PALÆONTOGRAPHICAL SOCIETY.

BRITISH FOSSIL ECHINODERMATA.

PART THIRD.

THE COLLYRITIDÆ, ECHINOBRISSIDÆ, AND ECHINOLAMPIDÆ.

BRITISH CARBONIFEROUS BRACHIOPODA.

PART V.

FOSSIL REPTILIA OF THE WEALDEN FORMATIONS.

PART V.

FOSSIL POLYZOA OF THE CRAG.

ISSUED FOR 1857.

LIST

OF THE

COUNCIL, SECRETARIES, AND MEMBERS

OF THE

PALÆONTOGRAPHICAL SOCIETY.

1859.

LAWS.

I.

That the Society formed be called the Palæontographical Society, and that it shall have for its objects the illustration and description of British Fossil Organic Remains.

II.

Each Subscriber of One Guinea, or more, annually, shall be considered a Member of the Society. Such subscription to be paid in advance, and shall be due on the 1st day of January, 1847, and each succeeding year.

III.

A Member shall, for each Guinea subscribed annually, be entitled to one copy of every publication issued by the Society, for the year to which his subscription relates. But no Member shall be entitled to receive his copy, or copies, until his subscription has been paid.

IV.

The number of copies of the Society's publications shall be limited to the number of Members, unless otherwise directed by the Council.

V.

The business of the Society shall be conducted by a President, Treasurer, Hon. Secretary, and a Council of sixteen Members, who shall be elected at a General Meeting of the Members, to be held annually in London.

VI.

The accounts of the receipt and expenditure of the Society shall be examined annually by two Auditors appointed by the Council; the Auditors to be Members of the Society, who are not Members of the Council, and their statement shall be circulated among the subscribers.

VII.

That the Editors of works published by the Society be entitled to a number of copies of their works, not exceeding twenty-five, as may be decided by the Council.

REGULATIONS FOR THE DELIVERY OF BOOKS.

They are delivered, free of expense, within three miles of the General Post Office, London.

They are sent to any place in England, beyond the distance of three miles from the General Post Office, by any conveyance a Member may point out. In this case the parcels are booked at the expense of the Society, but the carriage must be paid by the Member to whom they are sent.

They are delivered, free of expense, at any place in London which a Member, resident in the country, may name.

They are sent to any of the Hon. Local Secretaries of the Society, each Member being expected to pay the Local Secretary a due share of the carriage of the parcel in which the books are sent.

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Those Members who wish their books to be included in any of the parcels to Local Secretaries are requested to send in their names (with their Christian name in full) and particular address to the various Local Secretaries, who are respectfully requested to forward to the Secretary for London an accurate list of all such names, with as little delay as possible.

Unless intimation to the contrary be given to the Secretary for London, the future deliveries will be made in accordance with the delivery of the first volume.

The Council, desirous of imposing as little trouble as possible upon the Local Secretaries, particularly request that all subscriptions be paid by Members directly to the Treasurer, Searles Wood, Esq., Twickenham, Surrey, by Post Office Order on the *Twickenham Office*, or by Cheque on a *London* Banker. And as there is no other capital for conducting the affairs of the Society than the Subscriptions paid in advance, the Country Members are respectfully reminded that an *early* remittance is absolutely necessary.

As the quantity of plates and letterpress to be delivered to the Subscribers annually will be increased in proportion to the extension of the Society, the Members are respectfully urged to obtain as many new Subscribers, and at as early a period, as possible.

Gentlemen desirous of forwarding the objects of the Society, may be provided with circulars for distribution by application to the Hon. Secretary.

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tubercular surface is crowded with small granules; the tubercles of both areas are the same size.

Affinities and differences.—This urchin in its general *facies* bears so much resemblance to *H. gibberulus*, Agass., that at one time I considered it a variety of that species; but the absence of the gibbous crest, the fulness of the anterior border, the straightness of the anterior ambulacra, the form and direction of the posterior pair, together with the difference observed in the shape of the longitudinal valley, have induced me to separate it from that species under the name *H. ovalis*. By its oval shape and elongated apical disc it is distinguished from *H. agariciformis*, and by the shortness of the single inter-ambulacrum from *H. caudatus*.

Locality and Stratigraphical position.—I have collected this species only from the marly fossiliferous vein which traverses the upper ragstones of the Inferior Oolite, in the zone of *Ammonites Parkinsoni*, Sow., near Hampen, Gloucestershire, where it is associated with *Holectypus depressus*, Leske, *H. hemisphæricus*, Desor, *Pedina rotata*, Wright, *Clypeus Hugi*, Agass., *Clypeus Plottii*, Klein, *Trigonia costata*, Sow., *Pectin symmetricus*, Morris, *Ammonites Parkinsoni*, Sow. I have found one specimen in the Trigonia bed at Cold Comfort, where it was associated with the large *Perna isognomonoides*, Stahl.

B. *Species from the Coral Rag.*

Hyboclypus stellatus, *Desor*.

Hyboclypus stellatus. Desor, Catalogue raisonné Annales des Sciences Naturelles, 3e série, tome vii, p. 152.
— — Desor, Synopsis des Echinides Fossiles, p. 193.

This urchin is described by M. Desor as "Espèce intermédiaire par sa forme, entre les *H. canaliculatus* et *H. marcon*, mais différant de l'un et de l'autre par ses ambulacres postérieurs qui sont rectilignés an lieu d'être arqués. T. 76 (type du l'espèce).

"*Formation.*—Corallien du Wiltshire. Rare.

"*Collection.*—M. Le Viscomte d'Archiac."

I only know this species from the above notice, as I have never been so fortunate as to see a specimen of it in any of the collections of Coral-rag urchins which I have examined.

Family 7—COLLYRITIDÆ, *Wright*, 1856.

Famille 7me—Dysastéridées, *Albin Gras*, 1848.
Famille 1re—Collyritidæ, *D'Orbigny*, 1853 (pars).
Famille des Dysastéridées, *Desor*, 1856.

The urchins forming this family have a thin test which, in general, has an ovoid, elongated, or cordiform shape. The ambulacral areas converge at two points on the upper surface, which are more or less apart, whilst in all other Echinoidea, they converge towards one point, the apical disc, around which are the genital apertures, and the holes for the eyes. In the Collyritidæ, on the contrary, the ambulacra are divisible into two groups, the anterior, composed of the single area, and the anterior pair, meet at the apical disc, which is composed of the three anterior ocular, and four genital plates; the posterior, composed of the posterior pair of ambulacra, meet at some distance from the former, and form an arch over the anal opening. This disjunction of the ambulacra occasions a corresponding separation of the elements of the apical disc, as three of the ocular plates are placed before, and two behind, at the apices of the ambulacral areas; the four genital and three anterior ocular plates are intimately soldered together at the union of the three anterior ambulacral areas, and which junction forms the true vertex of the test.

The poriferous zones are narrow, the pores are unigeminal, and the tubercles in general small, numerous, perforated, and crenulated.

The mouth-opening is small, and placed near the anterior border; the peristome is oval or circular, and its margin is entire; the anal opening is round or oval, and is situated in the region of the posterior border, over which the two posterior ambulacra form an arch, the summit of which is more or less distant from the vent.

This family forms a small, natural group of urchins, connected with the Echinocoridæ on the one side, and with the Echinoconidæ and Spatangidæ on the other. Like the Echinoconidæ, the ambulacral areas in the Collyritidæ are narrow, the poriferous zones complete, the pores unigeminal throughout, and the tubercles perforated and crenulated. The genus *Hyboclypus* connects these two families by the elongated arrangement of the elements of the apical disc, and the partial disjunction of the apices of the three anterior from the two posterior ambulacra in that small group.

In the ovoidal form of the test, the structure of the ambulacra, and poriferous zones, the excentrical position of the mouth, and the supra-marginal situation of the vent, the Collyritidæ resemble the genus *Holaster*, by which they are connected with the family Echinocoridæ, but their two distinct ambulacral summits, placed at some distance apart, and the consequent disjunction of the posterior ambulacra from the apical disc, form a diagnostic character between them, and afford a good zootomical reason why they should not be united in one family, as proposed by the late M. A. d'Orbigny.

The petaloidal character of the ambulacra, circumscribed for the most part by *fascioles*, the bilabiate structure of the mouth, the completeness of the apical disc, and the union of the ambulacra around the same, form a group of characters by which the SPATANGIDÆ are distinguished from the COLLYRITIDÆ, which they only feebly resemble in external form, being widely separated from that family by organic structure.

M. Desor, who has carefully studied the species of this family, and figured them in his excellent 'Monograph on the Disasters,'* has made the following remarks on the affinities of the COLLYRITIDÆ, in his latest work now passing through the press.† "On nous objectera peut-être qu'il existe certains types, les Ananchydées par example, chez lesquels les ambulacres ne sont qu'imparfaitement bornés, et qui n'en sont pas moins très voisins des Spatangoïdes. Nous répondrons à ceci que cette ressemblance des Ananchydées avec les Dysastéridées est plus apparent que réelle. Sans doute que vus par en haut, les ambulacres des Ananchydées n'ont pas cette apparence pétaloïde qui charactérise à un si haut dégré les Clypéastroïdes, les Cassidulides et les vrais Spatangoïdes. Mais qu'on les regarde par la face inférieure et l'on retrouvera le véritable type des Spatangoïdes, savoir de très larges plaques ambulacraires en général lisses et percées d'une seule paire de pores, tandis que chez les Dysaster les plaques ambulacraires de la face supérieure ne subissent aucun changement sensible, et sont beaucoup plus petites que les plaques inter-ambulacraires. Il y a donc sous ce rapport une bien plus grande variété de structure ambulacraire chez les Ananchydées. De plus ces derniers ont en général le péristome bilabié et, ce qui est plus significatif, l'ambulacraire impair est différent des ambulacraires pairs, tandis que chez les Dysastéridées tous les ambulacres sont égaux. Ces considérations suffiront, je l'espère, pour expliquer pourquoi nous n'avons pas suivi l'example de M. d'Orbigny qui réunit les Dysaster et les Ananchydées en une seule famille, sous le nom de Collyridées.

"D'une autre côté, il importe également qu'on ne confonde pas les Dysastéridées avec les Galéridées, comme on a pu être tenté de le faire à une certaine époque, alors que la structure intime du test n'était pas suffisamment étudiée. Le fait que chez certains Galéridées particulièrement ceux du second type, les ambulacres ne convergent pas complètement ne constitue pas encore un démembrement de l'appareil apicial. L'écartement plus ou moins considérable des ambulacres n'est ici que la conséquence d'une disposition particulière des plaques ocellaires qui, au lieu d'être rejettées dans les angles externes des plaques génitales, se placent avec elles sur le même rang. Mais l'unité de l'appareil apicial n'est pas rompu pour cela. C'est une combinaison qui se produit également dans la famille des Ananchydées, dans celle des Galéridées et même chez certains Dysastéridées."

* Monographie des Dysaster, 1842.

† 'Synopsis des Échinides Fossiles,' p. 200.

The family Collyritidæ includes at present four genera *Disaster, Collyrites, Metaporhinus,* and *Grasia,* which are limited to the Oolitic and Cretaceous rocks. The most ancient form at present known was found in the Lias; the species attained their greatest development in the middle division of the Oolites, are sparingly found in the Neocomian, and Lower Cretaceous rocks, and finally disappear with the White Chalk.

The following table exhibits the stratigraphical distribution of the Oolitic species of this family.

Stratigraphical Distribution of the Oolitic Species of the Collyritidæ.

List of Species.	Lias.	Inferior Oolite.	Great Oolite.	Kelloway.	Oxfordian.	Corallian.	Kimmeridge.	Type localities.
Disaster.								
Disaster granulosus, Desml. .	—	—	—	—	*	—	—	Amberg, Streitberg, Würtemberg.
,, *anasteroïdes,* Leym. .	—	—	—	—	—	—	*	Bar-sur-Aube (Aube).
,, *Moeschii,* Desor . .	—	—	—	*	—	—	—	Kornberg (Argovie).
Collyrites.								
Collyrites prior, Desor . .	*	—	—	—	—	—	—	Frick, (Canton d'Argovie).
,, *ringens,* Desml. . .	—	*	*	—	—	—	—	England, France, Switzerland.
,, *ovalis,* Leske . .	—	*	*	—	—	—	—	England, France, Switzerland.
,, *elliptica,* Desml. . .	—	—	—	*	—	—	—	Chaufour, Mamers (Sarthe).
,, *castanea,* Desor . .	—	—	—	*	—	—	—	St. Croix, de Pouillerel.
,, *transversa,* D'Orbig. .	—	—	—	*	—	—	—	Escragnolles (Var).
,, *bicordata,* Leske. .	—	—	—	—	*	*	—	England, France, Switzerland.
,, *carinata,* Desml. . .	—	—	—	—	*	—	—	Gunsberg (Canton Soleure.)
,, *capistrata,* Desml. .	—	—	—	—	—	*	—	Würtemberg, Switzerland.
,, *Buchii,* Desor . .	—	—	—	—	—	*	—	Sirchingen, Würtemberg.
,, *Voltizii,* Agass. . .	—	—	—	—	*	—	—	Voirons près Genève.
,, *Desoriana,* Cotteau .	—	—	—	—	—	*	—	Chatel-Censoir, Druges (Yonne).
,, *pinguis,* Desor . .	—	—	—	—	*	—	—	Bötzberg, Geissberg (Argovie).
,, *Orbigniana,* Cotteau .	—	—	—	—	*	—	—	Stigny (Yonne).
,, *Loryi,* Alb. Gras. .	—	—	—	—	—	*	—	Echaillon (Isère).
,, *acuta,* Desor . .	—	—	—	—	*	—	—	Villiers-les-Hauts (Yonne).
,, *conica,* Cotteau .	—	—	—	—	*	—	—	Pacy, Ancy-le-Franc (Yonne).
,, *faba,* Desor . . .	—	—	—	*	—	—	—	Ueken près d'Effingen (Argovie).
Metaporhinus.								
Metaporhinus Michelinii, Cott. .	—	—	—	—	—	*	—	Châtel-Censoir (Yonne).
,, *Censoriensis,* Cott.	—	—	—	—	—	*	—	Châtel-Censoir (Yonne).
Grasia.								
Grasia elongata, Alb. Gras. .	—	—	—	—	—	*	—	Echaillon (Isère).

Genus—COLLYRITES,* *Deluc*, 1831; *Desmoulins*, 1835.

DISASTER, *Agassiz*, 1836.
DISASTER, *Desor*, 1842.
COLLYRITES, *d'Orbigny*, 1853.
COLLYRITES, *Desor* (pars), 1857.

The generic characters of this group have been already indicated in our description of the family of which it is the type. The Collyrites, in general, are urchins of moderate size, although some species attain a considerable magnitude. They have an ovoid, oblong, cordiform, or triangular shape, more or less depressed on the dorsal surface, and have the anterior border slightly grooved, with an anteal sulcus, in which the single area is lodged. The ambulacral areas are disjoined, and form two distinct summits on the dorsal surface; the anterior, composed of the single area and anterior pair, occupies the anterior third of the dorsal surface; and the posterior, composed of the posterior pair, meet over the vent near the posterior third. The poriferous zones are narrow, equal, and complete; the pores unigeminal, the holes round, oval, or oblong; and the zones visible throughout from the mouth to the summits.

The apical disc, situated at the anterior summit, at the junction of the three anterior ambulacra, is composed of four perforated genital plates, between which are interposed two large, ocular plates. The right antero-lateral genital plate is the largest, and supports a prominent, spongy, madreporiform body; the anterior ocular is a very small plate, which is lodged between the anterior genitals. The two posterior ocular plates are seen only in well-preserved specimens at the apices of the posterior ambulacra.

The mouth-opening is situated in the anterior third of the base; the peristome is obtusely pentagonal, approaching a circular form.

The oval or elliptical anal opening is situated in the middle of the posterior border, and is in general destitute of a distinct anal area, and always without a fasciole.

The tubercles are small, uniform in size, and are perforated and crenulated; the miliary granules are small and numerous.

The first known species of this genus were placed by systematic authors in different genera, with which they had few characters in common. Leske grouped them with the *Spatangites*, Lamarck with the *Ananchytes*, Defrance, Goldfuss, and Münster, with the *Nucleolites*. In 1831, M. Deluc, in a letter to M. Desmoulins,† proposed for the urchin which Lamarck named *Ananchytes elliptica*, that of *Collyrites sub-elliptica*, but it was not until August, 1835, that M. Desmoulins established definitely the genus *Collyrites*.‡

* From the Greek *Collyra*, a little loaf.

† Desmoulins 'Études sur les Échinides,' 1er Mémoire, p. 47.

‡ Desmoulins, loc. cit., p. 46.

About the same time M. Agassiz, was actively engaged in collecting materials for his great work on the Echinodermata, and in the course of 1836 appeared his Prodrome,* in which an important reform was proposed in the arrangement of that class, and many new genera were therein described for the first time; among these, was the genus *Disaster*, which nearly corresponded to the genus *Collyrites* of Desmoulins. The publication of this work formed an era in the History of the Echinidæ, and the author's classification and nomenclature was soon adopted by the naturalists of England, France, and Germany. In a note appended to the first page of the Prodrome, it was stated, that the memoir had been read before the Society of Natural Sciences at Neufchâtel, on the 10th of January, 1834,† which gave the Prodrome an apparent priority to the Mémoires of M. Desmoulins, and thus the genus *Disaster*, Agass. was adopted to the exclusion of the genus *Collyrites*, Desml. A closer investigation into the question of priority, however, showed that the memoir of M. Desmoulins was published in August, 1835. The Prodrome of M. Agassiz had been read in 1834, but was not published until July, 1836. In the interval which had elapsed between the reading and publication of the memoir, M. Agassiz had introduced into his work many important modifications, so much so, that the work published in 1836, was no longer the work which had been read in 1834; according, therefore, to the laws of nomenclature, the date of publication, and not that of the reading of a paper, after subsequent alterations and modifications, must serve to decide disputed points of priority in all questions affecting the natural history sciences.

In contending for the priority of his genus, M. Desmoulins‡ says—

"Le Prodrome de M. Agassiz a été publié en 1836, dans le 1er tome des 'Mémoires de la Société d'Histoire Naturelle de Neuchâtel:' j'ai donc un an d'antériorité sur lui. Il est vrai que ce Prodrome, d'après une note placée à la première page, a été lu le 10 Janvier, 1834, à la 'Sociètiè d'Hist. Nat. de Neufchâtel,' ce qui semblerait, dans un certain sens, faire tourner l'antériorité au profit de M. Agassiz; mais comme, dans ce travail, M. Agassiz adopté aux genres *établis par M. Gray en* 1835 (publiés d'après les renseignemens que j'ai pu recueillir en *Octobre*, 1835), il s'ensuit: 1^{e} Que le travail de M. Agassiz n'a pas pu être, en 1836, *imprimé tel qu'il avait été lu en* 1834, et que des details de genres et d'espèces ayant été modifiés entre la lecture et l'impression, celle-ci seule prend une date authentique pour les noms de genres. 2^{e} que j'ai une antériorité d'un an sur le genre *Disaster* de M. Agassiz, et une antériorité de deux mois sur l'*Arbacia* de M. Gray. Donc j'ai pu et dû conserver ma propre nomenclature, comme la plus ancienne. J'avais soumis cette question, avec tous ses détails, à un juge éclairé, parfaitement expert en ces sortes de matières, et j'ai agi d'après la décision motivée.

These historical facts are sufficient to justify the restoration of genus *Collyrites*, Desml.

* 'Prodrome d'une Monographie des Radiaires ou Échinodermes,' dans le premier tome des 'Mémoires de la Société des Sciences Naturelles de Neufchâtel,' 1836.

† 'Mémoires de la Soc. d'Hist. Nat. de Neufchâtel,' tome i, p. 168.

‡ 'Études sur les Échinides,' première Mémoire, p. 207.

in preference to that of *Disaster* Agass., by which name the urchins included in this group have been long known to English Geologists through the classical monograph on this genus published by M. Desor, in 1842.

A. *Species from the Inferior Oolite.*

Collyrites ringens, *Agassiz*. Pl. XXII, fig. 3 *a, b, c, d, e, f, g, h, i.*

Dysaster ringens.	Agassiz, Prodromus, 1^{er} vol., des Mém. de la Société des Sciences Naturelles de Neufchâtel, 1836.
Collyrites ringens.	Desmoulins, 3^{e} Mémoires sur les Echinides, p. 368, 1837.
Dysaster ringens.	Agassiz, Echinoderm. Foss. de la Suisse, 1^{re} partie, p. 5, tab. 1, figs. 7—11, 1839.
— —	Agassiz, Catalogus Systematicus, Ectyp. foss. p. 3, 1840.
— —	Desor, Monographie des Dysaster, p. 24, tab. 1, figs. 13—17, 1842.
— —	Agassiz and Desor, Catalogue raisonné des Échinides, Annales des Sciences Naturelles, 3^{e} série, tome viii, p. 33, 1848.
— Eudesii.	Agassiz, Catal. System, Ectyp. foss. p. 3, 1840.
— —	Desor, Monographie des Dysaster, p. 23, tab. 1, figs. 5—12, 1844.
— subringens.	M'Coy, Annals Nat. Hist., 2d series, vol. ii, p. 415, 1848.
— ringens.	Forbes, Mem. of the Geol. Survey, decade 3, pl. 9, figs. 1—10, 1850.
— —	D'Orbigny, Prodrome de Paléontologie, tome i, p. 289, 1850.
— —	Wright, Annals of Nat. Hist., 2d series, vol. ix, p. 207, 1851.
— —	Cotteau, Études sur les Échinides Fossiles, p. 46, pl. ii, figs. 10—13, 1852.
— —	Forbes, in Morris's Catalogue of British Fossils, 2 ed., p. 78, 1854.
Collyrites ringens.	Desor, Synopsis des Échinides Fossiles, p. 207, 1857.
— —	Cotteau and Triger, Échinides du Département de la Sarthe, pl. viii, figs. 5, 6, p. 48.
— Eudesii.	D'Orbigny, Paléontologie Française Ter. Cretacés, t. vi, p. 49, 1853.
— —	D'Orbigny, Note rect. sur divers genres d'Echid., Rev. Mag. de Zool., 2^{e} série, t. vii, p. 26, 1854.

Test sub-orbicular or sub-pentagonal, rounded anteriorly, rostrated posteriorly; upper surface convex, more or less depressed; sides tumid; vertex nearly central; apices of the ambulacra widely disjoined, posterior pair forming an arch over the anal opening; vent pyriform, situated in a sulcus on the posterior margin; base concave, very much undulated, inter-ambulacra extremely tumid, single posterior area very prominent and much deflected; mouth-opening small, sub-central, and sub-pentagonal.

Dimensions.—Height seven tenths of an inch; antero-posterior diameter one inch and one tenth; transverse diameter one inch and one twentieth.

As this urchin presents very variable proportions, I subjoin a table, by Professor Forbes, showing the dimensions of eight specimens from the inferior Oolite of Dorsetshire, measured in inches and twelfths.

	A	B	C	D	E	F	G	H
Length .	$1\frac{1}{12}$	$1\frac{1}{12}$	$0\frac{11}{12}$	$0\frac{8}{12}$	$0\frac{19}{24}$	$0\frac{9}{12}$	$0\frac{10}{12}$	$0\frac{10}{12}$
Breadth .	1	$1\frac{1}{24}$	$0\frac{11}{12}$	$0\frac{8}{12}$	$0\frac{8}{12}$	$0\frac{9}{12}$	$0\frac{10}{12}$	$0\frac{19}{24}$
Thickness .	$0\frac{6}{12}$	$0\frac{8}{12}$	$0\frac{7}{12}$	$0\frac{5}{12}$	$0\frac{5}{12}$	$0\frac{5}{12}$	$0\frac{5}{12}$	$0\frac{6}{12}$

Description.—The preceding table shows how much the general outline of this curious urchin varies in different individuals, so much so, indeed, that out of the varieties of *Collyrites ringens,* no less than three other species, *C. Eudesii,* Agass., *C. Agassizii,* d'Orb., *C. subringens,* M'Coy, have been described and proposed as distinct species. Having carefully examined and compared upwards of one hundred specimens of this urchin, I can confidently state that the orbicular, sub-pentagonal, and oblong varieties met with in the Inferior Oolites of Dorsetshire, are all referable to one and the same species, the extreme forms in different individuals being blended together by numerous intermediate gradations of structure.

The dorsal surface is uniformly smooth and convex, and more or less depressed, it is elevated posteriorly, and declines gently anteriorly, the vertex in general is situated nearer the anterior than the posterior border (fig. 3 *c*); the sides are tumid, the anterior border is flattened, and the posterior is produced and truncated (fig. 3 *c*); the antero-lateral is in general narrower than the postero-lateral region, and the prominence of the inter-ambulacral spaces in some individuals produces the sub-pentagonal varieties. The base is very unequal from the convexity of the inter-ambulacra, which form five nodulose eminences around the mouth; the posterior single area in particular is extremely prominent, gibbous (fig. 3 *b, c*), and much deflected; its posterior border is truncated and channelled to form the anal valley (fig. 3 *c, d*), which is bounded by two ridges, commencing at the apices of the posterior pair of ambulacra, and passing downwards and outwards towards the base, where they may be traced on the summit of the single area as far as the mouth (fig. 3 *b*). The anal opening has a pyriform shape, with its apex directed upwards; it is situated in the upper part of the valley, nearly on a level with the dorsal surface, and immediately below the ambulacral arch (fig. 3 *d, c*).

The ambulacral areas are all complete, at the dorsal surface they are on a level with the inter-ambulacral plates, but at the base, they lie in depressions. They are of unequal width, the single area being the narrowest, the posterior pair the widest, and the anterior pair of intermediate breadth; the single area is straight, and the anterior pair describe three curves in their course between the mouth and the disc (fig. 3 *c*); the three anterior ambulacra converge nearly in the centre of the back, at the front, and sides of the apical disc (fig. 3 *a, i*). The posterior pair are somewhat wider than the others, they curve gracefully round the single inter-ambulacrum (fig. 3 *c*), form an arch round its produced and truncated border, and converge above the anal opening (fig. 3 *d*); the ambulacral areas are formed of small plates, of which, on the dorsal surface, there are four opposite one inter-ambulacral plate (fig. 3 *e*), but at the base there are only about three in the same space (fig. 3 *f*). Each ambulacral plate is perforated at its outer side with two very small pores, placed obliquely across the zones (fig. 3 *e*), which are narrow, and observed with difficulty. Near the mouth the ambulacra widen, and the pairs of pores are disposed in about three oblique series of three pairs in each (fig. 3 *b*); as the plates are closely soldered together, their relation to the pores in this region is very indistinct.

The inter-ambulacral areas are of unequal width; on the upper surface they are on a level with the ambulacra, and with them form a uniform, convex back, but at the base they are extremely prominent and nodulated; so much so, that the ventral is as remarkable for its undulations as the dorsal is for the smoothness of its surface. The single inter-ambulacrum differs from the others in being produced posteriorly, and is extremely prominent and gibbous inferiorly (fig. 3 *b, c*).

All the plates are covered with minute, perforated tubercles, raised on uncrenulated bosses, and surrounded by sunken areolas (fig. 3 *g*); the inter-tubercular surface is so finely granulated that the tubercles appear conspicuous only when examined with a lens. The tubercles are most numerous at the base; the spines are unknown.

The apical disc is a curious structure, it is composed of two pairs of perforated ovarial plates (fig. 3 *h, i*), disposed in pairs at some distance apart, and separated by three largely developed ocular plates, which extend into the centre of the disc; the anterior ovarials are of an irregular shape, and separate the single ambulacrum from the antero-lateral ambulacra. On the surface of the right plate is the spongy, prominent, madreporiform body; behind and between them in the median line, is a small diamond-shaped plate, its anterior angle unites with the apex of the single ambulacrum, and its posterior border with the anterior ovarials; behind these are two rhomboidal-shaped plates, which articulate before with the anterior ovarials, laterally with the apices of the antero-lateral ambulacra, and behind with the posterior ovarial plates. Near the points of junction of these plates with the ambulacra, the three small eyeholes are situated, and behind the rhomboidal ocular plates the small, oblong, posterior ovarials are placed. I have failed to discover ocular plates at the summits of the posterior ambulacra in this species. The specimen which furnished these details has been mislaid, and could not be found in time for the artist, but a very similar type of structure exists in *Collyrites ovalis* (Pl. XXIII, fig. 2 *f*), where it is accurately drawn. The disc, it is right to state, was studied with the microscope under an inch object-glass.

The mouth is more or less sub-central, and lodged in a concavity formed by the prominent nodulated inter-ambulacra. It is obscurely decagonal, and appears as if round; in some specimens it is much nearer the anterior border than in others. The mouth and anus are nearly of the same size, and about one eighth of the length of the shell; no traces of jaws have yet been found, nor has the structure of the peristome been sufficiently made out.

