but all the others are in different stages of retraction.

Fig. 8. Transverse section of a polype of *Clavularia australiensis*, Variety B, showing that there are only a few zooxanthellæ adhering to the endoderm (compare *C. australiensis*, Variety A, fig. 5). The ectoderm is thick and vacuolated, the cells being irregular in shape. The siphonoglyphe is large and well-defined.

Fig. 9. A small portion of a colony of *Clavularia ramosa*, growing on a ramifying sponge.

Fig. 10. The growing point of a colony of *Clavularia ramosa*, showing two young polypes.

Fig. 11. Three forms of spicules found in *Clavularia ramosa*: *a*, a spicule from the body-wall; *b*, two spicules from the tentacles.

Fig. 12. A specimen of *Clavularia flava* growing on a piece of oyster-shell.

Fig. 13. Three forms of spicules found in *Clavularia flava*.

Fig. 14. Transverse section through a portion of the stolon of *Clavularia flava*, showing four endodermic canals in section.

Fig. 15. Spicule of *Clavularia garciæ*.

Fig. 16. A spicule of *Clavularia viridis*.

Fig. 17. Outline sketch of a transverse section through a polype of *Clavularia viridis*, to show the large and deep muscular ridges on the mesenteries.

Fig. 18. Transverse section through a portion of the body-wall of *Clavularia viridis*, showing the horny fibres, *h.f.*, and the lacunæ left after the solution of the calcareous spicules in the mesoglœa.

Reference letters used in all the figures:—*Ect.* Ectoderm; *End.* Endoderm; *Lac.* Lacunæ; *Mes.* Mesoglœa; *Musc.* Muscular ridges; *Siph.* Siphonoglyphe; *Stom.* Stomodæum; *Zx.* Zooxanthellæ.

L.P. King del.
M.P. Parker chromo.

STEREOSOMA CELEBENSE

West, Newman imp.

L.B.King del
M.P.Parker chrome.

West, Newman imp.

CLAVULARIA GARCIÆ.

M.F.Parker chromo.
L.B.King del.

West, Newman imp.

CLAVULARIA REPTANS.

L.B.King del.
M.P.Parker chromo.

West, Newman imp.

CLAVULARIA CELEBENSIS.

A.W.Hickson del.
M.P.Parker chromo.

West, Newman imp.

CLAVULARIA VIRIDIS.

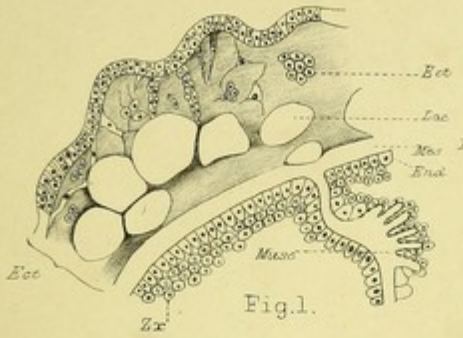


Fig. 1.

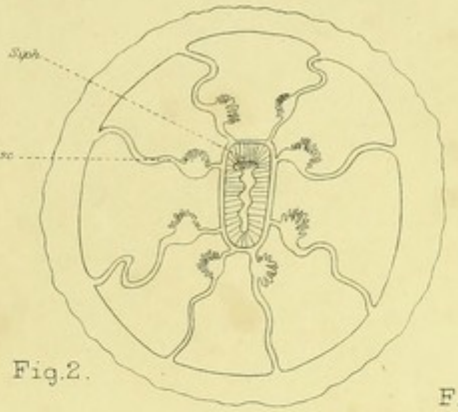


Fig. 2.


Fig. 3.


Fig. 4.


Fig. 6.

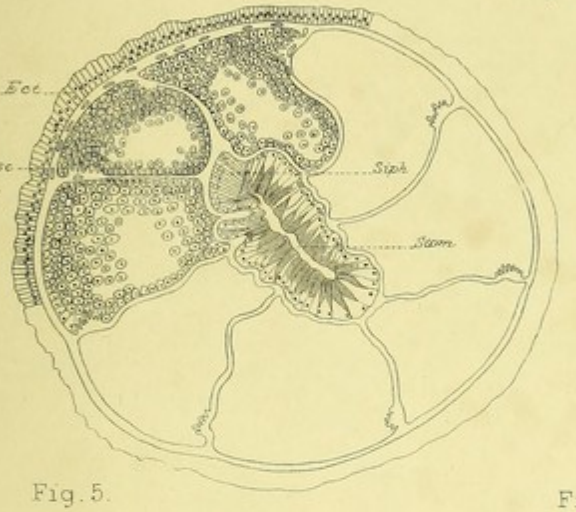


Fig. 5.


Fig. 7.

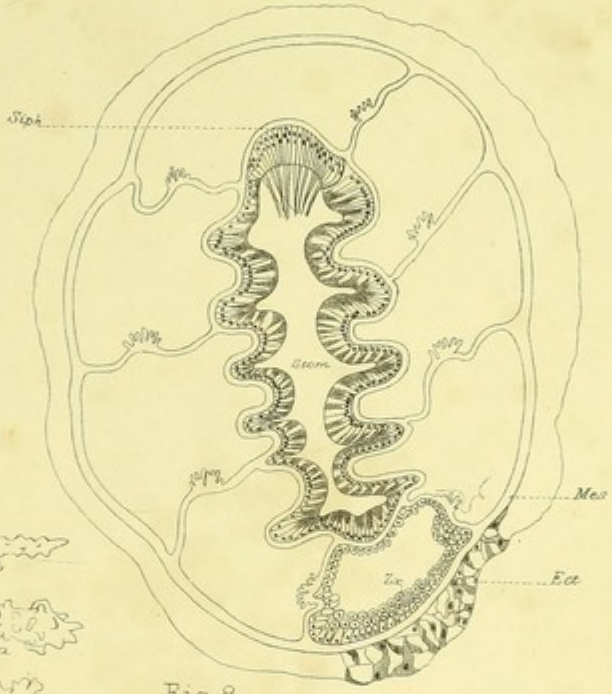


Fig. 8.