Affinities and differences.—Many specimens of this urchin agree with M. Desor's figures of *Disaster Eudesii*, Agass., whilst others have the depressed dorsal surface, and angular outline of *D. ringens*, Agass. As I have many series of intermediate forms connecting these two extremes, I have referred them all to one species. On this subject, M. Cotteau observes that he collected, with M. Moreau, from the "Oolite ferrugineuse" of Tour du Pré, a suite of specimens of *D. ringens;* these presented various degrees of tumidity and more or less circularity of outline; among them were all the gradations conducting to *D. Eudesii*, Agass., from this he concluded that the urchin figured in his excellent work, and which may be taken as a fair representation of many of our specimens, is a small and more elongated variety of *D. ringens*, Agass.* This conclusion, Professor Forbes† admits, agrees with the experience of the collectors of the Geological Survey.

Professor M'Coy, in his memoir 'On some new Mesozoic Radiata,'‡ enumerates *D. Eudesii* as a British species from the Inferior Oolite of Dundry and Bridport, and has described another form under the name *D. sub-ringens*. As he has favoured me with a sketch of this urchin, I can state with certainty that it is only a large individual of *D. ringens*. The characters which Prof. M'Coy regarded as specific, namely, the "greater gibbosity, and less prominence of the ridges on the under side," and, the "disproportionate narrowness of the three anterior ambulacra, as in *D. ringens*," vary almost in every one of the many individuals I have collected, I therefore do not hesitate to include *D. sub-ringens* among the synonyms of *Collyrites ringens*, Agass., which is distinguished from its congeners by the convexity of the basal portions of the inter-ambulacra, and especially by that of its single inter-ambulacrum.

Locality and Stratigraphical position.—All my specimens have been collected from the marly vein which traverses the upper ragstones of the Inferior Oolite of Dorsetshire, in the zone of *Ammonites Parkinsoni*, Sow. From this stratum I have collected it between Sherborne and Yeovil, at Burton Bradstock, Walditch Hill, and Chideock Hill, near Bridport. It is generally associated with *Collyrites ovalis*, Leske, *Holectypus hemisphæricus*, Agass., *Clypeus altus*, M'Coy, and *Stomechinus bigranularis*, Lamck.

* 'Études des Échinides Fossiles,' p. 48.

† 'Memoirs of the Geological Survey,' decade iii, pl. 9.

‡ 'Annals of Natural History,' 2d series, vol. ii, p. 420.

I have only seen one specimen (an oblong variety) which was said to have been found in the Cornbrash, near Fairford (Gloucestershire). Professor M'Coy states that it is not uncommon in the Inferior Oolite of Leckhampton; but this is a mistake, as it is not within the memory of any of our local collectors that any Collyrite has been found in the Inferior Oolite of that locality.

On the continent, it is found in the Marnes à Discoidées (Vesulien) of Goldenthal, Mont-Terrible, Salins, Besançon, Neufchâtel, the Inferior Oolite (Bajocien) of Tour du Pré (Yonne), and of St.-Vigor, Port-en-Bessin, Moutiers, Bayeux (Calvados). It was collected by M. Triger, from the Forest Marble, Ass. No. 4, of his table, at Pécheseul, Noyen, Saint-Pierre-des-Bois, Chemiré-le-Gaudin, département de la Sarthe, where it is abundant.

History.—This species was recorded for the first time by Agassiz, in his 'Prodrome,'* and it has been successively figured and described in his 'Échinodermes Fossiles de la Suisse,' M. Desor's 'Monographie des Dysaster,' M. Cotteau's 'Études des Échinides Fossiles,' 'Échinides du département de la Sarthe,' and Professor Forbes's 'Memoirs of the Geological Survey.' M. Desmoulins entered it in his 'Tableaux Synonymiques des Échinides.' The history of this species is so intimately connected with its previous description, that it is unnecessary to enter upon it further in detail under this head.

Collyrites Ovalis, *Leske.* Pl. XXIII, fig. *a, b, c, d, e, f, g.*

	Van Phelsum, p. 32, sp. 3 (*Egelschuitje twee-top*) i. e., *Echinoneus bivertex.*
	Knorr, Petrefactions, ii, p. 182, tab. E iii, No. 6.
	D'Annone, Acta Helvetica, vol. iv, p. 275, sq.; tab. 14, figs. 1, 2, 3.
	D'Annone, Miner. Belust., v, p. 161, tab. iv, figs. 1, 2, 3.
Spatangites ovalis.	Leske, Additamenta Kleinii ad Disposition. Nat. Echinoderm., p. 253, tab. 41, fig. 5, 1778.
Collyrites analis.	Desmoulins, Études sur les Échinides, p. 368, No. 14, 1837.
Disaster analis.	Agassiz, Échinodermes Fossiles de la Suisse, ii, p. 6; pl. 1, figs. 12—14, 1839.
Disaster avellana.	Agassiz, Catal. Syst. Ectyp. Foss., p. 3, 1840.
Disaster bicordatus.	Agassiz, Catal. Syst. Ectyp., Suppl., non Leske, non Goldfuss.
Collyrites elliptica.	Desmoulins, Tableaux Synonymiques, p. 366, 1835.
Disaster bicordatus.	Desor, Monographie des Dysaster, p. 9, tab. 2, figs. 1—4, 1842.
— —	Agassiz and Desor, Catalogue raisonné des Échinides, Annales des Sciences Naturelles, 3me série, tome viii, p. 31.
Disaster analis.	Desor, Monographie des Disaster, p. 10, pl. 2, figs. 8—10, 1842.

* 'Soc. d'Hist. Nat. de Neufchâtel,' tome i, p. 168, 1836.

DISASTER	AVELLANA.	Desor, Monographie des Disaster, p. 23, pl. 1, fig. 1—4, 1842.
—	—	Agassiz and Desor, Catal. rais. des Échinides, Ann. des Sc. Nat., 3^me^ série, t. vii, p. 32, 1847.
—	BICORDATUS.	Agassiz and Desor, Catal. rais. des Échinides, Ann. des Sc. Nat., 3^me^ série, t. vii, p. 31.
DISASTER	ROBINALDINUS.	Cotteau, Études sur les Échinides Fossiles, p. 73, tab. vii, figs. 1—5, 1849.
—	SYMMETRICUS.	M'Coy, Annals of Natural History, 2d series, vol. ii, p. 415, 1848.
—	AVELLANA.	Agassiz, Catal. Syst., p. 3.
—	—	D'Orbigny, Prodrome de Paléontologie, t. 1, p. 289, No. 43, 1856.
—	—	Desor, Monographie des Dysaster, p. 23, tab. 1, figs. 1—4.
—	—	M'Coy, Annals of Natural History, 2d series, vol. ii, p. 420, 1848.
DISASTER	BICORDATUS.	Wright, Annals of Natural History, 2d series, vol. ix, p. 210, 1851.
—	—	D'Orbigny, Prod. de Pal., t. i, p. 318, No. 399, 1850.
—	—	Forbes, in Morris's Catalogue of British Fossils, 2d ed., p. 77, 1854.
—	AGASSIZII.	D'Orbigny, Prod. de Pal., t. i, p. 290, No. 494, 1850.
COLLYRITES	BICORDATA.	D'Orbigny, Pal. Franç. Ter. Cretacés, t. vi, p. 49, 1853.
—	ANALIS.	D'Orbigny, ibid., p. 48, 1853.
—	AVELLANA.	D'Orbigny, ibid., p. 48.
—	AGASSIZII.	D'Orbigny, ibid., p. 48.
—	—	D'Orbigny, Note rect. sur divers genres d'Échinides, Rev. et Mag. de Zool., 2^de^ série, t. vi, p. 27, 1854.
—	BICORDATA.	D'Orbigny, ibid., p. 27.
—	ANALIS.	D'Orbigny, ibid., p. 27.
—	ANALIS.	Desor, Synopsis des Échinides Fossiles, p. 206, 1857.
—	OVALIS.	Cotteau, Note sur quelques Oursins de la Sarthe, Bull. de la Soc. Géologique de France, 2^de^ série, p. 649, 1856.
—	—	Cotteau et Triger, Échinides du Départment de la Sarthe, pl. vii, figs. 7—9, p. 45, 1857.

Plaster moulds R 15, R 16, type of *bicordatus*, Agassiz; Q 82, type of *analis*, X 76, type of *avellana*.

Test thin, oval, anterior and posterior borders nearly uniform in convexity; sides tumid; dorsal surface convex, sometimes flattened; vertex excentral, situated near the anterior third; anal opening pyriform, supra-marginal; postero-lateral ambulacra terminate by the sides or immediately above the anus; base smooth, convex, without undulations; mouth-opening small, situated at the junction of the anterior with the middle third.

Dimensions.—Eight tenths of an inch; antero-posterior diameter, one inch and one fifth; transverse diameter, one inch and one tenth.

Description.—After a careful examination of all the evidence on the subject, I have come to the conclusion that this is the urchin which was figured by Leske (tab. XLI, fig. 5), and described by that author as *Spatangites ovalis.* The *Ananchytes bicordata,* Lamk. to which it was formerly referred, is clearly the *Spatangites bicordatus* of Leske, and not the *S. ovalis* of that author; the confusion occasioned by this mistake, prevails throughout all the works which treat of the species, down to that of our friend M. Desor, in which its true synonyms, with one exception, according to our ideas on the subject, are given in his excellent 'Synopsis des Échinides Fossiles.' The *Spatangus ovalis* of Parkinson and Phillips is a Coral Rag urchin, and in my opinion is the *Spatangites bicordatus* of Leske. I reserve further details on this question until I give the description of the latter species.

M. Desor regards this urchin as an inflated variety of *Dysaster analis,* Agassiz, and preserves that author's specific name; but surely, if we admit the identity of the species, we should in justice to Leske retain his specific name *ovalis.* On comparing our urchins, however, with the very excellent figure given of *D. Analis* by M. Agassiz, I confess I have never met with so depressed a form as that figured in the 'Échinodermes Fossiles de la Suisse;' moreover, there is always an elevation before the apical disc, amounting in some individuals to a monstrosity, which does not exist in *D. analis;* the posterior ambulacra, likewise, terminate at a greater distance before the anal opening than in our specimens.

The regular oval outline of this urchin forms a striking contrast to the orbicular and sub-pentagonal figures of *Collyrites ringens;* the sides are tumid; the dorsal and lateral surfaces are smooth, and convex; and the test has a uniformly gibbous appearance, with a slight elevation on the upper surface; the ambulacra are all complete, passing, without interruption, from the mouth to their terminations on the dorsal surface, and on the same level as the inter-ambulacra; the three anterior ambulacra converge near the junction of the anterior with the middle third of the back, and the apex of the single area is separated from those of the antero-laterals by the anterior pair of ovarial plates; the single ambulacrum is the narrowest, the postero-lateral are the widest; and the antero-lateral of intermediate width; the anterior border is slightly flattened, and lies in a depression in the centre of this region; the single area passes in a straight line from the mouth to the vertex; the apex of this area rises into a small prominent triangular eminence, which forms the highest point of the test, so that the vertex is situated at the anterior third of the back (fig. 1 *c*), whilst in *Collyrites ringens,* it is at the posterior third.

The antero-lateral ambulacra (fig. 1 *c*), curve gently upwards, backwards, and forwards, from the mouth to the apical disc, thereby forming an undulated course. The postero-lateral pair take a long sinuous course from the mouth, passing backwards, outwards, and upwards, over the posterior border, and terminate by making rather a sharp curve at the upper end of the anal opening, or sometimes they form an arch immediately over that aperture (fig. 1 *d*); the point at which these areas terminate, in this species, is an important guide to its determination, and this character is very accurately delineated in Leske's original figure of his *Spatangites ovalis;* the apices of the postero-lateral ambulacra converge on the back at the distance of three fifths of an inch behind the antero-lateral pair.

The poriferous zones are narrow, and in consequence of the depth of the ambulacral plates the pores are wide apart; each plate is perforated with a pair of holes near its lower border (fig. 1 *e*), and there are from two to three ambulacral plates opposite one inter-ambulacral.

The pores are disposed in oblique pairs, they are very distinct on the sides and back fig. 1 *a*, *c*, *d*), but are small and indistinct at the base (fig. 1 *b*).

The inter-ambulacral plates are large and bent, each plate forming a double inclined (plane (fig. 1 *e*). The anterior are much narrower than the posterior areas; they are uniformly smooth and gibbous on the sides; the single inter-ambulacrum is bevelled obliquely, and slightly flattened at the upper part of the posterior border; at the extreme upper part of this region, and immediately beneath the centre of the arch formed by the posterior ambulacra, the anal opening is situated (fig. 1 *a*, *c*,*d*). It has a pyriform shape, with the apex directed upwards, and terminates between the apices of the posterior ambulacra. From its sides two obtuse ridges pass downwards and outwards, which gradually disappear about the middle of the area, near the anal opening; the tubercles are larger, and set closer together, than at any other part of the upper surface (fig. 1 *e*). The basal portion of the inter-ambulacrum is more gibbous and produced than the corresponding parts of the other inter-ambulacra.

The base is convex, with little or no undulation; anteriorly there is a slight concavity, and posteriorly an increased convexity, occasioned by the gibbosity of the single inter-ambulacrum (fig. 1 *b*, *d*). The small mouth-opening is lodged in a slight depression, situated near the anterior fourth of the antero-posterior diameter of the test, but the precise relative situation of this aperture appears to vary a little in different individuals. The peristome is sub-pentagonal, and in one specimen, appears to have rudimentary notches, which would imply that the *Collyritidæ* possessed jaws, but the organic evidence is too feebly developed to enable me to state that such is unquestionably the case, unless confirmed by a similar inequality of the margin in other specimens.

The apical disc is situated behind the sub-triangular vertex, and therefore occupies the anterior third of the back; it has a lengthened rhomboidal figure, and is formed very much like the disc of *C. ringens*, already described in detail. (See page 311.)

The single ocular plate is small, and occupies nearly the vertex, having behind it the two anterior ovarial plates, which are situated between the single and the antero-lateral ambulacra, the left plate being placed further forward than the right plate, which supports the madreporiform body. Behind the anterior ovarial are the two large anterior pair of ocular plates, and immediately behind them are the posterior ovarials (fig. 2 *f*). The position of the posterior pair of ocular plates I have not ascertained; if they exist at the summit of the posterior ambulacra, their true homological position, they are so intimately soldered to the surrounding structures that I have as yet failed to detect them with my compound microscope, provided with an inch object-glass; but the elements of the disc are, in general, united so entirely to the adjoining plates of the test in the COLLYRITIDÆ, that it is only in weathered specimens, or in those in which the shell has passed into the condition of calcareous spar, that we can distinguish the separate pieces of which it is composed. The tubercles on the sides and upper surface are small, and arranged in tolerably regular lines on the plates. There are, in general, three rows on each plate (fig. 1 *e*); those at the base are larger (fig. 1 *f*), and more prominent; they are raised on prominent bosses, which are surrounded by areolas, and the intermediate spaces are covered with close-set granules.

Affinities and differences.—The general outline of *C. ovalis* resembles *C. ringens*, but is distinguished from it by the following characters. In *C. ovalis*, the highest point of the back is near the anterior third, whilst in *C. ringens*, it is at the posterior third; in *C. ovalis*, the base is nearly uniformly convex, in *C. ringens* it is very much undulated; in *C. ovalis*, the apical disc is situated near the anterior third of the back, whilst in *C. ringens*, it is nearly central. The single inter-ambulacrum, likewise, is not so much developed; the anal opening is larger, and higher up, and the anal valley is more rudimentary in *C. ovalis* than in *C. ringens*.

This species is distinguished from *C. bicordatus*, Leske, by the posterior ambulacra always terminating in *C. ovalis* at or near the apex of the anal opening, whilst in *C. bicordatus*, the apices of these areas terminate at a point about one third of the distance between the vent and the disc. The same character, the proximity of the apices of the posterior ambulacra to the anal opening, serves to distinguish *C. ovalis* from *C. elliptica*. *C. ovalis* resembles *C. analis*, but in the former they are nearer the vent than in the latter. It is highly probable, however, that this is a mere variety, and not a specific difference.

Locality and Stratigraphical position.—I have collected this species in the marly vein which traverses the upper ragstones of the Inferior Oolite, in the zone of *Ammonites Parkinsoni*, Sow., at Walditch Hill, near Bridport, where it was associated with *Collyrites ringens*, and *Holectypus hemisphæricus*. It has been found by Mr. Walton in the same zone at Charlcomb, near Bath, and by Dr. Bowerbank in the Cornbrash of Wilts, where it is rare, as I only know of his solitary specimen from that formation.

History.—First figured by Knorr, and afterwards figured and described by Leske as *Spatangites ovalis*, in his edition of Klein's 'Echinodermata,' which figure was confused with the *Spatangites bicordatus* of the same author. It was beautifully figured as *Disaster bicordatus* by M. Desor, in his 'Monographie des Dysaster;' afterwards by M. Cotteau under the name *Disaster Robinaldinus*, in his 'Études des Echinides Fossiles,' and described under the name *D. symmetricus,* by Professor M'Coy. It was recorded by Professor Forbes as an abundant species, collected by the officers of the Geological Survey, from several Inferior Oolite localities in Dorsetshire.

M. Desor enumerates the following localities where this species is found. Knorr and Leske's type specimens came from the Marnes à Discoidées (Vesulien) de Muttenz près Bâle. It is found likewise in the Great Oolite (Bathonien) de Macon, de Bysé près Caen, la Latte près Nantua (Ain), environs de Besançon, Véseloy (Yonne), Calcaire à Polypiers (Bathonien) de Croisille, Charroux, and M. Triger collected it in abundance from the Bradford Clay, Ass. No. 1, 2, and 3, of his table, and from the Forest Marble bed No. 1 at Monné, La Jaunelière, Tassé Champfleur, Petit-Oiseau, and several other localities in the department of the Sarthe.

B. *Species from the Coral Rag.*

Collyrites bicordata, *Leske.* Pl. XXIII, fig. 2 *a, b, c, d, e, f, g, h.*

	Andreae Briefe aus der Schweiz, p. 16, tab. 2, fig. c, 1763—1776.
Spatangites bicordatus.	Leske, apud Klein, Dispositio Naturalis Echinodermatum, tab. 42, fig. 6, p. 244, 1778.
Spatangus ovalis.	Parkinson, Organic Remains, vol. iii, tab. 3, fig. 3, 1811.
Spatangites ovalis.	Young and Bird, Geology of the Yorkshire Coast, tab. 6, fig. 9, p. 215, 1828.
Spatangus ovalis.	Phillips, Geology of Yorkshire, tab. 4, fig. 23, p. 127, 1829.
Disaster ovalis.	Agassiz, Prodromus, Mémoires de la Soc. des Sc. Nat. de Neufchâtel, tome i, 1836.
Collyrites ovalis.	Desmoulins, Tableaux Synoptiques, p. 368, 1837.
Disaster propinquus.	Agassiz, Échinoderm. Fossiles de la Suisse, part i, p. 2, tab. 1, figs. 1—13, 1840.
— ovalis.	Agassiz, Catalogus Systematicus ectyporum Echinodermatum fossilium, p. 3, 1840.
— propinquus.	Desor, Monographie des Dysaster, p. 14, tab. 3, figs. 24—26, 1844.
— truncatus.	Dubois, Voy. au Caucase, (Ser. Geol.), tab. 1, fig. 1.
— —	Desor, Monographie des Dysaster, p. 17; des Galérites, tab. 13, figs. 8—11, 1844.
— —	Agassiz and Desor, Catalogue raisonné des Échinides, Annales des Sciences Naturelles, 3me série, tome viii, p. 32, 1847.
— ovalis.	Agassiz and Desor, ibid.
— —	Cotteau, Études sur les Échinides Fossiles, p. 86, tabs. 8 and 9, 1849.
— —	Wright, Annals and Magazine of Natural History, 2d series, vol. ix, p. 213, 1851.
Collyrites bicordata.	Desor, Synopsis des Échinides Fossiles, p. 204, 1857.

Test nearly oval, broader before than behind, upper surface convex, more or less depressed; sides rather tumid, front border slightly grooved, posterior border feebly truncated, ambulacral areas of unequal width, posterior pair the widest, anterior ambulacral summit nearly central, posterior situated nearly mid-way between the apical disc and the vent; base flat anteriorly and laterally, convex behind; mouth-opening small, circular, situated at the anterior fourth of the base, tubercles small, placed at some distance apart, three or four concentric rows on each large plate. Anal opening oval, situated in the upper part of the posterior border, about midway between the ambulacral arch and the basal angle.

Dimensions.—A. Height, one inch and one twentieth; transverse diameter, one inch and nine tenths; antero-posterior diameter, two inches and one tenth. B. Height, one inch and one twentieth; transverse diameter, one inch and three quarters; antero-posterior diameter, one inch and nine tenths. C. Height, eight tenths of an inch; transverse diameter, one inch and four tenths; antero-posterior diameter, one inch and a half.

Description.—It is rather remarkable that so much confusion should have arisen regarding the only two *Collyrites* figured by Leske, and that a complete transposition of his specific names should have been the result of this mistake. The urchin now under consideration is, doubtless, the *Spatangites bicordatus*, Leske, which was erroneously identified by Parkinson with the *Spatangites ovalis*, Leske, this formed the starting point of the error, which has been faithfully copied by succeeding authors until corrected by M. Desor, who has given, in his 'Synopsis,' the correct synonymy of this species. A single character, which has been well represented by Leske, determines this point, namely the position of the posterior ambulacral summit, in *Spatangites bicordatus* it is between the apical disc and the vent, whilst in *Spatangitis ovalis* it is immediately above the anal

The general form of *Collyrites bicordata* is nearly oval, the anterior half is more enlarged than the posterior half (fig. 2 *a*, *b*), the upper surface is uniformly convex (fig. 2 *c*), and the base is flat (fig. 2 *b*, *c*), the anterior border forms the segment of a much larger circle than the posterior border, and it has a median depression which extends to the mouth in which the single ambulacrum is lodged (fig. 2 *a*), the sides are slightly tumid and the posterior border feebly truncated, the greatest width of the test is behind the antero-lateral ambulacra, from which point it gradually tapers backwards (fig. 2 *a*).

The ambulacral regions are of unequal width, the three anterior areas are about the same diameter on the sides, but the posterior pair are one fourth larger, the single area is the shortest; in specimen C it measures $1\frac{1}{3}$ inch, the antero-lateral $1\frac{11}{20}$ inch, and the postero-lateral $1\frac{7}{10}$ inch in length from the peristome to the apical disc, the ambulacral plates are narrow, and on the sides of the anterior pair there are from six to seven plates opposite each large interambulacral plate (fig. 2 *e*); at the base they become much wider and are nearly half as deep as the inter-ambulacral plates (fig. 2 *b*). In the posterior pair the plates on the sides are much deeper, for in these areas there are not more than two or three plates opposite one large inter-ambulacral plate. The left postero-lateral ambulacral area extends farther forward than the right.

The inter-ambulacral regions are large and of unequal width; the antero-lateral areas are the narrowest, the single area is of the same width, and the postero-lateral are one third wider than the anterior pair; the large pentagonal plates composing these areas are bent in the middle, and there are from fifteen to sixteen pairs in each; the plates carry three or four concentric rows of small tubercles (fig. 2 *e*), numbering from fourteen to sixteen on each plate; the tubercles which are perforated are surrounded by well-defined areolas, raised on crenulated bosses (fig. 2 *g*), and the inter-tubercular surface is crowded with microscopic miliary granules (fig. 2 *g*); the basal are larger than the dorsal tubercles, especially those situated on the prominent portion of the single inter-ambulacrum; some of these have wide hexagonal areolas, closely set together (fig. 2 *h*).

The poriferous zones are narrow; in the anterior zones on the sides there are about six pairs of pores opposite each large plate (fig. 2 *e*), whereas in the posterior zones in the same portion of the test there are only three or four (fig. 2 *d*). At the base the pores are small, very indistinct, and placed widely apart.

The base is flat at the sides and before, but is convex in the region of the single inter-ambulacrum. As the basal portions of the ambulacral areas are nearly destitute of tubercles, and the basal portions of the inter-ambulacral areas are furnished with larger tubercles, the course of the former is readily made out by the comparatively naked track formed by them, from the border to the mouth (fig. 2 *b*).

The small circular mouth-opening is situated in a depression at the anterior fourth of the base, the peristome is entire, and there is no trace of notches nor of any armature for the mouth (fig. 2 *b*).

The apical disc is placed rather nearer the anterior than the posterior border (fig. 1 *a*). It has an elongated figure, but its elements are so intimately soldered together that their relative anatomy is with difficulty made out. In most specimens the anterior ovarials project between the single and the antero-lateral ambulacra (fig. 2 *f*) and the right plate, which is the largest, supports the madreporiform body on the same line. Behind the anterior ovarials the anterior pair of ocular plates are placed, and behind them come the posterior pair of ovarials, with the single imperforate ovarial behind and between them; the small single ocular plate is seen at the apex of the single ambulacrum, but the position of the posterior oculars I am unable to determine, notwithstanding the perfect conservation of one of my specimens.

The posterior border is slightly truncated; at its upper part, and nearly midway between the basal angle and the apex of the posterior ambulacra, the anal aperture is situated (fig. 2 *d*). It is a small oval opening, the longest diameter of which is in the direction of the longitudinal axis of the test. The basal portion of the single inter-ambulacrum is convex and prominent, more especially so nearest the border (fig. 2 *d*).

Affinities and differences.—This species very much resembles *Collyrites elliptica*, Lamk. From the Great Oolite and Kellovian strata of the Department of the Sarthe I possess for comparison a very good series of this species, collected and sent me by my friend, M. Triger, besides other good types from MM. Michelin, Bouchard, and Cotteau. I find that in *Collyrites bicordata* the shell is more cordiform, and the anteal sulcus is well developed, whilst in *C. elliptica* that depression is absent. The left postero-lateral ambulacrum generally rises higher up on the dorsum than the right postero-lateral ambulacrum. The anterior summit is rather more forward, and the basal portion of the single inter-ambulacrum is more prominent than in *C. elliptica;* whilst in the relative position of the mouth and vent, and the distance of the apices of the posterior ambulacra from the latter opening, there is much similarity between these two species.

Locality and Stratigraphical position.—The Yorkshire specimens have been collected from the lower calcareous grit, near Scarborough; they are in general denuded of their test, and are mostly deformed. C. W. Strickland, Esq., has collected several specimens in the Coralline Oolite of Hildenley, where they are associated with *Cidaris florigemma,* Phil., *Hemicidaris intermedia*, Flem., and *Pseudo-diadema hemisphæricum*, Agas. James Carter, Esq., of Cambridge, has collected this species from blocks of Oolitic drift at Holywell, St. Ives, the rock containing these specimens is a ferruginous, coarse-grained oolite, which I suppose may have been derived from the base of the Coral Rag, or lower calcareous grit. This gentleman has likewise obtained fine specimens of the same species at Ely, from a rock which he conjectures to be Kimmeridge clay. One of these urchins is figured in Pl. XXIII, fig. 2. It is unfortunate that a doubt should still exist relative to the true age of these beds, and I feel under many obligations to Mr. Carter, which it affords me great pleasure to acknowledge, for the series of specimens of *C. bicordatus* he has kindly communicated and generously given me. Professor Sedgwick has likewise been most obliging in making an examination of one of these specimens, and in expressing his opinion relative to the age of the Oolitic drift at Holywell, containing *C. bicordatus.* I have much satisfaction in adding that distinguished geologist's opinion on the subject, which accords with my own conjectures made from a palæontological and not from a stratigraphical point of view:

"I have no doubt," says Professor Sedgwick, in a letter to me on the subject, "the specimen is what is commonly called our glacial drift, not, however, a drift brought on icebergs, but a drift caused by a great change of level about the end of the so-called glacial period, and it contains fragments innumerable of rocks belonging to the whole series, from the lias to the chalk inclusive. Our general order of super-position round about Cambridge is, 1st, *gravel* and *drift* of different ages, irregular in thickness, and capping all the other deposits in a disorderly manner, without absolute continuity. 2d, *chalk*. 3d, *upper-green-sand*—very thin, but full of fossils, and now worked much for the phosphatic nodules called (by mistake) coprolites; 3 *a*, *galt* 3 *b*, *lower-green-sand* resting, with some discordance on the beds below. It is seen in one place resting on good Kimmeridge clay, in another immediately on Oxford clay. 4th, *Kimmeridge clay*. 5th, *Coral rag, or Middle Oolite*—no Portland Oolite in this country. The Coral rag is not continuous, and is only well seen in one spot, but it may exist in other places under the drift which conceals so many of our strata. 6th, *Oxford clay*.

"The lower Oolitic terrace, including everything from Cornbrash to Inferior Oolite, is far removed from us.

"There are good brick-pits in the upper part of the Oxford clay, and immediately over the clay are some stone bands, which may possibly represent the base of the Coral rag. My belief is that your fossil (*Collyrites bicordata*, Leske,) has been drifted out of the Coral Rag or Middle Oolite, which will agree well with your idea of the true place of this species."

The foreign distribution of this fine species is, according to M. Desor, from the Terrain à Chailles, or Inferior Corallian, equivalent to the lower calcareous grit of English geologists; in the Swiss Jura, it is found in that stage at Fringeli, Liesberg, Wahlen, Delémont, Porrentruy; of the Salinois Jura, at Mont Bregille, near Besançon. It is collected in the same stage in France, according to M. Cotteau, from the "Calcaires Oxfordiens" of Lucy-le-Bois, Villiers-les-Hauts (Yonne).

NOTES

On Foreign Jurassic species of COLLYRITIDÆ nearly allied to British forms, but which have not yet been found in the English Oolites.

Disaster granulosus, *Münster*. Syn. *Nucleolites granulosus*, Goldf., tab. xliii, fig. 4.

Test small, elongated, obovate, convex on the upper surface, flat on the under side, rounded before, and obliquely truncated behind; anterior ambulacral summit excentral, nearer the anterior border; posterior ambulacra much arched over the vent; tubercles numerous, irregularly scattered over the surface; granules, small, numerous, close-set.

Dimensions.—Height, three quarters of an inch; breadth, one inch and one eighth; length, one inch and three tenths.

Formation.—Oxford-gruppe, (Oppel.) Amberg, Streitberg, Bavaria.

Collections.—British Museum, Continental collections. My cabinet. Common.

Disaster anasteroïdes, *Leymerie*. Syn. *Disaster anasteroïdes,* Cotteau, Échinides Fossiles, tab. xlvi, figs. 4—10.

This Disaster closely resembles the preceding species, but is larger and less cylindrical than it.

Dimensions.—Height, seven tenths of an inch; breadth, one inch; length, one inch and four tenths.

Formation.—Kimmeridge of Bar-sur-Aube.

Collections.—M. Leymerie, M. Cotteau.

Disaster Moeschii, *Desor*. Syn. *Disaster Moeschii,* Cotteau et Triger, Échinides du Département de la Sarthe, Pl. XIV, figs. 9—11, p. 51.

Test elongated, sub-cylindrical, enlarged and rounded before, truncated obliquely, and square behind; upper surface convex, base flat; ambulacra narrow; anterior summit removed to a considerable distance from the posterior summit; apical disc small, square, vent pyriform, supra-marginal; peristome extremely excentral.

Dimensions.—Height, six tenths of an inch; breadth, seven tenths; length, one inch.

Formations.—Great Oolite, Saint-Marceau, (Sarthe), Étage, Callovien, Hornussen, Kornberg (Argovia), Erlinsbach, and Pouillerel, near Chaux-de-Fonds, Switzerland.

Collections.—MM. Guéranger, Moesch, Cartier, Nicolet, Mus. Neuchâtel. Rare.

COLLYRITES ELLIPTICA, *Lamk.* Syn. *Disaster ellipticus,* Desor. Monographie des Disaster, tab. ii, figs. 5—7.

Test regularly elliptical, convex above, more or less depressed, plano-convex below; the apices of the posterior ambulacra converge at a point about one third of the distance between the vent and the anterior summit, which is more or less excentrally forwards.

Dimensions.—This species varies very much in size and relative dimensions, the following is M. Cotteau's estimate from abundant materials:—"A. *Circular variety.*—Height twenty millimètres; transverse diameter, forty millimètres; antero-posterior diameter equal to the transverse. B. *Elongated variety.*—Height twenty-three millimètres; transverse diameter, thirty-eight millimètres; antero-posterior diameter, forty-two millimètres. C. *Large variety.*—Height forty millimètres; transverse diameter, sixty millimètres; antero-posterior diameter, sixty-three millimètres. (This is the *Disaster malum,* Ag.)"

Formation.—Kellovian, Chaufour, Mamers, "Kelloway Ferrugineux." (Sarthe.)

Collections.—Very common in most collections. I have a fine series in my cabinet, sent by M. Triger, M. Cotteau, and M. Michelin, from this locality.

COLLYRITES PINGUIS, *Desor.* Synopsis des Échinides Fossiles, p. 205.

Test depressed, of an elliptical form, with the border inflated, resembling *C. bicordata* a little, but larger than that form; posterior ambulacra nearly straight and rising much higher than the vent.

Formation.—Oxfordian superior of Bötzberg, and Geisberg, near Brugg (Argovia).

Collections.—Mus. Bâle, Coll. MM. Gressly, Schmiedlin, and Cotteau.

Collyrites orbigniana, Cotteau. Échinides Foss. Pl. IX, figs. 3—5.

Test oval, cordiform, upper surface inflated, under surface flat; the posterior ambulacra ascend in nearly a straight direction, and meet above the vent.

Dimensions.—Height, three quarters of an inch; breadth, one inch; length, one inch and one twentieth.

Formation.—Oxford-clay of Stingy, (Yonne). Rare.

Collection.—D'Ormois.

Collyrites Loryi, *Albin Gras.* Catal. des Foss. de l'Isère, tab. ii, figs. 1—3.

Test elongated, contracted behind; the posterior ambulacra rise high up on the dorsal surface, as in *C. bicordata,* but the ambulacral areas are narrower.

Formation.—Corallian d'Echaillon (Isère). Rare.

Collection.—M. Albin Gras.

Collyrites Desoriana, *Cotteau.* Échinides Foss. Pl. XXXIX, fig. 1.

Test large, oval, or sub-elongated; anterior border with an anteal sulcus; posterior border obtuse; convex and depressed on the upper surface, flat on the under surface; the three anterior ambulacra narrow, anterior pair flexed; summit nearly central; posterior ambulacra converge at a considerable distance above the vent.

Dimensions.— Height, thirty-three millimètres; breadth, seventy-four millimètres; length, eighty-seven millimètres=three inches four tenths. *Cotteau.*

Formation.—Inferior Corallian of Châtel-Censoir, and Druyes, (Yonne).

Collection.—M. Cotteau; known only as a siliceous mould, and in general deformed.

Collyrites castanea, *Desor.* Synopsis des Échinides Fossiles, p. 207.

"Test very much inflated, short, almost spherical, contracted and sub-rostrated posteriorly; posterior ambulacra much arched, and converging immediately above the vent, which is only visible below; inferior surface convex and undulated; the ambulacra repose in depressions, and the inter-ambulacra form convexities between them; the single inter-ambulacrum is very prominent." *Desor.*

Formation.—"Kellovien de St.-Croix, de Poillerel près Chaux-de-Fonds. Pas trop rare."

Collections.—"Mus. Neuchâtel, coll. of MM. Campiche, Nicolet." *Desor.*

Collyrites Voltzii, *Agass.* Syn. *Disaster Voltzii*, Agassiz. Échinodermes Foss. de la Suisse, tab. iv, figs. 11—13. Desor, Monogr. des Disaster, tab. i, figs. 18—21.

Test large, circular, depressed, convex above, flat below; posterior ambulacra very much arched and converging above the vent, which is large, pyriform, and infra-marginal; mouth-opening central; peristome circular; base nearly flat, and only slightly cushioned; the ambulacra lie in depressions, and the inter-ambulacra form inconsiderable convex prominences; the ambulacra are all equal in width, and there is no anteal sulcus; the pores are closely approximated, and form double rows near the peristome.

Formation.—"Oxfordien des Voirons près Genève. (Voltz)."

Collection.—Museum of Strasbourg. Very rare; only two specimens known, both of which are in this Museum. One of them measures 3½ inches in diameter.

Collyrites transversa, *d'Orbigny.* Paléontologie Française Ter. Crétacès. p. 50.

A large species, sixty-one millimètres in breadth. Under this name M. d'Orbigny notices a cordiform species, the length of which is only nine tenths of its breadth, and is as high as it is long. This species is remarkable for its transverse form, its nearly round figure, and deep anteal sulcus.

Formation.—" Du 12e étage Callovien des environs d'Escragnolles (Var.)"

Collection.—M. d'Orbigny.

Collyrites carinatus, *Leske.* Syn. *Spatangites carinatus,* Leske, apud Klein, tab. 51, figs. 2, 3. Goldfuss, Petref. Germ., tab. xlvi, fig. 4. Desor, Disaster, tab. iii, fig. 1.

Test small, inflated, cordiform; with an anteal sulcus, and a carina or ridge more or less marked, which extends from the middle of the upper surface to the vent. Base convex and cushioned, single inter-ambulacrum very prominent at the base, anal opening marginal.

Formation.—Oxfordien de Gunsberg (Cant. de Soleure). Oxfordthon; Thonkalke mit *Terebratula impressa,* Weisser, Jura (*a*). (Oxfordian.) *Quenstedt.*

Collyrites capistrata, *Desmoulins.* Syn. *Spatangus capistratus,* Goldfuss, Petref. Germ. Agassiz, Echinid. Foss., tab. iv. Desor, Disaster, tab. iii.

Test cordiform, rounded anteriorly, with an anteal sulcus, tapering behind, and inflated at the sides, without a dorsal carina; vent in the middle of the posterior border; postero-lateral ambulacra rise high up on the dorsal surface and converge at a point nearly equidistant from the anterior summit and the vent.

Dimensions.—Height, seven tenths of an inch; breadth, one inch; length, one inch and one fifth.

Formation.—Corallien inférieur d'Urach, (Würtemberg), de Porrentruy, Ste. Croix. Weisser, Jura *a* (Oxfordian). *Quenstedt.* Würtemberg.

Collections.—Museums Neuchâtel, Bâle, British. Abundant.

Collyrites excentrica, *Münst.* Syn. *Neucleolites excentricus,* Goldfuss, Petr. Germ., tab. xlix. Desor, Disaster, tab. iv, figs. 1—3.

Test small, nearly circular, or elliptical, abruptly truncated posteriorly; posterior ambulacra converge above the vent, which opening is high up towards the dorsal surface.

Formation.—Jurassic limestone near Kehlheim; age not determined.

Collection.—Museum at Munich, coll. Count Münster.

Collyrites faba, *Desor.* Synopsis des Échinides Fossiles, p. 209.

"Test small, intermediate in form between *C. capistrata* and *C. bicordata,* Leske, less triangular than the former, but more contracted behind; posterior ambulacra converge at some distance above the vent, which is nearly entirely visible above."

Formation.—"Kellovien d'Ueken, près d'Effingen (Argovie)."

Collection.—"Moesch; very abundant." *Desor.*

Metaporhinus Michelinii, *Agass.* Michelin, Revue et Mag. de Zool., No. 8, 1854.

Collyrites Michelinii. Cotteau, Échinides Foss., pl. xl, fig. 5.

"A large species, rounded before, truncated behind; the anterior summit very excentral, and occupying the most elevated part of the test, which is prolonged forwards in the form of a rostrum."

Formation.—"Corallien (Calcaire à chailles) de Druyes et Châtel-Censoir (Yonne)."

Collection.—"MM. Michelin, Cotteau." *Desor.*

Metaporhinus censoriensis, *Desor.* Synopsis des Échinides Fossiles, p. 211.

Collyrites censoriensis. Cotteau, Échinides Foss., pl. xl, figs. 6, 7.

This singular urchin resembles the preceding species; according to M. Cotteau, it is more inflated, and rounder before, but not so much sloped behind; the posterior ambulacra are more flexuous and unite nearer the vent.

Formation.—Corallien of Châtel-Censoir, (Yonne).

Collection.—M. Cotteau, a single specimen; a plaster mould in my cabinet.

GRASIA ELONGATA, *Michelin.* Revue et Mag. de Zool., No. 8, 1854.

HYBOCLYPUS ELONGATUS. Albin Gras, Cat. des Fossiles de l'Isère, tab. ii, fig. 1—3.

A large urchin, very much elongated, measuring seven centimetres in length, by four in breadth; the anterior ambulacral summit very near the anterior border; the posterior ambulacra meet high up on the dorsal surface near the middle of the test, and at a considerable distance from the vent.

Formation.—Corallien d'Echaillon (Isère); very rare.

Collection.—Dr. Albin Gras.

Family 9.—ECHINOBRISSIDÆ, *Wright,* 1856.

Famille des CASSIDULIDES, *groupe des* NUCLEOLIDES, *Agassiz* and *Desor,* 1846.
Famille des NUCLÉOLIDÉES (in pars) *Albin Gras,* 1848.
Famille des ECHINOBRISSIDÉES (in pars) *D'Orbigny,* 1855.

The family ECHINOBRISSIDÆ, as I have defined it, comprehends only those urchins which have petaloidal or sub-petaloidal ambulacra; the vent lodged in a dorsal sulcus, or opening at the posterior border; the mouth edentalous; and the peristome pentagonal and sub-central.

The test, in all the smaller species, is thin, has a sub-quadrate, oblong, sub-pentagonal, circular, or clypeiform shape; is uniformly covered with small imperforate tubercles, raised on uncrenulated bosses, and surrounded by deep sunken areolas (Pl. XXIV, fig. 1 *h*); the spines are small, short, and slender (Pl. XLI, fig. 1); the tubercles at the base are always larger, and more fully developed, than those on the upper surface.

The ambulacral areas are narrow and lanceolate; they are enclosed by poriferous zones of unequal width, the pores being placed more or less wide apart in different regions of the zones; the holes of the inner row are circular, those of the outer are oblong or slit-like, and they often communicate with the inner series by transverse sulci. In consequence of this structure, the ambulacra present elegant petaloidal forms, more or less developed in different species, but always lanceolate above, expanded in the middle, and contracted and open below. The poriferous zones at the border and base are narrow, and the pores are small, equal, and placed wide apart (Pl. XXIV, fig. 1 *i*).

The apical disc is in general small, and composed of at least ten elements; of the five genital plates, four are perforated, and one is imperforate; the right antero-lateral plate is always the largest and carries the madreporiform tubercle, which is often very large, and nearly conceals the other elements of the disc; the five ocular plates are small, with marginal orbits (Pl. XXIV, fig. 1 *g*), placed opposite the apices of the ambulacra.

The vent is large, and in general opens into a valley situated in the upper surface of the inter-ambulacrum, or at the middle or margin of the posterior border; in the only living species at present known, *Nucleolites recens*, Edwards, from New Holland, figured in the illustrated edition of the 'Règne Animal,' this aperture is found to be closed by a series of small plates, in the same manner as the anal aperture is filled up in the ECHINIDÆ and SPATANGIDÆ. I have copied this figure in Pl. XLI, fig. 1 *a*, and a specimen of the urchin, without spines or anal plates, is now in the collection of living Echinoderms in the British Museum.

The mouth-opening is small, sub-central, and edentulous; the peristome in general is pentagonal, and in the genus *Clypeus* is surrounded by five oral lobes (Pl. XXVIII, fig. 1 *b*).

The inter-ambulacral areas are wide; the plates composing these portions of the test are large, and bent in the middle; each plate supports about three rows of small tubercles, which are arranged in lines, with much regularity (Pl. XXXII, fig. 1 *c*).

The Echinobrissidæ have many organic characters in common with the Echinolampidæ, but they are distinguished from that family by the position of the vent, and by the absence of the poriferous petals which in the latter surround the mouth.

The Echinobrissidæ, thus limited, nearly corresponds with the group of Nucléolidées in the family Cassidulées of Agassiz and Desor; it differs from the family Nucleolitidæ of Dr. Albin Gras, and the family Echinobrissidæ of M. d'Orbigny, by the elimination of all the urchins therefrom which have a basal vent, peristomal lobes and petals, and an organization in accordance with the genus *Echinolampas.*

Genus—ECHINOBRISSUS, *Breynius*, 1732.

Nucleolites, *Lamarck*, 1801.
— *Goldfuss*, 1826.
— *Agassiz*, 1837.
Echinobrissus, *D'Orbigny*, 1855.
— *Desor*, 1857.
— *Cotteau*, 1858.

This natural group is composed of small urchins, which have an oval, oblong, sub-quadrate, or sub-circular form, more or less convex on the upper surface, and slightly concave beneath; the test is rounded anteriorly, more or less produced, truncated, or lobed posteriorly, and is in general narrow before, and wider behind; the vent opens in the upper surface into a dorsal valley, which in one section extends from the apical disc to the posterior border, and in another is limited to the lower half thereof; the aperture is closed by a series of small anal plates, which are usually absent in fossil species, but are preserved in the only living example of the genus at present known (Pl. XLI, fig. 1).

The base is more or less concave; the small mouth-opening is excentral, and lodged in a depression, nearer the anterior than the posterior border; the peristome in many of the species is regularly pentagonal, in others it is oblique. M. d'Orbigny* has separated the latter into a distinct genus, under the name *Trematopygus*, but these oblique-mouthed species can at most be considered only as a section of the genus *Echinobrissus;* which are supposed to be special to the Cretaceous Rocks.

The apical disc is small, square, and compact; it is composed of four perforated genital plates, arranged in pairs, and one single imperforate plate; the right antero-lateral is the largest, and supports the madreporiform tubercle; the five small

* 'Paléontologie Française Ter. Cretacés,' tome vi, p. 374.

ocular plates are triangular, and occupy depressions between the larger genital plates, opposite the summits of the petaloid ambulacra.

The tubercles are small on the upper surface, and larger at the base.

The genus Echinobrissus was established by Breynius in 1732, in his important memoir 'De Echinis et Echinites,' in which it was thus characterised: "*Echinobrissus est Echinus, cujus oris apertura centrum basis fere occupat, ani vero in vertice conspicitur, a centro aliquantulum remota, et in sinu quodam ori oblique opposita.*"*

Klein, who published two years afterwards, unfortunately did not preserve any of the well-defined genera of his learned contemporary, and his commentator, Leske, in 1778, placed the *Echinobrissus* of Breynius among the *Spatangus* of Klein. When Lamarck, in 1801, instituted his genus *Nucleolites,* he appears not to have been aware that the same group had been well figured and accurately defined sixty-nine years before by Breynius; in his great work, "Animaux sans vertèbres," he reproduced his genus Nucleolites, and for the first time refers to Breynius's work for figures of the species.

M. Agassiz, in dismembering Lamarck's Nucleolites, did not restore Breynius's genus, although that author was most careful to reproduce the genera established by the older authors; thus, *Nucleolites columbaria,* Lamk., was repeated as the type of his new genus *Catopygus,* and *N. ovalus,* Lamk., became the type of *Pyrina,* whilst *N. scutatus,* Lamk., remained the type of *Nucleolites.* M. d'Orbigny restored the genera so well established by Breynius, and proved beyond all question that author's claim to *Echinobrissus;* M. Cotteau and M. Desor have both admitted the justice of his views, and the genus *Echinobrissus* now occupies the position from which it ought never to have been displaced.

A. *Species from the Inferior Oolite.*

Echinobrissus clunicularis, *Llhwyd.* Pl. XXIV, fig. 1 *a, b, c, d, e, f, g, h, i, k.*

Echinites clunicularis.	Llhwyd, Lithophylacii Brittanici Ichnograph., p. 48, 1698.
Echinobrissus planior.	Breynius, Schediasma de Echinis, tab. vi, figs. 1, 2, 1732.
Nucleolites Sowerbyi.	Defrance, Dic. Sciences Naturelles, tome xxxv, p. 213, 1825.
Clypeus lobatus.	Fleming, British Animals, p. 479, 1828.
— clunicularis.	Phillips, Geology of Yorkshire, tab. vii, fig. 2, 1829.
Nucleolites clunicularis.	Blainville, Dic. Sciences Naturelles, tome lx, p. 188, 1830.
— latiporus.	Agassiz, Échinoderm. Foss. de la Suisse, p. 43, tab. vii, figs. 13—15.
— clunicularis.	Desmoulins, Tableaux Synonymiques des Échinides, p. 358, 1837.

* 'De Echinis et Echinites, sive Methodica Echinorum Distributione, Schediasma,' 1732.

NUCLEOLITES CLUNICUNARIS.	Dujardin, in Lamarck's Animaux sans vertèbres, 2e ed., tome iii, p. 345, 1840.
— TERQUEMI.	Agassiz, Catalogue raisonnée des Echinides, Revue et Mag., 1847.
— THURMANNI.	Desor, Catalogue raisonnée des Échinides, Annales des Sciences Naturelles, 3e série, tome vii, p. 154, 1847.
— PYRAMIDALIS.	M'Coy, Annals and Magazine of Natural History, 2d series, vol. ii, p. 116, 1848.
— CLUNICULARIS.	Forbes, Memoirs of the Geological Survey, decade 1, pl. ix, 1849.
— EDMUNDI.	Cotteau, Échinides Fossiles, p. 67, tab. v, figs. 1—3, 1850.
— CONICUS.	Cotteau, Échinides Fossiles, p. 64, tab. iv, figs. 4—6, 1850.
— CLUNICULARIS.	Wright, Annals and Magazine of Natural History, 2d series, vol. ix, p. 297, 1851.
— —	Bronn, Lithaea Geognostica, 3e auflage, Band. ii, p. 152, 1852.
— —	Guéranger, Essai d'un rept. Paléont. de la Sarthe, p. 25, 1853.
— —	Forbes, in Morris's Catalogue of British Fossils, 2d ed., p. 84. 1854.
ECHINOBRISSUS CLUNICULARIS.	D'Orbigny, Note rectif. sur divers genres d'Échinides, Rev. et Mag. Zool., 2e série, t. vi, p. 24, 1854.
— TERQUEMI.	D'Orbigny, ibid., p. 24, 1854.
— LATIPORUS.	Ibid.
— THURMANNI.	Ibid., p. 25, 1854.
— CLUNICULARIS.	Desor, Synopses des Échinides Fossiles, p. 263, pl. xxx, figs. 18—20, 1857.
— TERQUEMI.	D'Orbigny, Paléontologie Française Ter. Cretacés, t. vi, p. 390.
— LATIPORUS.	Ibid., p. 391, 1857.
— SARTHASENSIS.	Ibid. ,, ,,
— CLUNICULARIS.	Ibid. ,, ,,
— CONICUS.	Ibid. ,, ,,
— EDMUNDI.	Ibid. ,, ,,
— THURMANNI.	Ibid. ,, ,,
— CLUNICULARIS.	Cotteau and Triger, Échinides de depart. de la Sarthe, pl. x, fig. 7, p. 12.
NUCLEOLITES CLUNICULARIS.	Pictet, Traité de Paléont., t. iv, p. 217, Atlas, pl. xciv, fig. 10, 1857.
— SARTHASENSIS.	D'Orbigny, Prodrome de Paléontologie, tome i, p. 220, 1858.
AGASSIZ MOULDS.	P. VII, type. T. LXXXIII, *Nucl. Terquemi.* S. XLVI, *Nucl. latiporus.*

Test sub-quadrate, anterior border rounded, posterior bilobed; dorsal surface convex, declining abruptly anteriorly, more gently posteriorly; apical disc and vertex sub-central; ambulacral areas narrowly lanceolate above, converging below; dorsal valley deep, lanceolate, extending to the posterior border of the apical disc; posterior lobes gently tapering, not tumid; base concave and grooved by the ambulacra; mouth-opening sub-pentagonal, situated nearer the anterior border.

Dimensions.—Large Cornbrash specimen (fig. 1 *k*). Height, eighteen twentieths of an inch; anterior posterior diameter, one inch and thirteen twentieths; length from the border to the posterior sulcus, one inch and eleven twentieths; breadth across the apical disc, one inch and eight twentieths.

Cornbrash specimen (fig. 1 *a*).—Height, eight tenths of an inch; antero-posterior diameter, one inch and one quarter of an inch; transverse diameter, one inch and one quarter of an inch.

Inferior Oolite specimen.—Height, six tenths of an inch; antero-posterior diameter, one inch and three tenths of an inch; transverse diameter, one inch and three tenths of an inch.

Description.—This is doubtless the urchin to which Llhwyd* gave the name *Echinites clunicularis,* and described "Echinites è lapide selenite, quinis radiis è duplice serie transversarum lineolarum conflatis," he refers to the figures in Plott † and Lister, ‡ but as these exhibit no anal valley, it is impossible to say whether they represent this species or the Coral Rag form. The figure given by Breynius, § and described as *Echinobrissus planior,* represents this species as shown by the length of the anal valley, which reaches as high as the disc, whilst *Echinobrissus elateor,* fig. 3 of the same plate, represents *E. scutatus* from the Coral Rag. This most acute observer had therefore clearly distinguished and figured a diagnostic specific character which has been overlooked by subsequent authors, and led to much confusion in the synonyms of *E. clunicularis. Spatangus depressus,* of Leske, ‖ most probably represents a large quadrate variety of *E. scutatus,* and is consequently omitted from our list of synonyms. Dr. William Smith¶ figured in his plate of characteristic Coral Rag fossils an urchin to which he gave no name. This Fleming** refers to *E. clunicularis,* whilst he calls *E. lobatus* the species figured by Lister, forgetting that Llhwyd referred to Lister's figure as the type of *E. clunicularis.* Professor Phillips†† distinguishes the two species from each other, and restricts the name *E. clunicularis* to the Cornbrash form, whilst he figures the Coral Rag nucleolite as *E. dimidiatus.* Continental authors have made several species out of the simple varieties of *E. clunicularis;* but when we recollect the many varieties of figure and outline which this urchin exhibits, any erroneous multiplication of species is readily explained.

Professor Edward Forbes‡‡ considered *E. scutatus,* Lamk., a variety of *E. clunicularis.* This error, however, he afterwards corrected, when he became acquainted with the true

* 'Lithophylacii Britannici Ichnographia,' p. 48, No. 988.
† 'History of Oxfordshire,' table ii, fig. 12, 1698.
‡ 'De Lapidibus Turbinatis,' cap. 11, titulus xxvi, 1678.
§ 'Schediasma de Echinis,' tab. vi, figs. 1, 2.
‖ 'Dispositio Naturales de Echinodermatum,' tab. li, figs. 1, 2.
¶ 'Strata Identified by Organized Fossils.'
** 'British Animals.'
†† 'Geology of the Yorkshire Coast.'
‡‡ 'Memoirs of the Geological Survey,' decade i, pl. ix.

types of Lamarck's species. In fact, *Echinobrissus clunicularis*, Llhwyd, may be regarded as the type of that section of nucleolites in which the anal valley extends from the border to the apical disc, and *Echinobrissus scutatus*, Lamk., of that smaller section in which the anal valley never extends from the border to the disc.

Professor M'Coy* described three nucleolites under the names *planulatus*, *pyramidalis*, and *æqualis*. The two latter forms appear to be varieties of *E. clunicularis*, and *planulatus* a variety of *E. scutatus*. I have not seen the original specimens which belong to the Cambridge Museum; but the author having kindly furnished me with outlines of these urchins to assist me in identifying his species, I have formed that opinion from his figures.

This urchin exhibits much diversity as regards size, outline, height, and tumidity. Its most typical forms are found in the Inferior Oolite and Cornbrash, and one of the best specimens I know is that from the cabinet of my friend, the Rev. A. W. Griesbach, which forms the subject of our figure. The suite of specimens before me from these *terrains* vary from a sub-orbicular to a sub-quadrate outline, and present nearly all the intermediate forms. They are rounded anteriorly, a little contracted before, enlarged at the sides, and more or less bilobed posteriorly. The upper surface is convex, and exhibits various degrees of elevation; in some it is much depressed, in others it rises into a sub-conical form. In a series of specimens before me scarcely two have the same proportional height. The vertex is almost always excentral and inclined towards the anterior border; but the amount of inclination, like the height, varies considerably in different individuals.

The ambulacral areas have a petaloid or lanceolate figure, with sub-parallel sides; the single area and the anterior pair are nearly of the same length and width, and the posterior pair are the longest and widest (fig. 1 *a*, *c*). The poriferous zones vary in structure on the dorsal and ventral surfaces; in the petaloid portion of the dorsal surface the pores of the inner row are round, those in the outer row are oblong, and the furrow uniting the pores varies in depth in different examples (fig. 1 *f*); in a large specimen there are about forty pairs of pores in the petaloid portion of the dorsal zone; between each pair there is a short row of small microscopic granules which separates the outer oblong pores from each other (fig. 1 *f*). In all the non-petaloid portion of the zones, the pores are small, round, and very indistinct (fig. 1 *e*); at the sides and outer third of the base, near the mouth, however, they become more distinct.