Fig. 9.


Fig. 10.

Fig. 11.

Fig. 13.


Fig. 15.

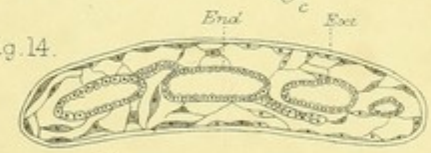


Fig. 14.

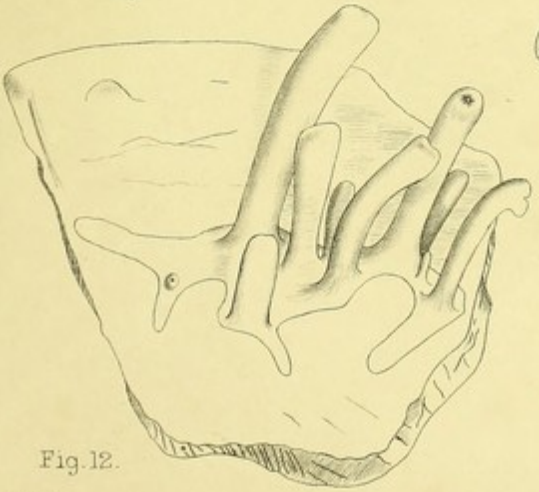


Fig. 12.

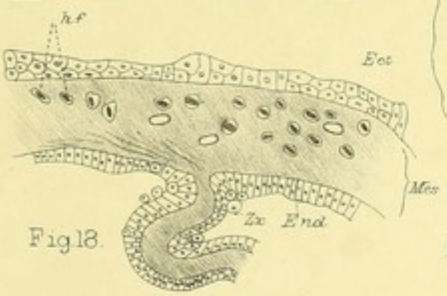


Fig. 18.

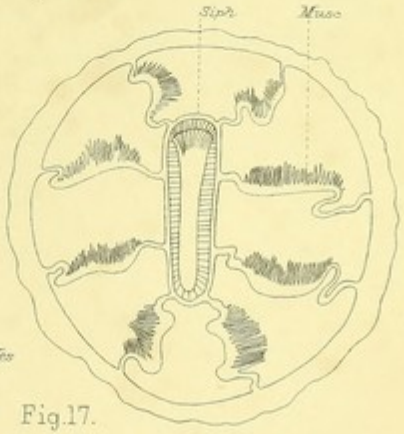


Fig. 17.


Fig. 16.

S.J.H. del.
M.P.Parker lith.

West, Newman imp.

STRUCTURE OF STEREOSOMA AND CLAVULARIA.

FLEMPTON POLLING DISTRICT (District M).

1894.

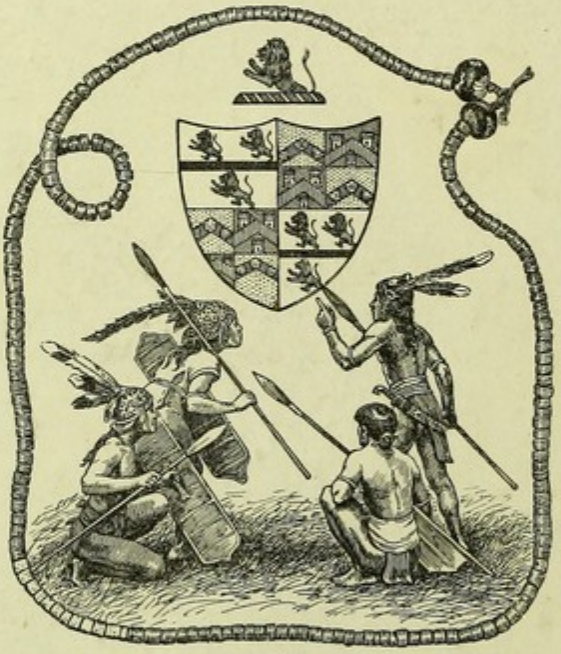
Parish of WORDWELL.

Occupation Electors (other than Lodgers).

DIVISION ONE.—*Parliamentary Electors and County Electors.*

No.	Name of each Elector at full length, the Surname being first.	Place of Abode.	Nature of Qualification.	Description of Qualifying Property.
M 175	Arbon, William	Wordwell	Dwelling house	New barn
M 176	Bell, Andrew	Wordwell	Dwelling house (successive)	The farm, from Culford
M 177	Clarke, George	Wordwell	Dwelling house	Chequers belt
M 178	Collins, Thomas	Wordwell	Dwelling house	Chequers belt
M 179	Cutting, Theophilus	Wordwell	Dwelling house	New barn
M 180	King, George	Wordwell	Dwelling house	New barn
M 181	King, Robert	Wordwell	Dwelling house	Church cottage
M 182	Murton, David	Wordwell	Dwelling house	Chequers belt
M 183	Newdick, John	Wordwell	Dwelling house	Chequers belt

† *Not entitled to vote in respect of this entry at a Parliamentary Election.*



BOOK-PLATE
OF
CHARLES·HOSE