The inter-ambulacral areas are of unequal width; the posterior pair are nearly one fourth wider than the anterior pair, and the single area is the widest (fig. 1 *a*). The anal valley extends from the posterior part of the disc to the border; it is narrow above, wider in the middle, and expanded below, in the excavated portion; it has vertical parallel walls, which gradually diverge, then approximate, and afterwards expand outwards, forming a well-defined groove (fig. 1 *a*). The pyriform anal opening is situated at the extreme end of the

* 'Annals of Natural History,' 2d series, vol. ii, p. 416.

valley (fig. 1 *d*). The surface of all the plates is covered with small, close-set, spinigerous tubercles, surrounded by circular areolas, and having the interspaces minutely granulated (fig. 1 *e*). At the base the tubercles are larger, their summits are perforated, and they are surrounded by wider and deeper areolas (fig. 1 *h*). The diagram of the dorsal structure (fig. 1 *i*) shows the relative disposition of the plates in both the areas and poriferous zones, and fig. 1 *k* is a correct figure of the Rev. A. W. Griesbach's unique and largest specimen from the Cornbrash of Rushden.

The apical disc (fig. 1 *g*) is composed of four perforated ovarial plates, and a small imperforate ovarial. The right antero-lateral plate is the largest, and extends into the centre of the disc; it supports on its surface a prominent spongy madreporiform body. The left antero-lateral and postero-lateral ovarials are about the same size; the oviductal holes in each are near the apex of the plates; the single imperforate plate is much smaller than the others. The five ocular plates, with marginal eye-holes, are wedged in the angles of the ovarials, and the surface of all the discal plates is granulated. Fig. 1 *g* represents these discal elements in the most perfect development I have ever met with them in this species, and it is, I believe, the first correct figure which has been given of the apical disc of this common and well-known urchin.

The base is more or less concave, most so in the pyramidal varieties (fig. 1 *b*); the ambulacral areas radiate in depressed furrows from the margin of the mouth-opening, becoming shallower and wider as they approach the border. The poriferous zones are more apparent near the peristome, and the pores lie close together in oblique pairs. The mouth-opening is excentrical, being situated in a deep depression nearer the anterior than the posterior border. The tubercles at the base are larger and set wider apart than those on the dorsal surface; their summits are likewise perforated, and their bosses surrounded by wider and deeper areolas (fig. 1 *h*), the intermediate space being filled with larger granules.

Affinities and differences.—This species resembles very much *E. scutatus*, Lamk., and *E. dimidiatus*, Phil.; it is distinguished from these forms by the length of the anal valley, which extends from the disc to the margin, whilst in *E. scutatus*, Lamk., and *E. dimidiatus*, Phil., there is an undepressed portion of test between the disc and the commencement of the valley. The posterior lobes are likewise more tapering and less tumid than in the Coral Rag species. *E. clunicularis* is distinguished from *E. orbicularis*, Phil., by its sub-quadrate shape, by its sides increasing in diameter towards the posterior part, and by its posterior bilobed border. The same group of characters serve to distinguish it from *E. Woodwardii*, Wright, a species remarkable for its tumid sides and long narrow anal valley.

Locality and Stratigraphical position.—This urchin makes its first appearance in the *Clypeus Plottii* bed of the Inferior Oolite, in the zone of *Ammonites Parkinsoni*. The specimens from this rock often attain a considerable size; the flattened varieties are the largest, and the pyramidal the smallest. I have collected this species from the upper zone of the Inferior Oolite at Rodborough, Birdlip, and Shurdington Hills, and from Hampen, Naunton, and Stow-in-the-Wold, Gloucestershire; from the Stonesfield Slate at Sevenhampton, Eyeford, and near Pewsdown; from the Great Oolite of Minchinhampton, Salperton, and near Cirencester; from the Forest Marble near Trowbridge; from the Cornbrash near Cirencester, Gloucestershire; and from Chippenham and Trowbridge, Wilts. Mr. Hull has collected it from that formation near Shilton, and Mr. Gavey near Woodstock. The Rev. A. W. Griesbach has collected the finest specimens I have seen from the Cornbrash at Rushden, Northamptonshire, where they attain a very large size (fig. 1 *a, k*), and are found in excellent preservation. Messrs. Bristow and Gapper, of the Geological Survey, collected specimens in abundance from the Cornbrash of Dorset, and I have likewise found it in the same rock at Gristhorpe Bay, and Scarborough, Yorkshire. It forms, therefore, a very characteristic urchin of the upper portion of the lower division of the Oolitic series, extending without interruption from the zone of *Ammonites Parkinsoni* to the uppermost beds of the Cornbrash; a practised eye, however, can readily detect the varieties which are gathered from the Inferior Oolite, Great Oolite, and Cornbrash; the Inferior Oolite forms are usually large and depressed, the Great Oolite small and dwarfed, and the Cornbrash the largest and best developed of the series.

The foreign distribution of this species, according to M. Desor, is Calcaire à Polypiers (Bathonien) de Ranville, Forest-Marble de Châtel-Censoir (Yonne), Vesulien du Hornussen, Kreisacker, Wolfliswyl et Frick (Argovie), Meltingen. (Canton de Soleure), Maiche (Doubs).

It was collected in abundance by M. Triger from the Great Oolite (department of the Sarthe) at "La Jaunelière (tuilerie), Domfront (four à chaux), Conlie, Monnè, Saint-Christophe, route de Mamers à Maroiette, Aubigné (ferme de Gesnes-le-Gaudelin), Pécheseul, Noyen, Saint-Pierre-des-Bois, route de Contilly à la Perrière."

Table of M. Triger, Bradford Clay, Ass. Nos. 1, 2, and 3, and Forest Marble, Ass. No. 4.

B. *Species from the Great Oolite.*

Echinobrissus Woodwardii, *Wright*. Pl. XXIV, fig. 2 *a, b, c, d, e*.

Nucleolites Woodwardii.	Wright, Annals and Magazine of Natural History, 2d series, vol. 13, p. 161, pl. xii, fig. 5 *a—e*, 1852.
— —	Forbes, in Morris's Catalogue of British Fossils, 2d ed., p. viii, ad. sp.
Echinobrissus Woodwardii.	Desor, Synopsis des Échinides Fossiles, p. 268.

Test thin, sub-quadrate; sides tumid; dorsal surface flatly convex; anal valley deep, narrow, and spear-shaped, extending from the apical disc to the posterior border; ambulacral areas narrowly lanceolate; posterior lobes short, and truncated; base flat; inter-ambulacral areas slightly inflated at the base; single inter-ambulacrum scarcely produced; mouth-opening pentagonal, excentral; apical disc small, central.

Dimensions.—Height, six tenths of an inch; antero-posterior diameter, one inch and one tenth; transverse diameter, one inch and one fifth; the larger specimens are so much deformed that their proportional dimensions cannot be accurately given.

Description.—This species was formerly considered a variety of *E. orbicularis*, Phil., but a careful study of many specimens of the former, compared with good typical examples of the latter, convinces me that these two urchins are specifically distinct.

The test is thin, and not often well preserved; the specimen drawn (fig. 2 *a*, *b*) is a small but tolerably perfect individual; the outline is sub-quadrate, the shell is one tenth of an inch more in breadth than in length; it is a little narrower anteriorly, than posteriorly, and the posterior border is broadly truncated; the sides are very tumid (fig. 2 *c*), sometimes irregularly so; and the test is higher across the apices of the postero-lateral ambulacra than at any other point (fig. 2 *c*); the tumidity of the sides produces a greater flatness of the upper surface than is observed in any of its congeners. The ambulacral areas are nearly all of the same width; they have a narrow, graceful, lanceolate form (fig. 2 *a*), from the mouth to about midway between the margin and the apical disc they are nearly all of equal width; at this point the pores gradually change their form, they are slightly separated for a short distance, and again converge as they approach the disc; the pores of the inner row are round (fig. 2 *d*), those of the outer row form oblique slits; the widest part of which is external; the round pores are formed by notches in the upper part and sides of the small plates forming the avenues, and the oblique pores by uncalcified portions of the margins of the same plates; from the termination of the petaloidal portion of the zones to the mouth, the pairs of pores are small, and set wider apart, whilst the diameter of the areas remains the same; near the peristome they are crowded close together and form arches, the convexity of which is towards the mouth-opening. The inter-ambulacral areas are of unequal width; the anterior pair are the narrowest, the posterior are wider than the anterior pair, and the posterior single inter-ambulacrum is the widest (fig. 2 *a*). The anal valley forms a long narrow depression,extending from the disc to the border; it has perpendicular sides, and a small vent opens into it about the middle; the base is flat, becoming more or less concave near the mouth (fig. 2 *b*); the anterior and posterior pairs of inter-ambulacra are moderately convex in this region, and the basal portion of the inter-ambulacrum is very slightly produced; the mouth-opening is excentral, situated in a depression nearer the anterior than the posterior border; the peristome has a pentagonal shape, with five rudimentary lobes. The surface of the plates is covered with microscopic tubercles (fig. 2 *d*), arranged in tolerably regular oblique rows; on each plate there are from twenty to thirty, disposed in three or four rows (fig. 2 *d*); and those at the base are somewhat larger than the tubercles on the upper surface. The apical disc is small, and nearly central; its elements are so intimately soldered together, that its general form alone can be made out; none of the specimens I have examined display the separate plates; the eyeholes are marginal, at the apices of the ambulacra, and the ovarial holes are further outwards, and between them, whilst the madreporiform tubercle occupies the centre of the disc. The test is very thin, and almost always deformed by tumidity, and the upper surface is often irregular from this cause. The beauty and regularity of the small specimen I have figured, forms an exception to almost all the other specimens I have seen.

Affinities and differences.—This species resembles most *E. orbicularis*, Phil., which is the only form amongst its Oolitic congeners for which it can be mistaken. The following diagnostic characters will enable the geologist to distinguish these allied forms from each other. In *E. Woodwardii* the sides are very tumid, and the dorsal surface is flat, whilst in *E. orbicularis* the sides taper, and the upper surface is convex. In *E. Woodwardii* the base is flat, and the inter-ambulacra are slightly produced, whilst in *E. orbicularis* the base is concave, and the inter-ambulacra convex and prominent. In *E. Woodwardii* the anal valley is narrow, in *E. orbicularis* it is wide. In *E. Woodwardii* the outline is sub-quadrate, in *E. orbicularis* it is circular; the petaloidal disposition of the dorsal portion of the poriferous zones extends farther down the sides in *E. orbicularis* than in *E. Woodwardii*. It differs from *E. Brodiei* and *E. scutatus* in the anal valley extending from the disc to the border, whereas in these species there is always an undepressed portion of test between the disc and the valley. Between *E. Woodwardii* and *E. clunicularis* the difference in the general shape and development of the posterior lobes is so great, that they cannot be mistaken for each other.

Locality and Stratigraphical position.—I have collected this urchin from the Great Oolite at Minchinhampton, near Cirencester, at Salperton tunnel, Great Western Railway, at Highgate, and near Pewsdown, Gloucestershire, and at Burford, Oxon; as far as I know, it has not been found out of the Great Oolite. Mr. John Bravender, of Cirencester, collected this species at Tetbury, and between Tetbury and Bourton-on-the-Water, embracing a distance of twenty-five miles, in ten or twelve different localities; the specimens were found in a hard marly rock, at the upper part of the Great Oolite; the test is unfortunately not often well preserved. Mr. Frederick Bravender has kindly sent me the following note on the distribution of this urchin, which I herewith give entire:

"*Echinobrissus Woodwardii* is generally found in a rubbly bed, nearly, if not quite, at the top of the Great Oolite; and although this stratum covers a considerable tract of elevated country in the neighbourhood of Cirencester, this urchin has not been collected very plentifully, except in one or two localities. It has been found at Perrimore Quarry, on the Royal Agricultural College Farm, which is the best locality; at Coates, at the Woodhouse in Earl Bathurst's Park, at Downs Farm, and Stowell Park, on the Stow Road, and at Stratton, and North Cerney, near Cirencester. The specimens obtained from the Woodhouse were from some light excavations to mend a private road, where they were abundant. In one instance (near Stowell Park) the rubbly bed containing the *E. Woodwardii* was covered over with Bradford Clay, about two feet in thickness, when the characteristic fossil *Terebratula digona*, Sow., occurred in abundance. In two or three instances *E. Woodwardii* was found associated with *Trigonia Phillipsii*, Lyc., which has not been very long recognised as a Gloucestershire shell; it is not improbable that the two may be found together in Northamptonshire. I am not aware that this species has been found out of the Great Oolite.

In three specimens collected from the same white marly bed of the Great Oolite, whilst this sheet was passing through the press, the small apical disc is better preserved than in those I had previously examined. The ovarial plates are long, narrow, and lanceolate, with large, oblique, oviductal holes, perforated near their apices, the madreporiform body covers so much of the disc, that I cannot discern whether there are supplementary plates in its centre as in *E. orbicularis.* The ocular plates are small, and have minute marginal orbits.

ECHINOBRISSUS GRIESBACHII, *Wright*, nov. sp. Pl. XXV, fig. 1 *a, b, c, d, e, f.*

Test quadrate, elevated; sides tumid; posterior lobes small; apical disc large, expanded; anal opening large, adjoining the disc without any intermediate depressed space between the disc and the vent; poriferous zones narrow; pores approximated throughout; anal valley wide.

Dimensions.—Height, four tenths of an inch; antero-posterior diameter, three quarters of an inch; transverse diameter, nearly equal to the length.

Description.—I am indebted to my friend, the Rev. A. W. Griesbach, for calling my attention to this new form, which has hitherto, doubtless, been considered a small variety of *E. clunicularis.* After a careful study of this urchin, I feel disposed to adopt my friend's view, and in justice to Mr. Griesbach, I subjoin his notes on this species, in which he has most accurately pointed out its diagnostic characters:

"There is a small nucleolite found in the Great Oolite round about here, which I have for a long time heedlessly confounded with *N. clunicularis*, but which I yesterday discovered to be quite a distinct form, and I do not know any other species to which it can be referred. I have seen it at Wimmington, Higham Ferrers, and Blisworth, and have received a specimen from Mr. Brodie from 'Fuller's Earth Rock, Gloucestershire.' The specimens I have seen and collected have been, with only one exception, either entirely denuded of the test, or else so eroded as to leave no structure visible. I send you the one exception, which I found at Blisworth about four years ago (fig. 1 *a, c*). It is narrower than the usual form, which is quadrate—as broad as it is long. Mr. Brodie's specimen is considerably larger, but, though having the test, it has been scraped and spoiled. Compared with *N. clunicularis* (of which I have seven beautiful specimens from the Cornbrash of Rushden before me, four of these are depressed, and three high and conical), this nucleolite, among minor differences, presents the following main distinctions:

Affinities and differences.—" 1st. Whereas in *E. clunicularis* there is always a narrow depressed space (as long as the anal opening itself) between the apical disc and the vent; in *E. Griesbachii* there is *no such space,* but the anal aperture *immediately adjoins the apical disc* (fig. 1 *a, c*).

" 2d. The apical disc is proportionally *much* larger than in *E. clunicularis,* in consequence of which the apices of the ambulacra do not approach each other so nearly, and the perforations in the disc are wider apart (fig. 1 *b*).

" In this small urchin (fig. 1 *a*) the disc is fully as broad as in a fine specimen of *E. clunicularis*—one inch and three tenths in antero-posterior diameter.

" If several false species have been made out of *E. clunicularis,* that is no reason why we should too readily unite different forms under that name. I think this i a distinct species, and hope, therefore, to have avoided what might otherwise have been said, 'Incidit in Scyllam cupiens vitare Charybdim.' I have no idea that this form is *rare* in the Great Oolite, but it appears to have been overlooked."

ECHINOBRISSUS ORBICULARIS, *Phillips.* Pl. XXV, fig. 2 *a, b, c, d, e, f, g.*

CLYPEUS ORBICULARIS.	Phillips, Geology of Yorkshire, tab. vii, fig. 3, 1829.
— —	Agassiz, Prodrome d'une Monogr. des Radiaires Mem. Soc. des Sc. Nat. de Neuchâtel, t. i, p. 136, 1836.
— —	Dujardin, in Lamarck, Animaux sans vertèbres, 2d ed., t. iii, p. 348, 1840.
— —	Morris, Catalogue of British Fossils, p. 50, 1843.
NUCLEOLITES ORBICULARIS.	Forbes, Memoirs of the Geological Survey, decade first, description of pl. vii, 1849.
— —	Wright, Annals and Magazine of Natural History, 2d series, vol. ix, p. 301, 1851.
— —	Forbes, in Morris's Catalogue of British Fossils, 2d ed., p. 84, 1854.
	Davoust, Note sur les Foss. Spéciaux, à la Sarthe, p. 25, 1856.
ECHINOBRISSUS ORBICULARIS.	Desor, Synopsis des Échinides Fossiles, p. 265, 1857.
— —	Cotteau and Triger, Échinides du departement de la Sarthe,
— —	pl. ix, figs. 5—8, p. 57, 1858.

Test orbicular; upper surface irregularly convex and depressed; sides tumid; apical disc complex and central; ambulacral areas lanceolate; poriferous zones narrowly petaloid between the border and disc; posterior lobes obsolete; anal valley broad, extending from the disc to the border; vent large, situated in the upper part, near the disc; base flat or slightly concave; mouth sub-central, situated in a depression nearer the anterior border.

Dimensions.—Height, eight tenths of an inch; transverse diameter, one inch and six tenths; antero-posterior diameter, one inch and six tenths.

Description.—The tumid sides, obsolete lobes, orbicular circumference, its length and breadth being equal, with the broad, flat, and somewhat irregular dorsal surface, serve to distinguish this species from its congeners.

The ambulacral areas are narrow, and nearly all of the same width (fig. 2 *a*); they have a more petaloidal form than in the preceding species, and are furnished with two rows of small tubercles arranged in zig-zag lines on the areas, the external row being the largest and most regular (fig. 2 *e*), whilst the middle of the area is covered only with minute granules.

The poriferous zones are moderately wide, and with the ambulacral areas form well-developed petaloidal figures on the upper surface of the test; the pores of the inner row are round, those of the external row are oblong (fig. 2 *e*); there are about six pairs of holes opposite each inter-ambulacral plate; on the upper surface the pores are wider apart (fig. 2 *g*), on the sides they are close together (fig. 2 *c*), at the margin they are very indistinct (fig. 2 *f*), at the base they are scarcely visible and still more widely apart, and continue so to the peristome (fig. 2 *b*).

The inter-ambulacral areas are of unequal width; the antero-lateral pair are the narrowest, the postero-lateral are wider, and the single area is the widest (fig. 2 *a, b*); the sides are more or less tumid (fig. 2 *c*), and the upper surface is irregularly convex (fig. 2 *f*), in consequence of the antero- and postero-lateral areas being slightly depressed in the centre (fig. 2 *c, f*); the inter-ambulacral plates form long pentagons, bent upwards in the middle (fig. 2 *e*). Each plate is covered with about twenty very small tubercles, arranged in three rows; in a large majority of specimens they are so minute on the sides, margin, and upper surface that it requires the aid of a good lens to discover them, at the base they are larger and crowded closer together; each tubercle is surrounded by a sunken areola (fig. 2 *e*), and the inter-tubercular surface of the plates is closely crowded with microscopic granules which encircle the areolas or fill up all the intervening spaces. The single inter-ambulacrum is not at all produced, and the lobes are very small. The anal valley is large; it commences at the posterior border of the disc and extends to the margin (fig. 2 *a. g*). The large vent has an elliptical shape, and opens near the surface in the upper third of the valley, whilst the lower two thirds of that depression form a considerable furrow in the middle of the area (fig. 2 *a, g*).

The apical disc is large, and presents a very remarkable modification of the usual type of structure observed in other ECHINOBRISSIDÆ. As I have seen this structure in many specimens collected from localities widely apart, it must be regarded as a normal form in this species. Mr. Bone has figured this curious disc with great accuracy at fig. 2 *d*; the two pair of perforated ovarial plates have a pyriform shape, the right antero-lateral is the largest, and supports the spongy madreporiform body; between these there are introduced into the middle of the disc four small plates, and posterior to them three other smaller plates. The front rows are bounded before by the madreporiform plate, and behind by the left posterior ocular plates, and the three posterior plates lie between the posterior oculars. The surface of all the elements of the disc is covered with numerous close-set tubercles. The five ocular plates are cordate in form, and have marginal orbits. The abnormal deviation from the usual structure consists in the introduction of two rows of small plates behind and between the normal discal elements.

The base is concave and undulated (fig. 2 *b*), from the prominence of the interambulacra (fig. 2 *f*) and the depressions formed by the ambulacra which radiate in straight furrows from the peristome to the margin. The mouth lies at the bottom of a subcentral depression. The peristome is central and slightly five-lobed; the tubercles are more conspicuous at the base than on the upper surface, and are closely placed upon the plates.

The test is very thin, and the spines, which were preserved on one specimen, are moderately long and needle-shaped.

Affinities and differences.—The orbicular form and long anal valley liken this species to *Echinobrissus Woodwardii*, Wr., but the convexity of the upper surface, the wideness of the anal valley, the concavity of the base, and the slight tumidity of the sides, form a group of characters of sufficient value to distinguish it from that congeneric species. It resembles some of the small round varieties of *Echinobrissus Hugii*, Ag., but is readily distinguished from them by the anal valley extending from the disc to the border, whereas in *Echinobrissus Hugii*, Ag., there is always an undepressed portion of test between the disc and upper limit of the anal valley. From all other Oolitic species it is so entirely distinct that it is not likely to be mistaken for either of them.

Locality and Stratigraphical position.—This is a true Cornbrash urchin. I have collected it from that "terrain" near Cirencester, and Miss Slatter found it in the same rock near Fairford. Professor Phillips obtained his original type specimens from the Cornbrash at Scarborough, and I have collected it out of the same bed. I am indebted to my friend, John Leckenby, Esq., for a good series from that locality; and Edward Wood, Esq., of Richmond, most liberally gave me the fine large specimen from Scarborough figured in Pl. XXV, fig. 2 *a*. I have received a very fine series of this species from my friend, the Rev. W. A. Griesbach, which he collected from the Cornbrash at Rushden, Northamptonshire; these specimens have supplied abundant materials for the curious structure of the disc and other interesting details. One of these urchins (fig. 2 *f*, *g*) enabled me to exhibit a conoidal variety which sometimes occurs, but it would require many figures to do full justice to all the variations of outline observed in the Northamptonshire specimens; which likewise exhibit the sculpture on the plates much better than those from Yorkshire. The Gloucestershire specimens are rarely well preserved. This species is exceedingly rare in the Wiltshire Cornbrash, which contains in such abundance *E. clunicularis*, Lhwyd.

M. Triger collected *E. orbicularis* from the Forest Marble, Ass. No. 4, department of the Sarthe, at Pécheseul, Noyen, route de Mamers à Montagne, where it is very rare. I know of no other foreign locality in which it has been found.

Echinobrissus quadratus, *Wright*, nov. sp. Pl. XXVI, fig. 1 *a*, *b*, *c*, *d*.

Test quadrate, elongated, depressed, narrow before, wide behind; posterior border deeply sulcated; anal valley short, wide, and with sloping sides, extending to the apical disc, which is excentral and nearer the posterior border; dorsal surface much inclined from the apical disc to the anterior border; sides narrow; base very concave; plates of the test closely covered with small tubercles.

Dimensions.—Height, seven tenths of an inch; antero-posterior diameter, one inch and nine twentieths; transverse diameter, one inch and three tenths of an inch.

Description.—This nucleolite has by some been considered to represent *Nucleolites major*, Agass., in the English Oolitic rocks, but a careful examination of M. Agassiz's figure, given in the 'Échinodermes Fossiles de la Suisse,' will convince the inquirer that this urchin is very distinct from the Swiss form; in our nucleolite the apical disc is excentral, and situated nearer the posterior border, whereas in *E. major* the excentral disc is nearer the anterior border; the mouth-opening in our nucleolite is small and nearly circular, whilst in *E. major* it is pentagonal, and much nearer the anterior border. Besides these organic distinctions, they belong to widely different stages of the Oolitic rocks, *E. quadratus*, Wright, being found in the Cornbrash, whereas *E. major*, Agas., was collected from the "terrain Portlandien de la Vallée de la Birse."

E. quadratus is a large, elongated nucleolite, with a well-defined quadrate outline, much wider behind than before; the upper surface is flat, and the slope from the disc to the anterior border is long and gently declined; the ambulacral areas are nearly all of the same width, and terminate at a short distance from the apical disc, (fig. 1 *a*); they pass entirely straight from the border to the disc, without forming curves as in *E. clunicularis*, Lhwyd.

The poriferous zones are narrow; the pores forming the external row are only a little larger than those of the inner row (fig. 1 *d*), and there are seven pairs of pores opposite each large plate; the inter-ambulacral areas are of unequal width, the anterior pair are the narrowest, and the posterior pair and single inter-ambulacrum are the same diameter; their upper surface is uniformly convex, and the plates are covered with tubercles, set closely together (fig. 1 *d*). There are five or six rows on each plate, the areolas of which are so nearly approximated that there are much fewer granules between them than in the nearly allied *E. clunicularis;* the tubercles likewise are larger than in that species. (Compare Pl. XXIV, 1 *e*, with Pl. XXXVI, fig. 1 *d*.)

The upper surface of the single inter-ambulacrum is very much depressed to form the anal valley, the sides of which slope obliquely inwards, and form an angle of 65° with the base (fig. 1 *a*); the posterior border is much indented by this depression, and forms quite a concave depression behind (fig. 1 *a*, *b*).

The apical disc is rather larger than in *E. clunicularis;* it occupies the vertex of the test, and is placed nearer the posterior than the anterior border. The four genital holes are large and distinct, and the madreporiform body is not very prominent.

The base is concave, and the small excentral mouth-opening (fig. 1 *b*) is situated nearer the anterior than the posterior border; the peristome is circular or subpentagonal, with five rudimentary oval lobes. The poriferous zones lie in depressions, and distinctly radiate from its circumference (fig. 1 *b*). The basal tubercles are larger than the dorsal; they are placed so close together that the areolas are separated only by single rows of granules (fig. 1 *b*).

Affinities and differences.—I have already pointed out the diagnostic characters by which this species is distinguished from *E. major,* Agas., the nucleolite which most nearly resembles it in form, size, and general outline. Its next nearest affinity is with *E. clunicularis,* Lhwyd; from this species it is distinguished, however, by its quadrate shape and depressed dorsal surface, by the wide anal valley, with its oblique sloping sides and concave posterior border. The apical disc is likewise situated behind the centre of the test, and the tubercles are larger and more closely crowded together. The structure of the anal valley and the excavated character of the single inter-ambulacrum serve at a glance to distinguish it from *E. scutatus,* Lamk.

Locality and Stratigraphical position.—All the specimens that I know of this species were collected by Mr. William Buy from the Cornbrash near Sutton-Benger, Wilts, where it is extremely rare; it occurs with the small gray variety of *E. clunicularis,* associated with *Holectypus depressus,* Lamk., *Acrosalenia Wiltoni,* Wright, *Acrosalenia hemicidaroides,* Wright, *Stomechinus intermedius,* Agas., *Acrosalenia spinosa,* Agas., *Avicula echinata,* Sow., *Terebratula obovata,* Sow., *Terebratula lagenalis,* Schloth., and other well-known Cornbrash forms.

C.—*Species from the Coralline Oolite.*

Echinobrissus scutatus, *Lamarck.* Pl. XXXVI, fig. 2 *a, b, c, d, e, f.*

Echinites cordatus.	Lang, Lapid. Figur. Helvetiæ, p. 119, tab. xxxv, fig. 1, 1708.
Echinobrissus elatior.	Breynius, Schediasma de Echinis, p. 63, tab. vi, fig. 3, 1732.
Spatangus depressus.	Leske, Additamenta ad Kleinii Dispositionem Echinodermatum, p. 238, tab. li, figs. 1, 2, 1778.
Nucleolites scutatus.	Lamarck, Syst. Animaux sans vertèbres, tome iii, p. 36, 1816.
Clypeus cordatus.	Smith, Strata Identified, plate of Coral Rag Fossils, 1817.
Echinus depressus.	Schlotheim, Petrefactenkunde, p. 313, 1822.
Nucleolites scutatus.	Defrance, Dict. des Sciences Naturelles, tome xxxv, p. 213, 1825.
— scutata.	Blainville, Dict. des Sciences Naturelles, tome xxxv, p. 213, 1825.
— scutatus.	Deslongchamps, Encycloped. Method., ii, p. 570, No. 1.
— —	Goldfuss, Petrefacta Germaniæ, Band. i, tab. xliii, fig. 6 *a—c*, p. 140, 1826.
— —	Desmoulins, Tableaux Synop. Échinides, p. 356, No. 5, 1836.
— —	Agassiz, Échinodermes Foss. de la Suisse, p. 45, tab. vii, figs. 12—21, 1839.
— clunicularis, var. *a major*.	Forbes, Memoirs of the Geological Survey, decade 1st, pl. ix, 1849.
— scutatus.	D'Orbigny, Prodrome de Paléontologie, tome i, p. 379, 1850.
— —	Bronn, Lethæa Geognostica, 3d Aufl. zweit, Band., p. 151, tab. xvii, fig. 13, 1851.
— —	Wright, Annals and Magazine of Nat. Hist., 2d series, vol. 13, p. 185, 1851.
— dimidiatus (pars)	Wright, Annals and Magazine of Nat. Hist., 2d series, vol. ix, p. 301, 1851.
— scutatus.	Forbes, in Morris's Catalogue of British Fossils, 2d ed., p. 84, 1854.
Echinobrissus scutatus.	Desor, Synopsis des Échinides Foss., p. 277.

Test elliptical, sub-quadrate, rounded before, enlarged, expanded, and bilobed behind; upper surface convex, more or less depressed; sides tumid; base concave; apical disc small, excentral, nearer the anterior border; dorsal valley wide, with perpendicular walls; apex separated from the disc by an undepressed portion of test; valley extending about two thirds the distance between the vertex and border; vent large and elliptical; base concave, much depressed at the excentral mouth-opening; peristome slightly pentagonal.

Dimensions.—Height, seven tenths of an inch; antero-posterior diameter, one inch and three tenths; transverse diameter, one inch and a quarter.

Description.—It is impossible to decide whether the urchin figured by Plot* in tab.

* 'History of Oxfordshire.'

ii, fig. 12, and by Lister* (tab. 7, fig. 26), refers to this species or *E. clunicularis*, in consequence of the omission of the anal valley in these figures, on which the true specific character strictly depends. Down to a very recent date, the two forms have been confounded with each other, although, when critically examined, the differences are very evident. The stratigraphical distribution of the two species is moreover well defined, *E. clunicularis* ranging from the superior zone of the Inferior Oolite to the Cornbrash, whilst *E. scutatus* is limited to the Calcareous Grit and other subdivisions of the Coral Rag. The abundance of this nucleolite in the Calcareous Grit near Oxford makes it highly probable that this was the form the older authors above cited had in view in their respective works. Lang's† "Echinites Cordatus quaternis radiis è duplici serie transversarum lineorarum conflatis" (tab. 35, fig. 1), probably represents a bad specimen of this urchin, in which the single ambulacrum had been obliterated. The specimen is described as being very rare, and was found in the hills around Bætstein and Luggeren. Leske's‡ figure of *Spatangus depressus* (tab. 51, fig. 1) apparently represents a quadrate depressed variety of this species, but in consequence of the anal valley being filled up with matrix, the true specific character is concealed. Many authors are of opinion that the figure of Goldfuss§ does not represent the true Lamarckian *Scutatus*, and Desmoulins has proposed to separate it, under the name *Goldfussii;* but after having studied a large number of individuals collected at Trouville, I have found many specimens with which the figure of Goldfuss entirely agrees. A sufficient margin has not been allowed for the varieties which the same species exhibits when obtained from different localities. M. Agassiz's ‖ figure of this nucleolite is very good, and represents, I think, the true type form of the species. This author participates in the opinion expressed by Desmoulins, in reference to which he says—

"En revanche je pense avec M. Desmoulins que Goldfuss a identifié à tort l'espèce qu'il a décrite sous le nom de *N. scutatus,* avec le *N. scutatus* de Lamarck, dont nous nous occupons en ce moment. Ce dernier en effet n'affecte nullement cette dépression de la face supérieure postérieure qui est trés saillante dans les figures de Goldfuss; c'est au contrare à la face antérieure qui est la plus inclinèe." "Afin de destinguer le *N. scutatus,* Lam., du *N. scutatus,* Goldf. (qui n'a point encore éte trouvé en Suisse), M. Desmoulins a donné à ce dernier le nom de *N. Goldfussii.*"¶

Professor Edward Forbes** considered this species as a variety of *N. clunicularis*, and described it as "*Var. a major, sub-depressa, lata, lateribus, tumidiusculis. Spatangus depressus,* Leske, ap. Klein, p. 238, t. 51, fig. 12 (copied in 'Enc. Meth.,' pl. 157, figs.

* 'De Lapidibus Turbinates,' cap. ii, titulus xxvi.

† 'Historia Lapidum Figuratorum Helvetiæ,' tab. 35, p. 119.

‡ 'Additamenta ad Kleinii Echinodermata,' p. 238, tab. 51, figs. 1, 2.

§ 'Petrefacta Germaniæ,' tab. 43, fig. 6.

‖ 'Échinodermes Fossiles de la Suisse,' tab. vii, figs. 19—21.

¶ Ibid., partie première, p. 46.

** 'Memoirs of the Geological Survey, decade 1, pl. ix.

5, 6). *Nucleolites scutata,* Lamarck, 'An. s. Vert.,' iii, p. 35; Defrance, 'Dict. Sc. Nat.,' vol. xxxv, p. 213. *N. scutatus,* Agassiz, 'Echin. Suiss.,' p. 45, pl. 7, figs. 19—21." This quotation shows my lamented friend's opinion when the description of his Pl. IX was written. At that time I believe he had not seen my Trouville specimens of *E. scutatus,* for on making with him a comparison of some type-forms of *N. scutatus,* Lamk., he readily admitted, after that examination, the specific differences existing between the *N. clunicularis* and the true Lamarckian species.

In my first memoir on the Cassidulidæ of the Oolites,* I grouped several individuals of this species with *E. dimidiatus,* Phil. At that time nearly all the English Coral Rag nucleolites were referred to Phillips's species; and I was only convinced of my error after I had examined a series of good type-specimens from Trouville, the original locality of Lamarck's species.

Echinobrissus scutatus, Lamk., when fully developed, is uniformly convex on the upper surface; it is rather narrower before than behind; its length nearly equals its breadth, when measured about the middle of the test; the flanks are rounded and tumid (fig. 2 *c*), and the posterior border is truncated (fig. 2 *b*); the vertex is situated nearer the anterior than the posterior border, and in the centre thereof is placed the apical disc; from this point the test slopes gently towards the posterior border, but more abruptly to the anterior side (fig. 2 *c*); the ambulacral areas are narrow, and nearly uniform in width, the posterior pair being a little broader than the anterior areas. The poriferous zones are petaloidal only on two thirds of the upper surface (fig. 2 *a, c*). The pores of the inner row are round, those of the outer row form oblique slits; on the flanks they are both round, more distant, and placed obliquely, thus ·.·. .·.·; at the border they become very small, and at the base indistinct; near the peristome they are again larger and more numerous; in the more crowded portions of the zones there are from six to seven pairs of pores opposite one of the large plates, and where they are more distinct on the sides there are four small pairs opposite one plate.

The two anterior inter-ambulacral areas are narrower than the posterior pair (fig. 2 *a*). There are about sixteen plates in a column, each plate forming a double inclined plane, and having its surface crowded with small equal-sized tubercles, arranged close together in three or four rows (fig. 2 *f*); the postero-lateral pair are wider and longer, and contain more plates in each column; in other respects they have a similar structure to the anterior areas. The single inter-ambulacrum is about as wide as the postero-lateral pair; it is truncated behind, and its border is grooved by the anal valley; this depression has a uniform width, is concave at its base and upper part, and there is always an undepressed portion of test between its termination and the apical disc (fig. 2 *a*); the anal opening is round, and is seen at the end of the valley (fig. 2 *a, d*).

The apical disc is small and excentral; its elements are so intimately soldered together, that the sutures in all my specimens are obliterated; the madriporiform tubercle is large

* 'Annals and Magazine of Natural History,' 2d series, vol. ix, p. 300.

and occupies the centre of the disc; it appears to cover the genital plates (fig. 2 *e*), and the four genital holes are large oblique slits, which extend into the inter-ambulacral areas (fig. 2 *e*).

The base is nearly flat at the sides, and slightly concave towards the mouth-opening (fig. 2 *b*). In large, well-developed specimens, the inter-ambulacral areas are a little prominent, and the course of the ambulacra is marked by corresponding depressions in the test; the poriferous zones are so feebly shown, that the pores can only be seen with a lens.

The mouth-opening is moderately large for a nucleolite; it is situated in a depression opposite the apical disc, and is nearer the anterior than the posterior border (fig. 2 *b*); the peristome is pentagonal, and each angle of the pentagon corresponds to an ambulacral area; the areas form inconsiderable petaloidal expansions as they radiate from the peristome, and the pores are crowded close together in the vicinity of the mouth-opening. The anal valley forms one of the distinctive characters of this species (fig. 2 *a*); it is of an ovate or lanceolate form, with a blunt apex; in some specimens it appears as if a portion of the inter-ambulacrum had been drilled out for the passage of the intestine; in some individuals it extends only half the distance between the margin and the vertex, whilst in others it reaches two thirds the length; in all the specimens I have examined, an undepressed portion of test separates the apical disc from the upper border of the anal valley; inferiorly, the valley forms a considerable sulcus, grooves the centre of the area, dividing its posterior border, and producing the cordate or bilobed form this species assumes (fig. 2 *a*, *b*).

Affinities and differences.—I have already stated that *E. scutatus* was formerly considered by English naturalists to be a variety of *E. clunicularis*, Lhwyd, and as such its history is more or less connected with that species. Were a student, therefore, to endeavour to unravel its synonyms from the books alone, he certainly would be puzzled in his search, as the critical remarks on *E. scutatus* have more frequently been made on book-statements than from an examination of specimens. If, however, a comparison be made between a series of *E. clunicularis*, Lhwyd, from the Cornbrash, with a corresponding series of *E. scutatus*, Lamk., from the Calcareous Grit, all doubts will be removed from the mind of the observer as to the specific differences existing between these species; and in default of such specimens, a careful study of Mr. Bone's most excellent figures in our Plates XXIV and XXVI, with the ample magnified details he has given therein, will afford sufficient evidence for our conclusion.

E. scutatus, Lamk., so nearly resembles *E. dimidiatus*, Phil., that the latter has by many been considered to be a variety of the former; this point, however, will be more properly discussed in the section devoted to the description of *E. dimidiatus*, Phil.

These are the only English nucleolites which at all resemble *E. scutatus*. Between all the other older species and this Corallian form the distinctions are numerous and selfevident. Between the newer Portland species, *E. Brodeii*, Wr., and *E. scutatus*, a detailed analysis will be given in the section on that species.

Locality and Stratigraphical position.—I have collected *E. scutatus*, Lamk., from the Lower Calcareous Grit at Bullington-Green, near Oxford, where it was associated with *Cidaris Smithii*, Wright. I have discovered it was from this same quarry that the large type-specimen of the Cidarite figured in our Pl. II was obtained. I have gathered it from the Lower Calcareous Grit at Filey Brig, Gristhorpe Bay, and Scarborough Castle Hill, Yorkshire, and from the same formation at Marcham, and Faringdon, Berks. The Yorkshire specimens I chiseled out of blocks containing *Pygurus pentagonalis*, Phil., and other Calcareous Grit shells, and the Berkshire specimens were associated with *Cidaris florigemma*, Phil., and *Hemipedina Marchamensis*, Wright. I have collected it from the Coralline Oolite at Calne, Wilts, where it is very abundant in some beds. In one slab, about nine inches square, obtained from a large quarry near the town, there are about fifty specimens, more or less imperfect, closely laid together. Like other urchins, it appears to have been gregarious, and would be found in great numbers if its head zone was exposed. *Cidaris florigemma*, Phil., *Hemicidaris intermedia*, Flem., *Acosalenia decorata*, Haime, *Pseudo-diadema versipora*, Phil., lie with it in the same slabs.

My friend, Charles Pierson, Esq., collected this species from a Pisolitic Oolitic rock—the Lower Calcareous Grit of English geologists—about one mile from Trouville, Calvados, where it is very abundant, and in a good state of preservation. M. Desor states that it is found in the Oxfordien of Trouville, and Vaches-Noires, Calvados, Lannois, Ardennes, and Chamsol, Doubs.

History.—The history of this species has been already so fully detailed in my analysis of its synonyms, that it is unnecessary to enter into any further details on the subject.

ECHINOBRISSUS DIMIDIATUS, *Phillips*. Pl. XXVI, fig. 3 *a, b, c. d.*

CLYPEUS DIMIDIATUS. Phillips, Geology of Yorkshire, pl. 3, fig. 16, p. 127, 1829.
NUCLEOLITES DIMIDIATA. Desmoulins, Études sur les Échinides, Synonyme Générale, No. 25, p. 362, 1836.
— DIMIDIATUS. Agassiz, Prodrome d'une Monogr. des Radiares, p. 9, 1837.
— PARAPLESIUS. Agassiz, Catalogus Systematicus, p. 4, 1840.
— DIMIDIATUS. Morris, Catalogue of British Fossils, p. 55, 1843.
— — Agassiz and Desor, Catalog. Raisonné des Échinides Annales des Sciences Naturelles, 3e série, tome vii, p. 154, 1847.
— DIMIDIATA. Bronn, Index Palæontologicus, p. 818, 1848.
— DIMIDIATUS. Forbes, Memoirs of the Geological Survey, decade 3, description of pl. ix, 1849.
— — D'Orbigny, Prodrome de Paléontologie, tome 1, p. 379, 1850.

NUCLEOLITES DIMIDIATUS. Wright (pars), Annals and Magazine of Natural Hist., 2d series, vol. ix, p. 300, 1851.
— SCUTATUS. Wright, Annals and Magazine of Natural Hist., 2d series, vol. xiii, p. 185, 1854.
— — Forbes, Morris's Catalogue Brit. Foss., 2d ed., p. 84, 1854.
ECHINOBRISSUS SCUTATUS, var. alongèe. Desor, Synopsis des Échinides Fossiles, p. 267.

Test elongated, narrower before than behind; convex above, concave below; sides tumid; apical disc excentral, nearer the anterior border; anal valley short and narrow, reaching two thirds the distance between the posterior border and summit, with a triangular undepressed space between its upper margin and disc; posterior lobes obsolete, posterior border only slightly grooved.

Dimensions.—Antero-posterior diameter, one inch and three tenths; transverse diameter, one inch and three twentieths; height, seven tenths of an inch.

Description.—This urchin is very abundant in the Coralline Oolite of Malton, from which rock it was first figured by Professor Phillips. Unfortunately he gave no description of the species, and his figure represented only one view of the nucleolite. Professor Edward Forbes, who carefully studied this form, gave the following diagnosis of its characters: "*N. ambitu ovato, antice rotundato, postice bilobato; dorso convexo, apice centrali, vertice sub-centrali, postice tumido; ambulacris anguste lanceolatis; sulco anali profundo, ovato obtuso, superne abbreviata, lobis posterioribus tumidis; ventre plus minusve concavo.*

"This species rarely exceeds one inch in length, and varies greatly in the convexity of its upper surface. The ovate anal sulcus, reaching about two thirds of the distance between the posterior margin and the true summit, conspicuously distinguishes it from *clunicularis*, with which it was confounded before being distinguished by Phillips."

When Professor Forbes published the above 'Note on British Nucleolites' appended to the description of pl. ix, decade 1, of the 'Memoirs of the Geological Survey,' he was not aware of the existence, in our Oolites, of *N. scutatus;* it is therefore probable that his diagnosis was framed to include some forms of that species.

E. dimidiatus has an oval outline, the upper surface of the test is uniformly convex; the sides and anterior border are very tumid in some specimens, and moderately so in others; the posterior border is rounded and only slightly grooved by the sulcus.

The ambulacral areas are narrow and lanceolate; the single area and anterior pair are narrower than the posterior pair, which are much longer and better developed than the others. The poriferous zones lie in slight depressions of the test, their petaloidal portions are wider than the homologous part of this species in *E. scutatus,* and there are five to six pairs of pores opposite each large plate.

The inter-ambulacral areas are of unequal width, the anterior pair are the narrowest, the posterior pair are one third wider than the anterior pair, and the inter-ambulacrum is the widest. There are about sixteen plates in each postero-lateral column, and the surface of each is covered with numerous small tubercles (fig. 3 *d*), arranged in five or six horizontal rows.

The anal valley extends about two thirds of the distance from the posterior border to the apical disc; it is a narrower and more shallow sulcus than the corresponding valley in *E. scutatus*, and the vent opens nearer the surface. Between its upper border and the disc there is a well-marked triangular space, in length about one third the distance between the disc and border; the base of which is formed by the arch of the sulcus and the lateral portions of undepressed test, and the sides, by the long, oblique, posterior poriferous zones (fig. 3 *a*); this space is undepressed, and the plates composing it differ in no respect from the plates occupying the same region in other areas. When viewed laterally, the test of *E. dimidiatus* forms a long gentle slope from the vertex to the posterior border (fig. 3 *c*), and a short abrupt slope towards the anterior border; this arises from the excentral position of the apical disc, and the greater height of the anterior portion of the test.

The base is concave towards the centre, and tumid at the sides; the small mouth-opening is situated opposite the apical disc; the peristome is pentagonal, and its angles correspond to each of the ambulacral areas; the tubercles at the base are larger and more closely crowded together than those on the upper surface; the poriferous zones are so indistinct at the base that they appear only as faint lines radiating from the peristome.

The apical disc is very small, the madreporiform body makes a slight pyriform prominence, and the pairs of perforated genital plates extend outwards between the ambulacral areas.

Affinities and differences.—In its general outline this species resembles *E. Goldfussii*, Desor, from the Kelloway ferrugineux of the Sarthe; in that species, however, the vent is nearer the border, and the test proportionately higher to its length. It so closely resembles *E. scutatus*, Lamk., that I formerly considered it a variety of the latter. It is, however, distinguished from *E. scutatus* by the following characters: the test is more elongated; the sides and base are more tumid; the apical disc is smaller and more excentral; the anal valley is smaller and shallower, and rarely extends so high up the area; the poriferous zones are wider, and their petaloid portions lie in slight depressions on the upper surface; the sides are very tumid, and they are frequently more irregular in outline and unsymmetrical in proportions than in *E. scutatus;* the base is more concave, and its sides more tumid; the slope of the dorsal surface likewise, from the disc to the posterior border, is longer and more inclined than in its nearly allied *E. scutatus.*

Locality and Stratigraphical position.—*E. dimidiatus*, Phil., is collected in considerable abundance from the Coralline Oolite at Malton, Yorkshire, where it is associated with *E. scutatus*, Lamk., *Clypeus subulatus*, Young, and *Pygurus giganteus*, Wr. The finest specimens are those which occur in the large Freestone quarry at the east of the town. C. W. Strickland, Esq., has obtained it in his quarry at Hildenley, near Malton, where it is associated with *Hemicidaris intermedia*, Flem., *Cidaris florigemma*, Phil., *Pseudo-diadema hemisphæricum*, Agas., *Collyrites bicordata*, Leske, *Pygurus pentagonalis*, Phil., and *Nucleolites scutatus*, Lamk.

D.—*Species from the Portland Oolite.*

Echinobrissus Brodiei, *Wright*, nov. sp. Pl. XXXV, fig. 1 *a, b, c, d, e*.

Test elongated, much depressed, nearly as broad before as behind; anterior border rounded; posterior border angular; anal valley wide, short, limited to the lower half of the inter-ambulacrum; apical disc small, nearly central; poriferous zones slightly petaloidal; base undulated, from the convexity of the inter-ambulacra; mouth-opening large, excentral, pentagonal, oblique, situated near the anterior border; inter-ambulacrum produced, recurved, and truncated posteriorly.

Dimensions.—Antero-posterior diameter, one inch; transverse diameter, nine tenths of an inch; height, four tenths of an inch.

Description.—Urchins are so extremely rare in the Portland Oolite of England, that the discovery of this specimen in that formation at Brill enables me to give a figure of a nucleolite, of which I had formerly observed fragments in the same formation at Portland. The test is unfortunately not well preserved in the Brill urchins, the matrix having adhered so firmly to the test of the largest specimen that the surface could only be exposed by the use of dilute acid, a process which at all times destroys the fine sculpture of the shell, and ought never to be employed in cleaning Echinoderms but as a "dernier resort" for disclosing structure in doubtful cases. The shell is elongated, a little wider behind than before, the anterior border is rounded, and the posterior angular. The upper surface is much depressed and uniformly convex, forming regular curves in the length and width (fig 1 *c, d*).

The small apical disc occupies the vertex, which is anteriorly excentral; its elements unfortunately are concealed by some closely adherent matrix, which cannot be removed.

The ambulacral areas are nearly all of the same width; the poriferous zones are narrowly petaloid, and both rows of holes are about the same size.

The inter-ambulacral areas are of unequal width; the anterior pair are the narrowest, the posterior pair the widest, and the single area of intermediate width; they are all uniformly convex, and covered with very small tubercles; the sides of the test are much depressed, and form an angle of about 25° with the base; the margin is rounded and flattened before, and gradually expands to within the eighth of an inch of the postero-lateral ambulacra; at this point it becomes rather abruptly truncated obliquely inwards and backwards, and is again transversely truncated at the posterior border (fig. 1 *b*); the upper half of the single inter-ambulacrum is smooth and undepressed (fig. 1 *a*); its lower half is occupied by the wide anal valley, with its perpendicular sides and large vent, which opens near the surface (fig. 1, *d*); from the sides of the valley two prominent ridges descend to the border, where they form obtuse prominences, the intermediate space being truncated (fig. 1 *a*).

The base is undulated from the convexity of the inter-ambulacra (fig. 1 *b*), and the depressions formed by the ambulacra as they radiate from the peristome; the large mouth-opening is situated nearer the anterior than the posterior border, in a slight depression of the test; the peristome is pentagonal, and its longest diameter is in the transverse direction (fig. 1 *b*). The tubercles at the base are large, and disposed with considerable regularity; at the anterior margin the granules surrounding the areolas form hexagons, as shown in (fig. 1 *e*).

Affinities and differences.—This species is so entirely unlike any of its English congeners that it cannot be mistaken for either of them, the flat, depressed upper surface, the length of the test, which is rounded before and angular behind, the wide, short anal valley, and large, transversely elongated mouth-opening, form a group of characters by which it is separated from them. The length of the test and position of the anal valley, groups it naturally with *E. Goldfussii*, Desor, and *E. pulvinatus*, Cotteau, both from the "Kelloway ferrugineux" of the department of the Sarthe. It is distinguished from the first by the flatness of the upper surface, and the size of the anal valley, and from the latter by the absence of the tumid sides, flat dorsum, and marginal valley, which characterise the French urchins. The like absence of tumidity in the sides of *E. Brodiei* distinguishes this species from *E. dimidiatus*, Phil., of the Coralline Oolite.

Locality and Stratigraphical position.—This nucleolite was collected from the Portland Oolite at Brill, Buckinghamshire, by my friend, the Rev. P. B. Brodie, who has kindly supplied the following note on a section of the Portland beds at that locality to accompany my description of this beautiful new form:

"The occurrence of any of the *Echinodermata* in the Portland Oolite is so rare, that it is desirable to give a short notice of the strata at the locality whence the specimen described by my friend, Dr. Wright, was obtained. The sections at Brill, in Buckinghamshire, are well known from Dr. Fitton's able memoir, 'On the Strata below the Chalk,' and therefore I shall content myself by a very brief account of those which came more immediately under my own inspection, which are in fact identical with those given by that geologist. The summit of the hill is capped by the Lower Green Sand, as stated by Dr. Fitton, but as this seems to be identical with the beds above the Portland at Great Hazeley, whence I procured several small Paludina similar to a species described by Professor

Phillips, in his interesting paper on the 'Iron Sands of Shotover.'* It seems probable that those at Brill and Hazeley are of the same age, and must be classed as estuarine deposits, belonging rather to the Wealden than the Lower Green Sand. It is as well, perhaps, to mention these two localities, because they are not referred to in Professor Phillips's paper. Many years ago I found nodules of iron sand containing Paludinæ in the Vale of Wardour, in Wiltshire, and possibly a more careful examination might serve to identify them with the estuarine sands of Shotover above mentioned.

"The top of the Portland Rock consists of a white or gray calcareous stone, with *Perna mytiloides*, Lamk., *Trigonia gibbosa*, Sow., and *Trigonia incurva*, Sow., which is underlaid by beds of hard grit divided by clay. This is succeeded by a white limestone, seen also in the Vale of Wardour and other places; it contains casts of *Trigonias* and other shells. It is in many respects a remarkable stratum, being in parts of a soft, marly texture, which readily crumbles to pieces when struck with the hammer. A seam of clay with broken shells divides this from a hard, rough, calcareous stone, of a brown colour, used for building purposes, and from this some good specimens of *Perna mytiloides*, Lamk., with the shell attached, may be procured. Between this and the Portland sand there are several coarse bands of stone, more or less calcareous and sandy, with a large preponderance of green particles of silicate of iron; the nodules are full of the characteristic fossils of this formation, viz., *Pecten lamellosus*, Sow., *Trigonia gibbosa*, Sow., *Astarte cuneata*, Sow., *Cardium dissimile*, Sow., a large *Spondylus* with spines, *Panopœa*, *Exogyra*, and *Serpula* (which usually occur together in great perfection on the edges of the stone), a large species of *Mytilus*, with *Modiola*, *Natica elegans*, Sow., *Buccinum naticoides*, Sow. (both of which retain the shell in some specimens), and *Cerithium Portlandicum*, Sow. The shells in this lower division are numerous, and often better preserved than is usually the case in the Portland series; this locality therefore well deserves a careful search. I have little doubt that the *Echinobrissus* came from one of these beds, overlying the Portland sand, as the stone from whence I extracted it agrees exactly in lithological structure therewith. The inferior shelly strata are largely used round Brill for road-mending, and I may add that I found the two specimens of this new urchin in a heap of stone which was placed there for this purpose, at the foot of the hill close to the quarries. The total thickness of the strata exposed above the sand may be somewhere about twenty-five feet.

"I am not aware whether any *Bryozoa* have been previously noticed in the Portland Oolite; but it seems worth while to mention their occurrence at Swindon, near the Reservoir, where I obtained a few specimens in ferruginous sand attached to single valves of *Trigonia gibbosa*, Sow.

* 'Journal of the Geological Society,' vol. xiv, part 3, No. 55, for August, 1858.

NOTES

On Foreign Jurassic species of the genus ECHINOBRISSUS nearly allied to British forms, but which have not yet been found in the English Oolites.

A.—*Species in which the anal valley extends to the apical disc.*

Echinobrissus elongatus, *Agass.* Syn. *Echinobrissus elongatus,* Cotteau and Triger, Échinides de la Sarthe, pl. x, figs. 8—11.

A narrow, oblong, elongated nucleolite, thin at the border, convex before, truncated, thin, and recurved behind; apical disc central; anal valley wide and reaching the disc; ambulacra narrow; zones slightly petaloidal; base concave; mouth excentral, small, and situated in a depression.

Dimensions.—Height, half an inch; length, one inch and one tenth of an inch; breadth, seven tenths of an inch.

Formation.—Calcaire à polypiers (Bathonien) Normandy. Forest marble (Sarthe).

Collections.—M. Deslongchamps. My cabinet; the specimens sent by Professor Deslongchamps.

Echinobrissus crepidula, *Desor.* Syn. *Nucleolites crepidula,* Cotteau, Échinides Fossiles, pl. v, figs. 4—6, p. 68.

A small elongated urchin, very flat, rounded, and narrow anteriorly, dilated and sub-rostrated posteriorly; anal valley elongated, deep, and broad, extending from the disc to the border; mouth pentagonal and sub-medial.

Dimensions.—Height, five millimètres and a half; length, fourteen millimètres; breadth, eleven millimètres.

Formation.—Forest marble of Châtel-censoir (Yonne), where it is abundant only as siliceous moulds of the interior.

Collections.—M. Cotteau. Museum of Paris.

ECHINOBRISSUS AMPLUS, *Agass.* Syn. *Nucleolites amplus*, Agassiz, Catal. raisonné, p. 96.

" A large species, as broad as it is long, convex above, and nearly square; posterior border declined, thin, and emarginate; anal valley extending to the ambulacral summit, which is central; base concave; mouth-opening excentral." Desor.

Formation.—" Marnes à Discoidées (Vésulien) de Wolfliswyl (Argovie); Val de Laufen·

Collections.—Moesch, Mus. Bâle. Coll., Gressly.

ECHINOBRISSUS PLANULATUS, *Roemer.* Syn. *Nucleolites planulatus*, Roemer, Oolit. Gebirges, pl. i, fig. 19, p. 28.

A small elongated nucleolite, remarkable for its extremely depressed dorsal surface; it is rounded before, truncated behind, and has the posterior border slightly emarginated.

Formation.—Upper Coral Rag of Lindner Berges (Hanover).

Collections.—M. Roemer. My cabinet, specimen sent by Professor Roemer.

ECHINOBRISSUS MAJOR, *Agass.* Syn. *Nucleolites major*, Agassiz, Échinoderm. Foss. Suisse, part i, pl. vii, figs. 22—24, p. 46.

A large, quadrate, elongated nucleolite, rounded before, enlarged behind, having the posterior border truncated, and strongly emarginated; base concave; mouth pentagonal, and near the anterior margin.

Dimensions.—Height, seven tenths of an inch; length, one inch and three tenths; breadth, one inch and three twentieths.

Formation.—" Portland inférieur (Astartien Oolitique) de Laufon avec *Pygurus Hartmanni*, Delémont (Jura Bernois)." Desor.

Collection.—M. Gressley.

ECHINOBRISSUS GRACILIS, *Agass.* Syn. *Nucleolites gracilis*, Agassiz, Échinoderm. Foss. Suisse, part i, pl. vii, figs. 10—12, p. 44.

A small, beautiful nucleolite, rounded before, abruptly enlarged behind the disc, emarginated and truncated posteriorly; ambulacra very narrow; anal valley wide and deep; mouth-opening very excentral near the anterior border; summit slightly excentral.

Dimensions.—Height, half an inch; length, seven tenths of an inch; breadth at the widest part, nearly equal to the length.

Formation.—Portlandien inférieur (Astartien) de Rædersdorf Haut Rhin, Porrentruy.

Collection.—M. Gressley. Very rare.

B.—*Species in which the anal valley does not extend to the apical disc.*

ECHINOBRISSUS GOLDFUSSII, *Desmoulins.* Syn. *Echinobrissus Goldfussi*, Cotteau and Triger, Échinides de la Sarthe, pl. xix, figs. 1, 2, p. 86.

A small nucleolite, rounded before, sub-truncated and slightly dilated behind; upper surface convex and inflated; much sloped from the summit to the posterior border; base flat, vertex excentral and anterior; anal valley short, wide, and deep, arched above, expanded below, extending one third of the distance between the border and disc; vent elliptical near the surface; mouth-opening anteriorly excentral; peristome pentagonal.

Dimensions.—Height, half an inch; length, nineteen twentieths of an inch; breadth, nearly eight tenths of an inch.

Formation.—Kelloway ferrugineux, Montbizot, Department of the Sarthe, Largues (Haut Rhin); Launoy (Ardennes); Étage Oxfordien.

Collections.—MM. Cotteau and Triger.

ECHINOBRISSUS PULVINATUS, *Cotteau*, Échinides de la Sarthe, pl. xix, figs. 3, 4, p. 87.

A moderate sized, oblong nucleolite, round before, sub-truncated behind, thick and inflated at the borders, depressed at the upper surface; base sub-concave and slightly undulated; apical disc sub-central, nearer the anterior border; anal valley far removed from the summit, and forming a sulcus in the posterior border; mouth-opening small and excentral.

Dimensions.—Height, eleven twentieths of an inch; length, one inch and one twentieth; breadth, nine tenths of an inch.

Formation.—Kelloway ferrugineux, near Mamers, Sarthe; very rare.

Collections.—MM. Michelin and Cotteau; my cabinet.

Echinobrissus Icaunensis, *Cotteau.* Échinides Foss. de l'Yonne, pl. xlv, figs. 6—8, p. 326.

Test elongated, depressed, narrow before, wider behind; apical disc excentral, nearer the anterior border; anal valley short, wide, extending only half way between the border and disc; vent large and elliptical; base concave; mouth-opening excentral, nearer the anterior border; peristome pentagonal.

Dimensions.—Height, four tenths of an inch; length, one inch and one tenth; breadth, nine tenths of an inch.

Formation.—Kimmeridgien ("Calcaire des environs de Tonnerre et de Chablis), Gray (Haute Marne)," Cotteau; very rare.

Collections.—M. Cotteau, M. Rathier.

Echinobrissus truncatus, *Desor.* Synopsis des Échinides Fossiles, p. 268.

A new species with a very elongated form, nearly uniform in width throughout, and slightly enlarged behind; anal valley, supra-marginal; the entire length of the sulcus seen only when the posterior border is examined.

Formation.—"Portlandien supérieur (Virgulien) d'All près Porrentruy. Très rare." Desor.

Collection.—Mus. Bâle.

Genus—CLYPEUS, *Klein,* 1734.

This genus includes all the large discoidal urchins, with petaloid ambulacra, in which the vent opens at the upper surface into an anal valley; the dorsal portions of the poriferous zones are widely petaloidal; the ambulacral summit is central, or excentral, and when this is the case, the excentricity is always towards the posterior border; the elements of the apical disc are closely soldered together, there are two pairs of perforated genital plates, one single imperforate plate, and five ocular plates, the orbits are in general marginal and visible, and the spongy madreporiform body occupies the centre of the disc.

The base is flat, concave, or undulated, in different species; the mouth-opening is small and lodged in a depression, which is either central or sub-central; the peristome is surrounded by five oral lobes, formed by the terminations of the inter-ambulacra.

This group differs so slightly in all its essential characters from the genus *Echinobrissus,* that I formerly agreed with my late friend, Professor Forbes, to include all the species of Clypeus in the Lamarckian genus *Nucleolites.* After a more detailed study of the comparative anatomy of their tests, taking into consideration the magnitude and development of the long wide petaloidal poriferous zones, and the relation these parts had to the internal organs, I have determined to retain the genus.

Like *Echinobrissus,* the genus *Clypeus* includes two types of structure; in the first, the anal valley extends from the apical disc to the posterior border, this section includes the majority of the species, having for its type *Clypeus Plotii,* Klein. In the second, the anal valley does not extend to the disc, but is separated therefrom by a greater or less undepressed portion of test. The types of the second section are *Clypeus Hugii,* Ag., and *Clypeus subulatus,* Young.

All the species are limited to the Oolitic rocks, and they had their greatest development in the seas which deposited the lower division of the Jurassic series; as the Inferior Oolite, zone of Ammonites Parkinsoni; the Bath Oolite group, and the Cornbrash contain the most of the species. I know of none in the Oxford Clay, and the Coral Rag contains only one.

Section A. *Anal valley extends from the disc to the border.*

A. *Species from the Inferior Oolite.*

Clypeus Plotii, *Klein*. Pl. XXVIII and XXIX.

Polar Stone.	Plot, History of Oxfordshire, tab. ii, figs. 9 and 10, 1677.
Echinites.	Lister, Lapidibus Turbinatis, p. 224, pl. vii, fig. 27, 1678.
— clypeatus.	Llhwyd, Lithophylacii Britannici Ichinographia, tab. xiii, p. 48, No. 971, 1698.
Echinus discoides.	Morton, Natural History of Northamptonshire, p. 233, 1712.
Clypeus Plotii.	Klein, Natural. Disposit. Echinodermat., tab. xii, p. 22, 1734.
— —	Leske, Additamenta ad Kleinii Echinodermatum, p. 157, 1768.
Echinus sinuatus.	Linnæus, Systema Naturæ, by Turton, vol. iv, p. 144, 1801.
Clypeus sinuatus.	Parkinson, Organic Remains, vol. iii, p. 24, pl. ii, fig. 1, 1811.
Galerites umbrella.	Lamarck, Animaux sans Vertèbres, tom. iii, p. 23, No. 15, 1816.
— patella.	Lamarck, Animaux sans Vertèbres, tom. iii, p. 23, No. 14, 1816.
Echinites sinuatus.	Schlotheim, Petrefacktenkunde, i, p. 310, 1820.
Nucleolites patella.	Defrance, Dict. des Sciences Naturelles, tom. xxxv, p. 213, 1825.
Echinoclypeus umbrella.	De Blainville, Diction. des Sciences Naturelles, tom. lx, p. 189, 1830.
— patella.	De Blainville, Dict. des Sciences Naturelles, tom. lx, p. 189, 1830.
Galerites patella.	Deslongchamps, Encyclopéd. Méthodique, pl. cxliii, figs. 1, 2.
— —	Id., Enc., tom. ii, p. 434, No. 14.
Echinoclypeus umbrella.	De Blainville, Manuel d'Actinologie, p. 208, 1834.
Clypeus patella.	Agassiz, Prodrome, Mém. Soc. d'Hist. Nat. Neuchâtel, tom. i, p. 186, 1835.
— —	Agassiz, Échinodermes Fossiles de la Suisse, 1st part, p. 56, tab. v, figs. 4—6, 1839.
— —	Morris, Catalogue of British Fossils, p. 50, 1843.
— sinuatus.	Morris, Ibid.
— angustiporus.	Agassiz, Cat. raisonnée, An. Sc. Nat., tom. vii, p. 156, 1847.
— excentricus.	M'Coy, Annals and Magazine of Natural History, p. 417, 1848.
Nucleolites sinuatus.	Forbes, Memoirs of the Geol. Survey, decade i, 1849.
— —	Wright, Annals and Mag. of Nat. Hist., vol. ix, p. 306, 1851.
Clypeus patella.	Bronn, Lethæa Geognostica, Band. ii, p. 152, tab. xv, fig. 9, 1852.
Nucleolites sinuatus.	Forbes, in Morris's Catalogue of British Fossils, 2d ed., p. 84, 1854.
Clypeus Plotii.	Salter, in Hull's Memoirs of the Geological Survey, 1857.
Clypeus sinuatus.	Desor, Synopsis des Échinides Fossiles, Pl. XXXV, p. 276, 1858.

Dimensions.—Height, one inch and seven tenths; antero-posterior and transverse diameters nearly equal, measuring four inches and four tenths.

Description.—This well-known and widely distributed urchin was first figured by Dr. Plot in his 'History of Oxfordshire,' tab. ii, figs. 9, 10, and was accompanied with the following quaint remarks:

"Of *Brontiæ,* therefore, or *Ombriæ* (call them which you will), we have several sorts in Oxfordshire, which yet all agree in this, that they are a sort of solid irregular hemispheres; some of them oblong, and having somewhat of an oval; others either more elevated, or depressed on their bases. All of them divided into five parts, most times inequal, rarely equal, by five rays issuant from an umbilicus or center, descending from it down the sides of the body, and terminating again somewhere in the base. They are never found in beds together, like some other formed stones, nor that I have yet heard of (says the ingenious Mr. Ray*) in great numbers in one place: but in the latter I must take leave to inform him, that though I think it in the main to be true, yet that at Tangley Fulbrook, and all about Burford, they are found in such plenty, that I believe it were easy in a little time to procure a cart-load of the first sort of them, carefully exhibited in tab. ii, figs. 9, 10, whose innermost texture, though it seem to be nothing more than a coarse rubble-stone, yet is thinly cased over with a fine laminated substance (the plates lying obliquely) much like *Lapis Judaicus.* In form they are flat, depressed upon the basis, in colour generally yellow, their rays made of a double rank of transverse lines, with void spaces between the ranks, visible enough on the top of the stone (fig. 9), but not so distinguishable on the bottom (fig. 10); the whole body of the stone, as well as the spaces included within the rays, being elsewhere filled with annulets much more curiously wrought by nature than by the tool of the graver.

"The center of these rays, by Pliny called modiolus, by Aristotle umbilicus, is never placed on the top of the stone, but always inclining to one side, as that at the bottom does to the other; the axis lying obliquely to the horizon of the stone. Which gave occasion to a learned Society of Virtuosi, that during the late usurpation lived obscurely at Tangley, and had then time to think of so mean a subject, by consent to term it the *Polar-stone*, having ingeniously found out by clapping two of them together, as suppose the figs. 9 and 10, that they made up a globe, with meridians descending to the horizon, and the pole elevated, very nearly corresponding to the real elevation of the pole of the place where the stones are found."†

Klein‡ gave the following diagnosis of this urchin: "Species 1, Plotii; maximus discum referens; Burfordinensis, Hist. Oxon., tab. ii, figs. 9, 10. Luydii prope Fulbrock in agro Oxon. Integra testa intra demissos circulos stellata, superficiem quinque, tæniæ profundæ duplicatæ ac crenatæ et unus altus sulcus lævis in undecim, basin vero quinque sulci angustiores in totidem segmenta dividunt." In tab. xii, this author figured a large

* 'Observations Topograph.,' p. 116.

† Plot's 'History of Oxfordshire,' pp. 90, 91.

‡ 'Naturalis Dispositio Echinodermatum,' p. 22.

Clypeus which was communicated to him by Dr. Heucher from the Royal Cabinet of Dresden; this urchin was described by Leske* in his additions to Klein's Monogragh as a distinct species, under the name *Clypeus sinuatus;* by subsequent authors, *C. Plotii*, Klein, with the author's reference to Plot's figure as the type of the same, is omitted. Although Leske described both species and pointed out the diagnostic differences which he supposed to exist between them, nevertheless Klein's reference to the type of the English species has been overlooked, and Leske's name given to this urchin. Lamarck† introduced still further confusion into the subject by describing the flattened varieties of *Clypeus Plotii*, Klein, under the name *Galerites patella*, and this new specific synonym was adopted by Defrance,‡ Deslongchamps,§ De Blainville,‖ and Agassiz,¶ and is retained by most Continental palæontologists at the present time. As it has been one of my objects to trace the true history of every species described in this work, even at the risk of disturbing a name which has passed unchallenged for nearly a century, justice to Klein renders it imperative that his name should be retained to the urchin which was first figured by Dr. Plot, and that of *Clypeus sinuatus*, Leske, to the specimen contained in the Dresden collection; should a further examination of that urchin show that it is only a tumid variety of *C. Plotii*, Klein, the priority of the latter will still entitle it to be retained as the name of this species.

Although this large buckler-shaped urchin has been well known to naturalists for nearly two centuries, nevertheless no good figure of the test, with details of its structure, has been given until now; this is the more remarkable, when the beauty and abundance of the species is considered, together with its importance in Oolitic geology.

The test exhibits many varieties of form and outline; some of these have received specific names and descriptions by different authors, of which *Clypeus angustiporus*, Agass., and *Cl. excentricus*, M'Coy, are examples. This urchin attained its most typical form and best development in the seas which deposited the beds constituting the zone of Ammonites Parkinsoni of the Inferior Oolite; the specimens found in the Stonesfield Slate, Great Oolite, and Cornbrash are in general smaller, and deviate more or less from the Inferior Oolite forms.

The ambulacral areas on the dorsal surface are narrowly lanceolate; the anterior pair, and single area, are about the same width; but the posterior pair are wider; they are all more or less slightly flexed (Pl. XXVIII, fig. 1 *a*); at the base they form narrow depressed bands, which radiate from the mouth to the circumference (fig. 1 *b*), and give a stellate character to the base of the test.

* 'Additamenta ad Kleinii Dispositionem Echinodermat

† 'Animaux sans Vertèbres,' tom. iii, p. 23, No. 14.

‡ 'Diction. des Sciences Naturelles.'

§ 'Ecyclopéd. Méthodique.'

‖ 'Diction. des Sciences Naturelles.'

¶ 'Echinodermes Fossiles de la Suisse.'

The poriferous zones are broadly petaloidal on the dorsal surface; at the border the pores are as closely approximated as they are at the base (Pl. XXIX, fig. 1 *a*, *b*); about two lines up the sides they become abruptly apart, and continue so throughout the zones; they again gradually approximate in the vicinity of the disc (fig. 1 *a*, *b*); the holes of the inner row are round, those of the outer row are slit-like, and the outer and inner holes of each pair are united by fine fissures (Pl. XXIX, fig. 1 *c*); the intermediate septa having a single row of small granules on their surface; at the base the pores forming a pair are small, and closely approximated; the zones are very narrow, and form wavy lines, in which the bigeminal pores are placed at intervals apart, sometimes they are disposed in rectilineal order, and sometimes arranged in triple oblique pairs; at Pl. XXIX, fig. 1 *g*, I have represented this arrangement of the pores in one of the basal zones, where each small ambulacral plate is seen to be perforated by a pair of pores. As the ambulacral plates are much narrower on the upper surface than they are at the base, the pores are more numerous, and more closely approximated on the dorsal surface, where there are from eight to ten pores opposite each large plate (Pl. XXIX, fig. 1 *c*).

The inter-ambulacral areas are of unequal width, the anterior pair are the narrowest, the single area is the widest, and the posterior pair of intermediate dimensions; there is often a slight depression down the centre of each area in the line of the median suture, which, with the flat petaloidal depression formed by the poriferous zones, produces a series of undulations on the upper surface of the areas (Pl. XXIX, fig. 1 *b*). The single inter-ambulacrum is deeply cleft by the anal valley, which commences narrow at the disc, expands towards the middle, and still more so at the border (Pl. XXIX, fig. 1 *a*). The sides are vertical, and the vent is seen at the extremity of the channel, and is figured in shadow in fig. 1 *a*. The border of the test forms a series of graceful undulations, from the prominence and convexity of the inter-ambulacral and the narrowness of the ambulacral areas. (Pl. XXIX, fig. 1 *a* and fig. 1 *b*, shows the undulation of the border.)

The tubercles on the upper surface are small, and nearly equal in size throughout both areas; those in the ambulacra are arranged in oblique V-shaped rows, and those on the inter-ambulacral plates in nearly horizontal rows, of which there are five or six on each large plate (Pl. XXIX, fig. 1 *c*). At the base, they are more unequal in size, and larger than on the upper surface; in the middle of the area they are smaller; at the sides they are larger, and sometimes the large tubercles are perforated, as shown at fig. 1 *e* and fig. 1 *f*. They are surrounded by deep areolas, and between these depressions the surface of the plates is covered with fine granulations (fig. 1 *e*). It is right to remark, that in the specimens I have hitherto examined the perforation of the large basal tubercles is an exceptional, rather than a general character.

The apical disc is large, and lies in a depression behind the vertex. Its plate-elements are rarely seen separate, except in specimens which have been decomposed, as in this urchin, the genital and ocular plates are all firmly anchylosed together from early age;

the four ovarial holes project into the inter-ambulacral spaces, and the five ocular holes are seen at the apices of the ambulacra (Pl. XXIX, fig. 1 *d*). The madreporiform body occupies the centre of the disc, and presents a fine spongy structure on its surface.

The base is flat, or slightly concave; the basal portions of the inter-ambulacral areas are convex, and separated from each other by narrow, depressed ambulacral valleys (Pl. XXVIII, fig. 1 *b*), which radiate in straight lines from the mouth to the border, the margin of the ambulacra being defined by the narrow poriferous zones.

The mouth is excentral, and situated nearer the anterior than the posterior border (Pl. XXVIII, fig. 1 *b*). The peristome is surrounded by five prominent oral lobes, which are separated from each other by the depressed ambulacra, as they radiate from the mouth. At Pl. XXIX, fig. 1 *h*, another view is given of this quinque-lobed opening.

There is a very marked distinction in the varieties of *Clypeus Plotii* collected from the Inferior Oolite and the Great Oolite; so much so, that they have been considered, by good local observers, to belong to two distinct species. On this point my excellent friend, the Rev. A. W. Griesbach, remarks—

"*Clypeus Plotii.*—I have two urchins on the table, both said to be this species. One of them is a very good specimen from the *Great Oolite*, Kingsthorp, the other an *Inferior Oolite* specimen from Rodborough Hill. These urchins appear to belong to two distinct species, for I think their differences can hardly be less than specific. I have no doubt but you have specimens both from the Great and Inferior Oolite. Pray compare them. I will just say, meanwhile, that in the Inferior Oolite specimen the apical disc is *all but central*, while in the Great Oolite one it is *much nearer* the *posterior margin.* In the Great Oolite specimen the apices of the ambulacra are *deeply sunk below the plane of the test*, while in the Inferior Oolite specimen they are *in the same plane as the test.* And, in the Inferior Oolite specimen, the region of the shell which contains the anal furrow is *very tumid*, and towards the disc *nearly as high as the highest part of the shell;* in the Great Oolite specimen the posterior part of the test corresponding is *extremely and abruptly depressed and flattened.* In general form the Inferior Oolite specimen is high and spherical, the Great Oolite specimen low and flattened. May not these two forms eventually prove to be *C. sinuatus*, Leske, *C. Plotii*, Klein, respectively?"

Affinities and differences.—This large discoidal urchin is so distinct from all other congeneric forms that it can scarcely be mistaken for any of them. Its nearest affinities are with *Clypeus Michelini*, Wr., and *Clypeus Mülleri*, Wr.

It is distinguished from *Clypeus Michelini* by its greater convexity, the wideness of the poriferous zones, the size of the tubercles, and the width of the anal valley. From *Clypeus Mülleri*, Wr., by its orbicular outline, and the absence of the produced, deflected, and truncated posterior border, so characteristic of that species. From *Clypeus Hugii*, Ag., it is distinguished by the extension of the anal valley from the disc to the border; whereas in that species a portion of undepressed test always separates the disc from the valley.

From *Clypeus subulatus*, Young, it is distinguished by its orbicular outline and anal valley; in that urchin the outline is oblong, and the anal valley quite short and marginal. The height and convexity of *Clypeus Agassizii*, Wr., with its shallow anal valley and inflated test, prevent the possibility of mistaking *Clypeus Plotii*, Kl., for that urchin, which replaces it in some of those regions where the latter is absent.

Locality and Stratigraphical position.—The metropolis of *Clypeus Plotii* is the Trigonia grit of the Inferior Oolite, in the zone of Ammonites Parkinsoni; it is extremely abundant in some localities, but rare in others; over the central parts of the Cotteswold Hills it is found in great numbers; where its bed crops out at the surface, as near Naunton Inn, a cartload of weathered Clypei might sometimes be collected. My best specimens were obtained from near Stow-in-the-Wold. I have likewise collected beautiful examples at Rodborough Hill, Scar Hill, Shurdington Hill, Leckhampton Hill, Cleeve Hill, and at Cubberley, Cowley Wood, Pen Hill, Little Rissington, Adlestrop, Northleach, and Hampen, Gloucestershire; in the same zone near Burford, and Sarsden, and in the Stonesfield Slate at Stonesfield, Oxon. Mr. Lycett obtained one specimen from the Fuller's-earth, at Minchinhampton Common; it is found likewise in the Great Oolite at Minchinhampton, Gloucestershire; Kiddington, Oxon; and Kingsthorp, Northampton. Mr. Macneil, after many years' collecting, found only two specimens in the Cornbrash at Trowbridge, Wilts, both of which are now in my cabinet.

The Foreign distribution of this species, according to M. Desor, is "Oolite vesulienne du Kornberg près Frick et Buren près Gensingen (Argovie), Muttenz (Bâle), Porrentruy, Plasne près Poligny, St. André près Salins.

"Grande Oolite de Boulogne-sur-Mer, Chayal (Ardennes), Montanville, Flincy (Meuse), Noviant, Besançon."

Clypeus altus, *M'Coy*. Pl. XXVII, fig. 1 *a, b, c, d, e, f.*

Clypeus	altus.	M'Coy, Ann. and Mag. of Nat. Hist. 2d ser., vol. ii, p. 417, 1848.
Nucleolites altus.		Forbes, in Morris's Catalog. of Brit. Foss., 2d ed., p. 83, 1854.
Clypeus	Davoustianus.	Desor, Synopsis des Échinides Fossiles, p. 55, 1855.
—	altus.	Wright, Stratigraph. Distrib. Ool. Echinoder., British Association Reports, 1856.
—	Davoustianus.	Cotteau, in Davoust, Note sur les foss. spec. de la Sarthe, p. 7, 1856.
—	—	Cotteau, Note sur quelques Oursins de la Sarthe, Bull. de Geol. Soc. de France, 2e sér., t. xiii, p. 650, 1856.
—	—	Cotteau and Triger, Échinides du départ. de la Sarthe, pl. xii, figs. 1—7, p. 62, 1858.

Test sub-circular, broader than long, upper surface evenly convex, high, and sometimes sub-conical; base concave, very much undulated, from the extreme tumidity of the basal portions of the inter-ambulacra; apical disc central; poriferous zones petaloid on the upper two thirds of the dorsal surface; lower third, and basal portion, with parallel rows of unconnected pores; anal valley long, narrow, deep, extending from the disc to the border, fissure-like above, and slightly expanded near the margin; single inter-ambulacrum much deflected and beak-like, truncated at its extremity; mouth-opening small, sub-central, lodged in a deep depression, peristome surrounded by five oral lobes. Greatest diameter of the shell across the middle of the postero-lateral inter-ambulacra.

Dimensions.—Height, one inch and one fifth; antero-posterior diameter, two inches and six tenths; transverse diameter, two inches and nine tenths.

Description.—This beautiful Clypeus attains considerable dimensions, and preserves through all the phases of its development the specific characters enumerated in our diagnosis. It is remarkable for having the upper surface evenly convex, much elevated, or even sub-conical; it is likewise broader across the postero-lateral ambulacra than it is long, its base is more concave, the inter-ambulacral segments of this region are more tumid, and the outline of the basal margin more undulated (fig. 1 *c*, *d*), than in any other species.

The ambulacral areas are narrow at the margin, slightly enlarged at the upper third, and lanceolate at the apex. The poriferous zones in the upper two thirds of the dorsal surface are slightly petaloid; in the lower third the pores are small, parallel, equal, and unconnected (fig. 1 *a*, *c*); in the petaloid portion, the pores of the inner row are round, those of the outer row are slit-like and oblique (fig. 1 *e*); the ambulacral plates are very narrow, there being seven, with a corresponding number of pairs of holes, opposite each large inter-ambulacral plate (fig. 1 *e*).

The inter-ambulacral areas are of unequal width, the anterior pair are the narrowest, the posterior pair the widest, and the single area of intermediate dimensions; they are almost uniformly convex on the upper surface, and present very great inequalities at the base, more so, in fact, than in any other species of the ECHINOBRISSIDÆ. The single inter-ambulacrum is short, curved, much deflected, and truncated; it is deeply cleft by the anal valley, which extends from the apical disc to the margin; this sulcus is in the form of a deep fissure, with vertical parallel walls in the upper half of its length, but moderately expanded in the lower half (fig. 1 *a* and *d*).

The small, narrow, and elongated apical disc is well preserved in most of my specimens, and is situated near the centre of the test, immediately behind the vertex; it is composed of two small, anterior, perforated genitals (fig. 1 *f*), and two larger posterior perforated genitals, with a single, long, imperforate genital plate, which descends into the narrow anal valley; the spongy madreporiform body rises from the surface of the right anterior genital, and extends into the centre of the disc; the five small ocular plates have marginal eyeholes, and the surface of all the discal elements is covered with fine granulations.

This urchin, when viewed in profile, presents a considerable undulation around the border (fig. 1 *c* and *d*), occasioned by the narrowness of the ambulacra, and the extreme tumidity of the marginal and basal portions of the inter-ambulacra. It is as remarkable for the concavity of its base, and the cushion-like structure of its basal inter-ambulacra, as for the evenness and convexity of the dorsal portions of the same segments: the basal portions of the antero-lateral inter-ambulacra are small, and moderately convex (fig. 1 *c* and *d*), the postero-lateral pair are very prominent and tumid, and the single inter-ambulacrum is angular, deflected, and truncated at its extremity.

The small mouth-opening lies in a deep sub-central depression (fig. 1 *b*), and the peristome is surrounded by five small oral lobes; the basal portions of the ambulacra are narrow, and the poriferous zones so small and indistinct that the pores, even with a lens, are seen with difficulty; as they approach the mouth they increase in size and number, and form a series of triple oblique rows in the five petal-like expansions which radiate from the mouth (fig. 1 *b*).

The small tubercles are in general arranged in four horizontal rows on each plate (fig. 1 *e*); they are very uniform in size, and surrounded by sunken areolas, the tubercles at the base and border are larger than those of the upper surface; all the intermediate surface of the plates is covered with fine homogeneous granules, microscopic in size, but regular in their arrangement.

Affinities and differences.—This species resembles some of the smaller varieties of *Clypeus Plotii*, Klein, but is readily distinguished from these, and from all congeners, by its greater proportional breadth across the postero-lateral inter-ambulacra, the narrowness and fissure-like character of the anal valley, the remarkable undulations of the border, the tumidity of the basal inter-ambulacral cushions, and the concavity of the base. It resembles *Clypeus Mülleri*, Wr., in the shortness of the petaloid portion of the dorsal ambulacra, and the narrowness of the anal valley; but the oblong form of *Clypeus Mülleri*, the flatness of its base, and the depression of its dorsal surface, form diagnostic distinctions between them. In the narrowness of its ambulacral petals it resembles *Clypeus Michelini*, Wr., but the flat dorsal and basal surfaces of that species form distinctive characters by which the two urchins are readily distinguished from each other.

Locality and Stratigraphical position.—I have collected this urchin from the Inferior Oolite of Dorsetshire only, in the upper ragstones of that formation, appertaining to the zone of Ammonites Parkinsoni, as defined in the chapter on the Stratigraphical distribution of Oolitic Echinodermata. I have found it at Burton-Bradstock, and Walditch Hill, near Bridport, associated with *Ammonites Parkinsoni*, Sow., *Ammonites* *subradiatus,* Sow., *Stomechinus bigranularis,* Lamk., *Holectypus hemisphæricus,* Desor, *Collyrites ovalis,* Leske, and *Collyrites ringens,* Desml. It appears to take the place of *Clypeus Plotii* in the Parkinsoni zone of Dorsetshire, just as *Holectypus hemisphæricus,* Desor, replaces in the same rock in Dorsetshire *Holectypus depressus,* Lamk., which is so abundant a fossil in this zone of the Inferior Oolite in the Midland counties of England and so rare in the South.

History.—This urchin was first described by Professor M'Coy, in his paper on 'New Mesozoic Radiata;' the species was for a time overlooked, as no figure was given with the description; Professor M'Coy subsequently kindly sent me pen-and-ink outlines of all the species described in that memoir, by which I was enabled to identify the forms supposed to be new. This Clypeus has recently been beautifully figured, and well described as *Clypeus Davoustianus,* by my esteemed friend M. Cotteau, in his valuable monograph on the 'Échinides of the Sarthe.' It was not included in my memoir on the 'Cassidulidæ of the Oolites,' as at the time I could not find a specimen to study. Since the publication of that Prodrome I have collected a very fine series of this species; a comparison of the figures given by M. Cotteau, and the one now published in our Pl. XXVII, fig. 1, leaves no doubt as to the identity of the Sarthe *Clypeus Davoustianus,* Cot., and the Dorsetshire *Clypeus altus,* M'Coy.

Clypeus Michelini, *Wright.* Pl. XXX, fig. 2 *a, b, c, d.*

Nucleolites Michelini.	Wright, Ann. and Mag. of Nat. Hist., 2d series, vol. xiii, p. 161, pl. xii, fig. 6, 1854.
— —	Forbes, in Morris's Catalogue of Brit. Fossils, 2d ed., additional sp. of Echinodermata, 1854.
— —	Wright, Report Oolitic Echinod., Brit. Assoc. Reports, 1857.
Clypeus Michelini.	Desor, Synopsis des Échinides Fossiles, p. 277, 1858.

Test circular or oblong, discoidal and much depressed, posterior border produced, truncated and slightly deflected in old individuals; ambulacral areas narrowly lanceolate; poriferous zones narrow, only slightly petaloid on the dorsal surface, vertex and apical disc nearly central; anterior half of the upper surface convex, posterior half much declined; anal valley narrow above, diverging below, extending from the apical disc to the border; base flat, slightly concave; mouth excentral, peristome with five small lobes; postero-lateral inter-ambulacral areas slightly tumid at the base.

Dimensions.—Height, nine tenths of an inch; antero-posterior diameter, three inches and a quarter; transverse diameter, two inches and one fifth.

Description.—The outline of this urchin varies in different individuals, and likewise in the same individual at different periods of life; its most typical form is oblong, convex anteriorly, produced and truncated posteriorly, and enlarged in the region of the postero-lateral inter-ambulacra; in others the circumference is nearly circular, and in some few transversely oval; the first form is, probably, characteristic of adult life, as the elongation and truncation of the single inter-ambulacrum are markedly shown in the only two large specimens I have seen of this rare species. In all the test is very flat; the anterior half is gently and nearly equally convex, and the posterior half much declined towards the posterior border. The ambulacral areas are narrow, the anterior one most so; the antero-lateral and postero-laterals are about the same width; they have a lanceolate form, and are composed of very narrow plates; about three tenths of an inch above the margin, the pores slightly diverge, and continue about the same width apart until they approach the apical disc; the distance between the rows of pores in this species is less than in any other known Clypeus, and forms one of its diagnostic characters; in all the specimens I have examined the ambulacral areas are likewise slightly elevated above the general surface of the test. The inter-ambulacral areas are of unequal width, the antero-lateral pair are the narrowest, they are, however, about nine times the width of the anterior single ambulacral area; the postero-lateral pair are three tenths of an inch wider than the antero-laterals, and the single inter-ambulacrum is about the same width as the latter. The anal valley extends from the apical disc to the posterior border; it is very narrow, with deep perpendicular sides above, which become shallow and expanded below; the postero-lateral inter-ambulacra are enlarged at the margin; the single inter-ambulacrum is considerably produced, its posterior border is broadly truncated and slightly deflected, within which the expanded sides of the anal valley are excavated.

The base is nearly flat; the elevations are produced by the prominence of the postero-lateral inter-ambulacra, and the deflection of the single inter-ambulacrum. The small mouth-opening is excentral, and placed nearer the anterior than the posterior border; the peristome is surrounded by five small oral lobes, which make inconsiderable prominences at the base. The apical disc is small, and absent in most of my specimens; in one only is it preserved. The genital plates are nearly equal sized; the anterior and posterior pair are perforated, and the single plate is imperforate. The madreporiform tubercle rests on the right anterior plate, and extends into the middle of the disc. The ocular plates are small, and firmly wedged between the disc and summits of ambulacra; the eyeholes are large, and, with the four genital holes, form a circle of perforations around the circumference of the disc.

Affinities and differences.—*Clypeus Michelini,* in its oblong form, truncated posterior border, and narrow anal valley, resembles *C. Mülleri,* Wr.; but is readily distinguished from the latter by the form, narrowness, and structure of the ambulacral areas; in *C. Mülleri* they are expanded and petaloid, and in *C. Michelini* they are narrow and lanceolate; the pores at no point are at any great distance apart; the anal valley in both species extends from the apical disc to the margin, but in *Clypeus Michelini* it is more expanded below and deeper above than in *Clypeus Mülleri.*

I have now before me *Clypeus angustiporus,* Ag., from a coarse Oolitic rock (Bradfordien?) near Metz, collected by M. Terquem, and kindly sent me by M. De Lorière; this urchin appears to be a variety of *Clypeus Plotii;* from which *C. Michelini* differs in many particulars. In the French urchin the apical disc is excentral, the anal valley wide above and not much expanded below, the ambulacral areas are narrow, and the test declines gradually from the vertex to the anterior border, which forms a rather acute angle; the base is undulated, and the mouth-opening nearly central; these characters distinguish it from our urchin.

Clypeus Michelini differs so widely from all the varieties of *Clypeus Plotii* with which I am acquainted, that it cannot possibly be mistaken for either of them, if proper care be taken when a comparison is made between them.

Locality and Stratigraphical position.—I have collected this species chiefly from the Freestone beds of the Inferior Oolite at Wallsquarry and Nailsworth, Gloucestershire; the specimens figured in Pl. XXX, were cut out of the centre of a block of building stone; the Oolitic grains were imbedded in the plates of the test, and have in some measure injured their surface. I found two small specimens in the zone of Ammonites Humphriesianus, in a sandy bed of this middle division of the Inferior Oolite at Cleeve Hill, near Cheltenham, where it was associated with *Ammonites Brongniarti,* Sow., *Am. Humphriesianus,* Sow., *Am. Brocchii,* Sow. Mr. Reed, of York, collected several specimens *germinans* from the Inferior Oolite at Whitwell, Yorkshire; one of these, kindly given me by that gentleman, I have figured in Pl. XXVI, fig. 2. It was associated with *Stomechinus germinans,* Phil., *Trigonia costata,* Sow., *Gervillia Hartmanni,* Münst., and other Inferior Oolite shells.

B. *Species from the Great Oolite.*

Clypeus Mülleri, *Wright.* Pl. XXXIII, figs. 1, 2, 3, 4, 5, 6.

Nucleolites Soloduringus. Wright, Ann. and Mag. of Nat. Hist., 2d ser., vol. ix, p. 305, 1851.
— — Forbes, in Morris's Cat. of Brit. Foss., 2d ed., p. 84, 1854.
— — Wright, Report on Brit. Ool. Echinodermata, Brit. Assoc. Report, 1857.

Test oblong, posterior border much produced, deflected, and truncated; ambulacral areas largely petaloidal, with their apices closely approximated; apical disc and vertex excentral posteriorly, anal valley narrow, acutely lanceolate, with vertical walls, extending from the disc to the border; base concave, mouth-opening sub-central, peristome surrounded by five prominent oral lobes.

Dimensions.—Large specimen from the Forest Marble. Antero-posterior diameter, three inches and a quarter; breadth, three inches and three tenths.

Average-sized specimen from the Great Oolite. Height, eight tenths of an inch; antero-posterior diameter, two inches and a quarter; breadth, two inches and three twentieths.

Description.—This beautiful Clypeus was first found by my esteemed friend S. P. Woodward, Esq., in the Great Oolite near Cirencester, and was referred by him to *Clypeus Solodurinus*, Ag. In this opinion I formerly concurred, and described it under that name in my memoir on the 'Cassidulidæ of the Oolites,' already referred to in the synonyms of this species. Having discovered a marly vein in the Great Oolite which contained a number of specimens, I had an opportunity of studying this urchin in different stages of development; from this examination I ascertained that our original determination could not be maintained, as the three specific characters insisted upon by M. Agassiz, namely, the angular and truncated form of the posterior border, the nearer approximation of the vent to the summit, and the possession of a very thick test ("Le test est assez épais et recouvert d'une granulation assez uniforme sur toutes les parties intactes"*), were characters which did not hold good in the suite of specimens collected. I therefore determined to describe it as a distinct species, associating with it a name most justly esteemed by all physiologists.

Clypeus Mülleri has an oval form (fig. 2 *a*); rounded before, and slightly truncated behind; the test is very thin, and on that account is not often well preserved, the upper surface is flat and much depressed, it slopes more towards the posterior than the anterior border; the marginal fold is rounded, and the sides are tumid in proportion to the height of the test (fig. 2 *c*).

The ambulacral areas are narrowly lanceolate, nearly of equal width, and closely approximated around the disc; the dorsal portions of the poriferous zones are widely petaloid, each petal has an elegant leaf-like form, being narrow below, expanded in the middle, and lanceolate above; for a short distance above the border, the pores forming a pair lie close together (figs. 1 and 3), then gradually become wider apart, until they attain their maximum separation in the middle of the dorsal surface; from this point they again gradually approximate until they lie close together at the apex. The form of the ambulacral petals (fig. 2 *c*) is one of the diagnostic characters of this species when compared with *Clypeus Plotii;* in the latter the separation of the pores takes place much nearer the border than in *Clypeus Mülleri;* they likewise taper more towards the apex, and form a much more graceful figure on the upper surface of the shell than they do in that species.

* 'Échinodermes Fossilles de la Suisse,' prem. partie, p. 35.

The holes of the inner row are round, those of the outer row in the form of long slits (figs. 5 and 6); there is a narrow space external to the inner row (fig. 5), beyond that the slit commences and passes transversely across the zones (fig. 6), where it glides into the outer hole; one row of small granules occupies the space external to the inner row of holes (fig. 6), and on the upper surface of the septa dividing the pairs of pores a row of granules is disposed with great regularity (fig. 6); the ambulacral plates are narrow above and broader below; on the upper surface there are seven pairs of pores opposite one large inter-ambulacral plate, and at the base there are four pairs of pores opposite one large plate. The basal portions of the poriferous zones are narrow, and lie in shallow depressions of the surface; for about three fourths of the distance between the border and mouth-opening, the pairs of pores are placed wide apart, at the inner fourth they become more numerous and are disposed in close-set, triple, oblique pairs, which form a penta-phylloid floscelle around the mouth (fig. 2 *b*, fig. 3 *b*).

The inter-ambulacral areas are of unequal width; the anterior pair are the narrowest (fig. 2 *a*), the posterior pair the widest (fig. 2 *a*), and the single inter-ambulacrum about the width of the latter; this area is slightly produced, deflected, and abruptly truncated posteriorly.

The anal valley extends from the disc to the border; it is a narrow, lanceolate depression, with vertical sides (fig. 2 *a*, fig. 1), which gradually expands from the apex to the border; the vent opens at the extreme end of the valley beneath the disc, and the sides of the channel bulge slightly outwards to give increased space to the intestinal aperture: the base is nearly flat, and the inter-ambulacral segments form only inconsiderable elevations (fig. 2 *b*); the surface of the plates is covered with tolerably regular rows of very small tubercles, encircled by microscopic granules, the fineness and minuteness of the sculpture on the plates is therefore another character (fig. 5) by which it is distinguished from *Clypeus Plotii;* like other Clypei, the tubercles of the base are larger than those on the dorsal surface.

The vertex is excentral and posterior (fig. 2 *c*), and immediately behind it is placed the apical disc; which is small and closely wedged in between the apices of the ambulacra; the disc is composed of two pairs of perforated genital plates, the posterior being larger than the anterior pair; the large, spongy, madreporiform body occupies the center of the disc, and extends as far as the ocular plates (fig. 4), which are small and scarcely visible without the aid of a lens; their minute marginal orbits are seen opposite the apices of the ambulacra.

The mouth-opening is sub-central, nearer the anterior than the posterior border (fig. 2 *b*); the peristome is surrounded by five small prominent lobes, formed by the terminations of the inter-ambulacra; between the oral lobes the poriferous zones assume a depressed, leaf-like figure, freely perforated in this region for the passage of tubular organs, which, in this species, appear to have been very numerous around the mouth.

Affinities and differences.—*Clypeus Mülleri* more closely resembles *Clypeus Plotii* than any other English species; having affinities with it in the form and structure of the ambulacra, the extent and narrowness of the anal valley, and the depression of its dorsal surface. It is distinguished from *C. Plotii*, however, by its oblong figure, truncated posterior border, shorter and more graceful petaloidal ambulacra, finer and more minute sculpture on the plates, a flatter base, with smaller tubercles thereon. The large specimen of *Clypeus Mülleri* (fig. 1) very much resembles *Clypeus Michelini*, but the widely petaloidal character of the ambulacral areas in the former species present a great contrast to the structure of the homologous portion of the test in the latter urchin, and serve to distinguish them from each other; whilst the depression of the dorsal surface, the narrowness of the anal valley, the smallness of the apical disc, and the microscopic sculpture on the test, assimilate the two forms closely together.

It is distinguished from *Clypeus Solodurinus*, Ag., by having a much flatter under surface, with inconsiderable undulations of the inter-ambulacra; whilst, according to Agassiz, in the Swiss urchin, "La face inférieure est régulièrement ondulée par suite de la dépression des ambulacres." The test in *C. Mülleri* is likewise extremely thin, the sculpture fine, and almost microscopic; whilst in *C. Solodurinus*, "Le test est assez épais, et recouvert d'une granulation assez uniforme sur toutes les parties intactes."

Locality and Stratigraphical position.—I collected this Clypeus from the white marly vein which traverses the upper region of the Great Oolite in some parts of Gloucestershire, as near Cirencester, near Northleach, at Salperton tunnel, Great Western Railway, near Minchinhampton, and near Cowley Wood; in all these localities it was associated more or less abundantly with *Echinobrissus Woodwardi*, Wr. Mr. Frederick Bravender collected the fine large specimen figured in Pl. XXXIII, fig. 1, from the Forest Marble near Cirencester. The Rev. A. W. Griesbach found one specimen in the Cornbrash of Rushden, Northamptonshire, where it is extremely rare, as the specimen which my kind friend has communicated is the only one he has seen in that locality. M. Bouchard-Chantereaux sent me a specimen which he collected from the Great Oolite near Boulogne-sur-Mer.

History.—This urchin was first discovered by Mr. S. P. Woodward, in the Great Oolite near Cirencester; it was subsequently described in my memoir on the 'Cassidulidæ of the Oolites' as *Nucleolites Solodurinus*, and is now figured for the first time as *Clypeus Mülleri*. I dedicate the species to the memory of Jöhannes Müller, late Professor of Physiology in the University of Berlin, whose profound observations on the anatomy, physiology, and metamorphoses of the Echinodermata have thrown so much new and important light on the natural history of this class of the Animal Kingdom.

SECTION B. *Anal valley does not extend from the border to the disc.*

A. *Species from the Inferior Oolite.*

CLYPEUS HUGII, *Agassiz*. Pl. XXX, fig. 1 *a, b, c, d, e, f.*

CLYPEUS HUGII.	Agassiz, Échinodermes Foss. de la Suisse, 1e Partie, tab. x, fig. 2—4, p. 34, 1839.
— —	Agassiz and Desor, Cat. rais. des Éch. Ann. Sc. Nat., 3 série, tom. vii, p. 156, 1847.
— —	D'Orbigny, Prod. de Pal. Strata, t. i. p. 290, No. 496, 1850.
NUCLEOLITES HUGII.	Forbes, Mem. of the Geol. Surv. of Great Britain, Decade i, description of Pl. ix, 1850.
— —	Wright, Ann. and Mag. of Nat. Hist. 2d series, 1851, vol. ix, p. 303.
— —	Forbes, in Morris's Catalogue of Brit. Fossils, p. 84, 1854.
CLYPEOPYGUS HUGII.	Desor, Synopsis des Échinides Fossiles, p. 274, 1857.
ECHINOBRISSUS HUGII.	Cotteau and Triger, Échinides du département de la Sarthe, pl. vi, fig. 10—12, p. 58, 1858.

Test sub-orbicular, dorsal surface convex; apical disc central; ambulacral areas narrowly petaloid in the upper two thirds of the dorsal surface; anal valley short, and wide, occupying the lower half of the area; a considerable portion of undepressed test between the disc and valley, single inter-ambulacrum produced and deflected; base nearly flat, mouth-opening sub-central, nearer the anterior than the posterior border, peristome pentagonal, surrounded by five oral lobes; a penta-phylloid floscule around the mouth.

Dimensions.—Height, one inch; length and breadth nearly equal, two inches and one eighth.

Description.—All the specimens of this urchin I examined before the fine example figured in Pl. XXX, were small, and resembled *Echinobrissus*, but in this urchin the characters of *Clypeus* are well marked; the test is circular, being nearly as long as it is broad; it is rounded before (fig. 1 *a*), and slightly rostrated behind, by the prominence and deflection of the single inter-ambulacrum (fig. 1 *b*); the upper surface is uniformly convex (fig. 1 *c*), in the figured specimen it is rather conical, rising high at the vertex, and declining rapidly on all sides, more especially towards the posterior border; the base is flat or slightly concave, and the basal portions of the inter-ambulacra form prominent undulations between the narrow ambulacra (fig. 1 *b*, *c*). The ambulacral areas are narrowly lanceolate, the anterior pair curve gently upwards and outwards, and the posterior pair upwards and inwards; the poriferous zones are narrowly petaloid three fourths of their length between the border and disc; at the lower fourth the pores forming a pair are closely approximated, and the rows are very narrow; above this point the pores of the inner row are round, those of the outer row in the form of oblong slits (fig. 1 *e*), which are connected with the inner row by fine sutures; the transverse sulci disappear some distance above the border, the pores then become simple, oblique, and wider apart; in the basal portion of the zones the pores are minute and far apart, and their track is only traced by the depression formed by the ambulacra near the mouth-opening; around the peristome (fig. 1 *b*) the pores become more numerous, and form five leaf-like expansions. The inter-ambulacral areas are of unequal width, the anterior pair are the narrowest, the single area the widest, and the posterior pair of unequal dimensions (fig. 1 *a*); the anterior border is obtusely rounded, the sides swell gradually outwards to the junction of the posterior pair with the single area, the widest part of the test is in the direction of a line passing transversely across the vertex; the single inter-ambulacrum is slightly produced, deflected, and truncated (fig. 1 *a*, *d*); the anal valley is short and wide, and occupies the lower half of the inter-ambulacrum (fig. 1 *a*, *c*, *d*); between the upper portion of the valley-arch and disc the test is undepressed (fig. 1 *a*); the vent occupies the extreme termination of the valley, and its perpendicular sides are scooped out (fig. 1 *d*) to afford greater space for the passage of the intestinal tube and the closure of the aperture by its circle of anal plates (Pl. XLI, fig. 1).

The apical disc is small, and its elements so intimately soldered together that their separate study is impossible in the specimen figured; the disc, moreover, is so much covered over by the madreporiform body that the sutures are all concealed (fig. 1 *f*). In another small specimen the disc is composed of two anterior and two posterior perforated ovarial plates, and a single imperforate ovarial; the five ocular plates are very small and their orbits marginal.

The test is moderately thick, and the surface of the plates is covered with several horizontal rows of small tubercles (fig. 1 *e*); the base of each is encircled by a sunken areola, and the intermediate portion delicately sculptured with microscopic granules (fig. 1 *e*); the tubercles at the base are only a little larger than those on the upper surface.

The base is flat, slightly concave, or undulated, the ambulacra form straight valleys, and the inter-ambulacra moderately convex elevations; the prominence of these undulations and the deflection of the inter-ambulacrum are greater in proportion in small individuals. The mouth-opening is excentral, being situated near the junction of the anterior with the middle third of the antero-posterior basal diameter; the pentagonal peristome is surrounded by five lobes, and the terminations of the ambulacra form five leaf-like expansions, or a penta-phylloid floscule in which the pores are arranged in triple oblique ranks.

Affinities and differences.—The general outline of some of the smaller specimens of this urchin resembles *Echinobrissus orbicularis*, but the structure of the ambulacra, and of the apical disc, the size and position of the anal valley, together with the undepressed portion of test between the apex of the valley and disc, readily distinguish it. The larger form (fig. 1 *a*) differs so entirely from other Clypei that it cannot be mistaken for any of its congeners, whilst its orbicular outline, petaloidal ambulacra, small solidified apical disc, and mouth-opening provided with oral lobes, justify its position among the Clypei rather than with *Echinobrissus*, among which I formerly placed it.

Locality and Stratigraphical position.—I have collected *Clypeus Hugii* in the Lower Trigonia Grit, zone of Ammonites Parkinsoni Inferior Oolite, at Rodborough Hill, Shurdington Hill, Leckhampton Hill, and Ravensgate Hill; the large figured specimen was found at Shurdington Hill. I have collected many specimens from the Trigonia Grit at Hampen; many years ago it was found in considerable abundance in the upper ragstones of the Inferior Oolite with *Trigonia costata* at Charlcombe, near Bath. The Hampen specimens are associated with *Pedina rotata*, Wr., *Hyboclypus ovalis*, Wr., *Holectypus depressus*, Lamk., and *Clypeus Plotii*, Kl., with several species of Conchifera characteristic of that zone of life, as *Trigonia costata*, Sow., *Pecten symmetricus*, Mor., *Tancredia donaciformis*, Lyc., and *Quenstedtia oblita*, Phil., together with Anthozoa, as *Anabacia orbulites*, Lamx.

The foreign distribution of *Clypeus Hugii*, is, according to M. Desor, "Marnes à Discoïdes (Vesulien), de Hornussen et de Bozen (Argovie), des environs d'Olten, du Mont Terrible."

In Switzerland, he adds, this species is the faithful companion of *Holectypus depressus*, *Collyrites ovalis*, and *Echinobrissus clunicularis*, and one of the most characteristic fossils of the Marnes à Discoïdes, the zone of Ammonites Parkinsoni Inferior Oolite, so that its statigraphical position and palæontological associates is the same in the Alpine regions of Switzerland, as in the Cotteswold Hills.

The true zone of this species in the department of the Sarthe is yet uncertain, the only specimen found was collected near Mamers. I have no doubt its bed will be found to be the Inferior Oolite.

CLYPEUS AGASSIZII, *Wright*. Pl. XXXI and XXXII.

NUCLEOLITES AGASSIZII.	Wright, Ann. and Mag. of Nat. Hist., 2d series, vol. ix, p. 308, Pl. iii, fig. 3 *a—c*, 1851.
— —	Forbes, in Morris's Catalogue of Brit. Foss., 2d ed. p. 84, 1854.
CLYPEUS AGASSIZII.	Desor, Synopsis des Échinides Fossiles, p. 278, 1857.
— —	Davoust. Note sur les Fossiles spéciaux á la Sarthe, p. 25, 1856.
— —	Cotteau and Triger, Échinides du département de la Sarthe, pp. 16 and 61, pl. iii, fig. 1; pl. ix, fig. 9; pl. ix, fig. 1—3.

Test large, hemispherical, or sub-conoidal; margin sub-circular; a little longer in the antero-posterior diameter; rounded before, slightly rostrated, and truncated behind; vertex central, apical disc excentral, and inclined backwards; ambulacral areas very narrow; poriferous zones widely petaloid and conjugate from above the margin to the disc; at the margin and base, pores simple, non-conjugate, and scarcely visible; near the mouth more numerous and apparent, and arranged in triple oblique pairs; vent oblong, and near the surface; anal valley very shallow, commencing in the middle of the single inter-ambulacrum; an undepressed portion of test between the vent and disc, sometimes sulcated in the middle; base flat, or slightly undulated; mouth-opening large, subcentral; peristome surrounded by five prominent lobes; dorsal tubercles nearly microscopic; basal, a little more conspicuous.

Dimensions.—Height, two inches and one quarter; antero-posterior diameter, four inches and one fifth; transverse diameter, four inches.

Description.—The large size, the hemispherical or sub-conoidal form of the upper surface, the flat base, and superficial anal valley, readily distinguish this magnificent species from all other Clypei. The outline of the margin is nearly circular, the antero-posterior being a little more than the transverse diameter; the test is rounded before, and slightly rostrated, and truncated behind; the upper surface assumes a conoidal figure (Pl. XXXII, fig. 1, *a*); the vertex is central, and the test declines more towards the posterior than the anterior border.

The ambulacra are long, narrow, and lanceolate; the anterior area is straight; the antero-lateral pair describe an *f*-shaped curve on the sides of the test (Pl. XXXII, fig. 1, *a*); and the postero-lateral curve forwards upwards and inwards at the posterior surface (Pl. XXXII, fig. 1, *b*).

The poriferous zones are very large, and widely petaloid on the upper surface (Pl. XXXI, fig. 1, *a*); they are formed of an inner row of small, simple, round, or oval pores, which extend equidistant from the margin to the disc, and an external row, of long, narrow, transverse pores, connected with the inner row by conjugate sulci; the septa between the transverse pores support, on their upper surface, a regular row of small tubercles (Pl. XXXII, fig. 1, *c*). Near the marginal fold the pores of the outer row are round, like those of the inner row, and form narrow zones of close-set pores, only apparent by faint depressed lines, which mark the track of the zones from the border to the mouth; near the peristome the pores become more numerous, and here form a series of triple oblique rows of pairs. Pl. XXXII, fig. 1, *d*, represents one of the basal ambulacral areas, highly magnified (Pl. XXXI, fig. 1, *b*).

The inter-ambulacral areas are of unequal width at the margin; the anterior pair are the narrowest, the posterior pair are wider, and the single area is the widest; they are uniformly convex on the upper surface, and are formed of very large pentagonal plates, bent in the middle; each plate supports four horizontal rows of small tubercles, surrounded by sunken areolas, and having the inter-tubercular surface covered with fine, microscopic, homogeneous granules. Pl. XXXII, fig. 1 *c*, exhibits the ambulacral plates, poriferous zones, and two inter-ambulacral plates magnified three diameters, and shows that there are seven pairs of pores opposite each large plate.

The under surface is flat, and the basal portions of the inter-ambulacra are only slightly cushioned; the tubercles in this region are larger, and not so regularly arranged in rows as on the upper surface (Pl. XXXI, fig. 1 *b*), but are scattered more promiscuously over the surface.

The height of the test, and the excentral position of the apical disc, inclined backwards behind the vertex, occasions the curvature in the lateral ambulacra already described (Pl. XXXII, fig. 1 *a*). The disc is small, in proportion to the size of the test (Pl. XXXI, fig. 1 *a*), and is composed of two anterior, and two posterior perforated ovarial plates, and a single imperforate plate. The madreporiform body covers all the centre of the disc, and the five ocular plates are only indicated by their marginal orbits at the apices of the ambulacra; the elements of the disc are closely soldered together, and only occasionally seen distinct in some decomposed specimens.

The dorsal portion of the single inter-ambulacrum, when viewed posteriorly (Pl. XXXII, fig. 1 *b*), presents a triangular figure; the border forms the base, and the two postero-lateral-ambulacra the sides of the triangle; near the middle of this space is placed the oval vent, which opened near the surface (fig. 1 *b*); the anal valley, is a very shallow depression, from its sides, two nodulated ridges descend downwards and outwards towards the border, the plane of the intermediate space being a little beneath the general plane of the test (fig. 1 *b*). In some smaller specimens there is sometimes a narrow depression which passes upwards from the summit of the arch above the anal valley towards the disc, which is effaced in the large type specimen (fig. 1 *b*); in this urchin the space between the upper border of the opening and the disc is occupied to the extent of one inch by a smooth, slightly depressed portion of test; which, added to the oval vent, shallow valley, and superficial depression beneath, form a group of characters which well characterise this noble urchin; in the fine large specimen figured by my friend M. Cotteau from the Inferior Oolite of the Sarthe, a narrow sulcus extends from the disc to the summit of the anal arch.

The mouth-opening is large and sub-central (Pl. XXXI, fig. 1 *b*); it has a pentagonal form, and the peristome is surrounded by five large, prominent, oral lobes, formed by the terminal folds of the inter-ambulacra; alternating with the lobes, the five ambulacra form a depressed penta-phylloid floscule around the mouth opening, which imparts a marked stellate character to the flat base of this Clypeus.

Affinities and differences.—This fine species is distinguished from its congeners by its elevated, sub-conoidal, dorsal surface, its flat base, its excentral apical disc, declining towards the posterior border, its short, shallow, anal valley, and oblong vent. In some specimens the anal valley is more developed than in our large fine type urchin; this is apparent in two other individuals I possess, and M. Cotteau has made the same remark on some of the specimens which he has examined from the Sarthe: "Suivant, M. Wright, cette ouverture est à fleur du test, presque superficielle (*nearly superficial*). Ce caractère n'existe pas toujours, et dans plusieurs de nos exemplaires, notamment dans celui que nous avons fait représenter, l'anus s'ouvre dans un sillon aigu, au milieu d'une depression très-apparente de l'inter-ambulacre-postérieur; mais cette différence ne nous a pas empêché de le réunir au *Clypeus Agassizii*. Les échantillons d'Angleterre présentent eux-mêmes quelques traces de sillon et appartiennent certainement au même type que les nôtres." *

Locality and Stratigraphical position.—This urchin has hitherto been found only in the upper ragstones of the Inferior Oolite, near Bridport, in the zone of Ammonites Parkinsoni, at Barton-Bradstock, and Walditch Hill; its associates in the same bed are *Clypeus altus*, M'Coy; *Holectypus hemisphæricus*, Desor; *Stomechinus bigranularis*, Lamk.; *Collyrites ringens*, Desml.; *Collyrites ovalis*, Leske; *Hyboclypus gibberulus*, Ag.; *Ammonites Parkinsoni*, Sow.; *Ammonites subradiatus*, Sow.; *Trigonia costata*, Sow.

History.—First figured and described in my memoir on the Cassidulidæ of the Oolites 'Ann. and Mag. of Nat. Hist.', for 1851. It has recently been beautifully figured and well described by MM. Cotteau and Triger, in their fine monograph 'on the Échinides' of department of the Sarthe.

* Cotteau and Triger, Échinides du département de la Sarthe, p. 17, 1858.

Clypeus rimosus, *Agassiz*.

Clypeus rimosus. Agassiz and Desor, Catalogue raisonnè des Échinides des Sciences Naturalles, 3e serie, tome vii, p. 156.
— — Desor, Synopsis Échinides Fossiles, p. 277.

This urchin was entered in the catalogue raisonnè as, "Especc plate, discoide, à ambulacres costulès, Terr., Jurass. du Gloucestershire, Deluc;" in the 'Synopsis des Échinides Fossiles,' M. Desor gave the following detailed diagnosis of it: "Species discoidal, slightly convex, subrostrated posteriorly; ambulacral summit central; anal valley very narrow, extending to the apical disc; ambulacral petals convex and prominent, with very large poriferous zones, which equal in width the inter-poriferous spaces; base undulated, peristome excentrally forwards; the pores disposed in double ranks in the phyllodes; oral lobes small and not approximated." M. Desor, in a note, adds, "by its general form, as well as by its costulated petals, this species approaches much to *C. Michelini*, Wr., but the poriferous zones, instead of being distinguished by their narrowness, are remarkable for their breadth. Should it happen to be demonstrated by a series of examples that this character is not constant, it would be possible to unite these two species."

After a careful examination of all our Oolitic Clypei, with the view to identify M. Deluc's specimen, which was said to have been collected from the Inferior Oolite of Gloucestershire, I have been unsuccessful.

Long before the publication of M. Desor's Synopsis, it occurred to me that *C. rimosus* might be a variety of *C. Michelini,* one character, however, pointed out in the diagnosis, "poriferous zones very large, equalling the inter-poriferous space," is sufficient to prove that this is not the case, seeing that *C. Michelini* is as remarkable for the narrowness of the petaloid portion of the poriferous zones, as *C. rimosus* is for their breadth, and this character is constant in the large series of specimens I have examined. The breadth of the poriferous zones establishes an affinity with *C. Mülleri*, but in that species the test is oval, the ambulacra are on the same plane with the inter-ambulacra and not costulated as in *C. rimosus.* It is probable that this urchin may prove to be a depressed variety of *C. Plotii.*

Clypeus subulatus, *Young and Bird.* Pl. XXXIV, fig. 1 *a, b, c, d, e, f, g.*

Echinites subulatus.	Young and Bird, Geol. Surv. of the Yorkshire Coast, pl. vi, fig. 11, p. 214, 1827.
Clypeus emarginatus.	Phillips, Geology of Yorkshire, pl. iii, fig. 18, p. 127, 1829.
— —	Morris's Catalogue of British Fossils, p. 50, 1843.
Nucleolites emarginatus.	Forbes, Memoirs of the Geological Survey, Decade 1, descrip. pl. i.
— —	Wright, Ann. and Mag. of Nat. Hist., 2d ser. vol. ix, p. 310, 1851.
Pygurus emarginatus.	Desor, Synopses des Échinides Fossiles, p. 316, 1857.

Test large, oblong, and much depressed; sides equally declining; vertex and apical disc nearly central; ambulacra narrowly lanceolate; poriferous zones petalloid, on the upper three fourths of the dorsal surface; simple, in the lower fourth; anal valley short and deep, far removed from the disc, and occupying the lower third of the area; anterior border rounded; posterior border produced, rostrated, and deflected; base concave; mouth subcentral; basal inter-ambulacra much cushioned; margin gently undulated; tubercles small, and disposed in rows.

Dimensions.—Large specimen, fig. 1 *a, b.* Height, one inch; antero-posterior diameter, three inches and four tenths; transverse diameter, three inches and one fifth. Smaller specimen, fig. 1 *c, d.* Height, nine tenths of an inch; antero-posterior diameter, two inches and six tenths; transverse diameter, two inches and six tenths.

Description.—This beautiful Clypeus has hitherto been found only in the Coralline Oolite of Yorkshire, and was first described from that formation by the Rev. George Young, in his 'Survey of the Yorkshire Coast.' The figure given in that work is very bad, but the description is sufficiently accurate to identify the species: "The dorsal surface has the same elegant markings as No. 5 (*Pygurus pentagonalis*), but the petals are rather awl-shaped than lanceolate, from which peculiarity we name it *Echinites subulatus.* The middle part of each petal forms a slight ridge; on the contrary the five corresponding marks on the base, meeting in the mouth, are depressed. The base is concave, and the mouth is situated immediately under the vertex. The vent is in a short groove on the edge, but more towards the upper surface, as in some of the Spatangus family."*

When I published my memoir on the Cassidulidæ of the Oolites † I could not obtain a specimen of this urchin; most of those contained in the Yorkshire collections are either

* Geological Survey of the Yorkshire Coast, 2d ed. p. 214.

† Annals and Magazine of Natural History, 2d series, vol. ix, p. 310, 1851.

crushed or have been much injured in cleaning; fortunately I have obtained two good examples, which have been beautifully figured in Pl. XXXIV, one of these specimens was obtained from a band of clay and has the form and sculpture finely preserved.

The thin test has an oblong form, rounded before, dilated in the middle, and a little rostrated behind (fig. 1 *a*); the upper surface is uniformly convex (fig. 1 *c*); the sides decline equally towards the border (fig. 1 *d*), which is rather attenuated; when the shell is viewed in profile, the margin is seen to be much undulated (fig. 1 *c, d*).

The ambulacral areas taper gradually from the border to the disc (fig. 1 *a*), and lie on the same plane with the general surface of the test; the poriferous zones on the dorsal surface are petalloid for three fourths of the space between the border and disc, they lie rather beneath the general plane of the test, and form very uniform graceful petals on the upper surface, narrow below, gradually swelling out in the middle, and tapering to narrow lanceolate terminations at the disc (fig. 1 *a*); the pores of the inner row are round (fig. 1 *e*), those of the outer row in the form of long, narrow, transverse slits; the pores of both rows are conjugate through fine sulci; there are eight pairs of pores opposite one of the large plates, and a septum between each transverse slit, the outer surface of which supports a regular row of fine granules (fig. 1 *e*).

At the lower fourth of the areas the pores lie close together, the rows are here very narrow, and continue so across the base, the pairs of pores in this region, being placed at wider distances apart (fig. 1 *b*), near the mouth-opening they lie closer together in triple oblique rows in the penta-phylloid floscelles of the ambulacra, which radiate outwards between the lobes in depressions of the test (fig 1 *b*).

The inter-ambulacral areas are of unequal width; the antero-lateral pair are the narrowest, and the postero-lateral pair, and single area, are of the same width, but broader than the anterior pair; their surface is marked by two slight ridges, which radiate from the disc to the border, and subdivide each area into three segments. In specimens which have been scraped or filed, unfortunately almost universally the case with this Clypeus, these ridges are not seen; but in the small, nearly perfect specimen (fig. 1 *c, d*), they form a very prominent character in its upper surface, and which is faintly represented in fig. 1 *a* in the left antero-lateral segment. The inter-ambulacral ridges form distinct prominences at the border, and on the surface of the basal cushions; they likewise form two small carinæ on the deflected basal surface of the small specimen (fig. 1 *d*). The small tubercles are arranged in rows with great regularity on the plates, of these there are in general four on each; the tubercles are surrounded by sunken areolas, and the intermediate surface is covered with rather large granules (fig. 1 *f*), which give a highly ornamented sculptured surface to the test, when examined with an inch lens. The tubercles at the base are very much larger than those on the upper surface; some of them likewise are perforated, especially those situated in the concave depression in the vicinity of the mouth (fig. 1 *f*).

The single inter-ambulacrum forms one of the most remarkable features in the anatomy of the test; the anal valley is short, deep, and limited to the lower third of the dorsal portion of this area (fig. 1 *a*); the posterior part of this segment is rostrated, and much deflected (fig. 1 *d*), and its extremity abruptly truncated (fig. 1 *a, d*); the arch over the vent is narrow above, its sides slope a little inwards, and the opening expands towards the border (fig. 1, *a, d*); the vent opens near the surface beneath the arch (fig. 1 *d*); it has an oval form with its long diameter towards the vertex.

The base is concave (fig. 1 *b*), and the inter-ambulacra form prominent cushions between the narrow ambulacra, the convexity of these segments produces a considerable undulation in the border, which is well represented in fig. 1 *c, d;* the mouth-opening is sub-central, nearer the anterior than the posterior border, it has a pentagonal form, and the peristome is surrounded by five prominent oral lobes (fig. 1 *b*).

The apical disc is very small, it occupies the centre of the upper surface, and forms the vertex of the test; I have only seen one specimen in which this part is preserved. The separate plates are so intimately soldered together, that I can only recognise the four genital holes which perforate the test obliquely (fig. 1 *g*), and the five ocular holes at the summits of the ambulacra; the surface of the discal plates is covered by a spongy madreporiform body which forms the most conspicuous element in the small central disc (fig. 1 *g*).

Affinities and differences.—Clypeus subulatus is frequently mistaken for *Pygurus pentagonalis*, Phil., and lies with this name attached, in several Yorkshire collections. In fact, the oblong figure of the test, the apparent absence of an anal valley, which is always filled up with matrix, and seldom cleared out, the form of the ambulacral petals, and the central position of the small apical disc, produce an assemblage of characters which have misled local observers. M. Desor, in his synopsis, has placed this Clypeus in the genus Pygurus, and has added this note to his diagnosis—"Cette position exceptionnelle du périprocte n'est pas une raison suffisante pour éloigner cette espèce au *Pygurus* auxquels elle correspond par tours ses autres caractères." I can readily understand how this mistake has been committed, if M. Desor's opinion was formed from Phillips's figure, the only one up to the present time worthy of the name of a sketch which has been published. I trust, however, that Mr. Bones's beautiful plate, with its ample details will set the question at rest, for there can be no doubt that this urchin is a true Clypeus. It has no affinity with any other English congener; its concave under surface, and strongly-cushioned basal inter-ambulacra, resemble the base of *Clypeus altus;* but that species has an orbicular outline, and a long, narrow, anal valley, which widely separate it from *Clypeus subulatus.* It more nearly resembles *Clypeus Rathieri*, Cott., from the Forest marble of Châtel-Gérard (Yonne), than any other species; but the narrowness of the anterior border, the flatness of the base, and the excentral position of the disc, prove how specifically distinct they are from each other. I may add, that the small specimen from the clay band (fig. 1), is the only example I have yet seen which shows the basal surface, now published in fig. 1 *b*, for the first time.

Locality and Stratigraphical position.—This urchin has hitherto been collected only from the Coralline Oolite of Malton and Scarborough, although I have seen fragments of it in the Ayton quarries. It is usually imbedded in a white Oolitic limestone, firmly attached by the base in consequence of its inequalities, and, having the upper surface exposed, the matrix is usually removed by scraping; but the Oolitic grains frequently indent the surface of the plates. This species was formerly more abundant, than now, probably because the vein containing the fossil was worked more in former years. Almost all the specimens are fractured and crushed, and it is rare to find one which preserves the true type-form of the species. For the same reason we seldom observe the ridges which radiate from the disc to the mouth-opening, on the surface of each inter-ambulacral segment. I have never seen them distinctly, but in the two specimens I have figured, where they undoubtedly exist, and form a good diagnostic character for the species.

History.—It was first figured and described as *Echinites sublatus*, by Young and Bird, in their 'Geological Survey of the Yorkshire Coast,' and afterwards by Professor Phillips, as *Clypeus emarginatus*, in his 'Geology of Yorkshire;' the first name must therefore be retained. Professor Forbes gave a diagnosis of the species in his 'Notes on British Oolitic Nucleolites,' in the first decade of his 'Memoirs of the Geological Survey.' It was imperfectly described, for want of specimens, in my 'Memoir on the Cassidulidæ of the Oolites;' but is now figured, with full details, from two fine specimens, for the first time.

NOTES

ON FOREIGN JURASSIC SPECIES OF THE GENUS CLYPEUS NEARLY ALLIED TO BRITISH FORMS, BUT WHICH HAVE NOT YET BEEN FOUND IN THE ENGLISH OOLITES.

CLYPEUS SOLODURINUS, *Agassiz*. Syn. *Échinoderm, Foss, Suisse* I, p. 35, tab. v, figs. 1—3.

Test very thick, narrow, and elongated, posterior border angular, produced, and truncated; ambulacra narrow, poriferous zones petaloidal, contracted at the lower fourth, apical disc central; anal valley lanceolate; vent in its upper part, near the apical disc, which is small and nearly central; border undulated, base nearly flat, with prominent inter-ambulacral cushions; mouth-opening large, peristome surrounded by five lobes.

Dimensions.—Antero-posterior diameter, two inches and nine tenths; transverse diameter, two inches and eight tenths; height, eight tenths of an inch.

Formation.—"Oolite Vesulienne, d'Obergoesschen (Jura Soleurois), Egg (Argovie); Plasne près Poligny (Jura)." Desor.

Collections.—MM. Strohmeyer, Bronn, Marcou.

CLYPEUS BOBLAYI, *Michelin*. Cotteau and Triger. Échinides du depart. de la Sarthe, pl. xi, figs. 4, 5; p. 64.

Test moderate size, sub-circular, round before, slightly truncated behind; dorsal surface much depressed, almost flat; under surface sub-concave. Summit very excentrical posteriorly; anterior ambulacral areas much longer than the posterior. Poriferous zones widely petaloid on the upper surface, and becoming abruptly contracted near the border, where the pores are simple and non-conjugate; anal valley narrowly lanceolate, and becoming regularly wider from the disc to the border.

Dimensions.—Height, three quarters of an inch; antero-posterior diameter, three inches and nine tenths; transverse diameter, four inches and one tenth.

Formation.—Great Oolite, near Mamers Sarthe.

Collection.—M. Michelin; very rare.

Clypeus Rathieri, *Cotteau.* Échinides Foss., de l'Yonne, pl. vi, p. 71.

Test elongated, very flat on the dorsal surface, and concave at the base; anterior border rounded, and sub-truncated; posterior half of the test much wider and thicker; posterior border rostrated. Ambulacral areas widely petaloid in the middle of the dorsal surface, narrowly lanceolate near the disc, and contracted near the border; anal valley short, narrow, and marginal; occupying the lower third of the inter-ambulacrum, and forming a groove in the posterior border; mouth-opening small, sub-central; peristome surrounded by five lobes.

Dimensions.—Height, six tenths of an inch; antero-posterior diameter, two inches and a half; transverse diameter, two inches and a quarter.

Formation.—Siliceous beds of the Forest marble (Great Oolite) at Châtel-Gérard, Yonne.

Collection.—M. Rathier; very rare.

Clypeus Osterwaldi, *Desor.* Synopsis des Échinides Foss. p. 277.

Test large, depressed, enlarged, and rostrated posteriorly; anal valley very narrow, extending to the apical disc, which is central. Poriferous zones, in width about one half the ambulacral area; base, much undulated; mouth-opening excentral; peristome, with five lobes and a penta-phylloid rosette, in which additional pores are arranged in double and triple oblique ranks.

Formation.—"Great Oolite (Bathonien) de Noiraigue (Canton de Neuchâtel) au dessous des marnes à Discoidées. Abondant." Desor.

Collections.—M. Gresley, Mus. de Neuchâtel.

Clypeus rostratus, *Desor.* Synopsis des Échinides Foss. p. 278.

Test elevated, sub-conical; posterior border much rostrated; anal valley very much inclined, and almost vertical; ambulacral petals less elongated than in the preceding species; base concave, much undulated; mouth-opening excentral; peristome with three small lobes. Type of the species, T. 4.

Formation.—" Marnes à Discoidèes (Vesulien) du Kornberg près Frick et de Hornussen (Argovie)." Desor.

Collections.—Mus. Bâle, MM. Moesch, Schmidlin.

Family 10. ECHINOLAMPIDÆ, *Wright*, 1855.

NUCLEOLIDÉES (pars), *Albin Gras.*, 1848.
ECHINOBRISSIDÆ (pars), *D'Orbigny*, 1855.
ECHINOLAMPASIDÆ (pars), *Grey*, 1855.
CASSIDULIDES (pars), *Desor*, 1858.

The family ECHINOLAMPIDÆ includes all the urchins which have petaloid or sub-petaloid ambulacra; the vent, supra-marginal, marginal, or infra-marginal, opening at the surface of the test, and not into an anal valley; the mouth edentulous; the peristome surrounded by five oral lobes, with which petaloidal expansions of the basal ambulacra alternate

The thin test has in general an oval, oblong, sub-pentagonal, or orbicular form, the upper surface is convex, and depressed, elevated, or conoidal; the vertex is usually excentral, and situated nearer the anterior border.

The ambulacral areas and poriferous zones form elegant leaf-like expansions on the dorsal surface, and miniature petals at the base, where they develope an "oral rosette," or a penta-phylloid floscelle around the mouth; the leaves alternate with the prominent peristomal lobes, in which the pores are arranged in crowded oblique ranks.

The small apical disc is composed of a single imperforate, and four small perforated ovarial plates; the madreporiform body is proportionally large, extending over the other discal elements; the five ocular plates are very small, with marginal orbits.

The vent always opens at the surface of the test, and never into a valley, as in the ECHINOBRISSIDÆ. The opening has an oblong form; its long diameter corresponding with the transverse diameter of the test in some genera, and with the longitudinal axis in others; it occupies a marginal, supra-marginal, or infra-marginal position. In some existing species this aperture is closed by three thin, shelly valves, covered with tubercles; the lateral valves are larger and triangular, the central one linear, erect.*

The tubercles are often perforated, and surrounded by sunken areolas; in *Echinolampas* and *Pygurus*, the inter-tubercular surface is covered with a close set granulation, and the tubercles at the base are much larger than those on the upper surface.

The ECHINOLAMPIDÆ form a natural group, nearly equivalent to the *Echinanthi*, of Breynius,† and which that author thus defined:

"ECHINANTHUS *est Echinus cujus apertura pro ore est prope centrum, pro ano in, vel ad marginen, longissime ab ore distantem.*"

Figuram omnes hujus species habent *ovalem*, cujus altera extremitas angustior, altera latior, in qua semper apertura pro ano observatur. Ceterum pori in vertice *schema* efformant *floris* cujusdam *penta-petali*, quasi acu artificiose delineatum; et hæc ratio est cur huic Generi *Echinanthi* nomen imposuerim.

* 'Gray's Catalogue of the Recent Echinida of the British Museum,' p. 35, 1855.

† 'De Echinus et Echinites,' p. 59.

This definition unfortunately embraces forms which appertain to several genera. Even the three species figured as *Echinanthus,* in Tab. iv, of Breynius's work, from the position of the vent, represent two distinct types.

The ECHINOLAMPIDÆ resemble the ECHINOBRISSIDÆ in the general organization of their test; but the species are distinguished from those of that group by the position of the vent, the development of the peristomal lobes, the basal ambulacral rosette, and by the tubercles, in some genera at least, being perforated.

In the following table I have given a short diagnosis of the genera, and include in the family ECHINOLAMPIDÆ, together with their stratigraphical distribution in time.

A TABLE SHOWING THE CLASSIFICATION AND DISTRIBUTION OF THE ECHINOLAMPIDÆ.

FAMILY.	DIAGNOSIS.	GENERA.	FORMATION.
ECHINOLAMPIDÆ.	Test, oblong, inflated; petals long, narrow, nearly reaching the border; vent transverse, supra-marginal.	PYGORHYNCHUS, *Agassiz.*	Tertiary.
	Test oblong, depressed; petals short, narrow, limited to the dorsum; vent oval, marginal, or supra-marginal.	ECHINANTHUS, *Breynius.*	Tertiary and Upper Cretaceous.
	Test ovoid or discoid; petals wide, long, nearly reaching the border; vent, transverse, infra-marginal.	ECHINOLAMPAS, *Grey.*	Living and Tertiary.
	Test large, discoidal, or elevated; petals large, long, reaching the border; vent infra-marginal, longitudinal, surrounded by a distinct area.	PYGURUS, *Agassiz.*	Cretaceous and Oolitic.
	Test oblong, depressed; petals long, narrow, reaching the border; vent longitudinal, marginal.	BOTRIOPYGUS, *D'Orbigny.*	Cretaceous.
	Test elevated, or conical; petals narrow, lanceolate, short, limited to the dorsum; vent small, transverse, without area; base flat, without elevation.	FAUJASIA, *D'Orbigny.*	Upper Cretaceous.
	Test large, oval or circular, much elevated, or conoidal; petals long, straight, wide, equal, not contracted below; vent infra_ marginal, triangular; base flat.	CONOCLYPUS, *Agassiz.*	Tertiary and Cretaceous.

PLATE XXIII.

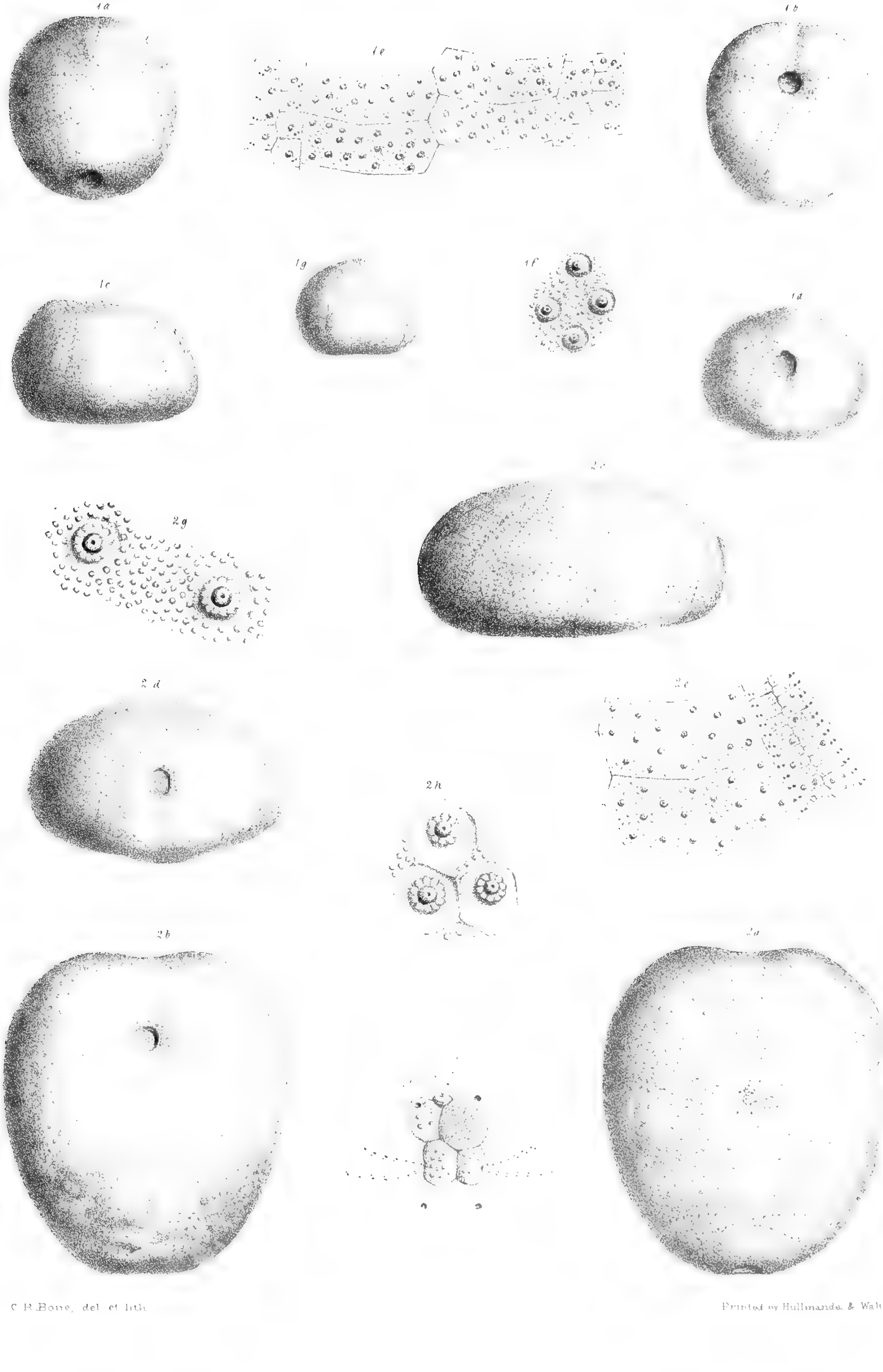
Collyrites from the Inferior Oolite and Coral Rag.

Inferior Oolite Species.

1 *a.* Collyrites ovalis, *Leske*, p. 314. Upper surface, natural size.
b. Under surface of the same test.
c. Lateral view of ditto.
d. Posterior view of ditto.
e. Ambulacral areas, poriferous zones, and inter-ambulacral plates, magnified thrice.
f. Primary tubercles and miliary granules, highly magnified.
g. Anterior view of a smaller test.

Coral Rag Species.

2 *a.* Collyrites bicordata, *Leske*, p. 319. Upper surface, natural size.
b. Under surface of the same test.
c. Lateral view of ditto.
d. Posterior view of the same, showing the anal opening.
e. Ambulacral area, poriferous zones, and inter-ambulacral plates, magnified thrice.
f. Anterior pair of ovarial plates, and madreporiform body, with the single, and anterior pair of ocular plates, magnified four times.
g. Primary tubercles, and miliary granules, of the dorsal plates, highly magnified.
h. Primary tubercle, and hexagonal areolas from the base; ditto.



C. R. Bone, del. et lith.

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PLATE XXIV.

Echinobrissi from the Inferior Oolite, Great Oolite, and Cornbrash.

Inferior Oolite and Cornbrash Species.

1 *a.* Echinobrissus clunicularis, *Llhwyd,* p. 332. Upper surface, natural size.
b. Under surface of the same test, natural size.
c. Lateral view of ditto ditto.
d. Posterior view, showing the anal valley, and inter-ambulacrum.
e. Ambulacral area, poriferous zones, and inter-ambulacral plates; magnified thrice.
f. Ambulacral area, and petaloid portion of the poriferous zones; highly magnified.
g. Apical disc, and madreporiform body; magnified four times.
h. Primary tubercles, and miliary granules, highly magnified.
i. Diagram of the upper surface, showing the relative anatomy of the shell.
k. The largest test of this species yet found; from the Rev. A. W. Griesbach's cabinet; natural size.

Great Oolite Species.

2 *a.* Echinobrissus Woodwardi, *Wright,* p. 337. Upper surface, natural size.
b. Under surface of the same test, natural size.
c. Lateral view of ditto, showing its tumid sides; natural size.
d. Ambulacral area, poriferous zones, and inter-ambulacral plates; magnified four times.
e. Upper surface of a large test.

Pl. XXIV

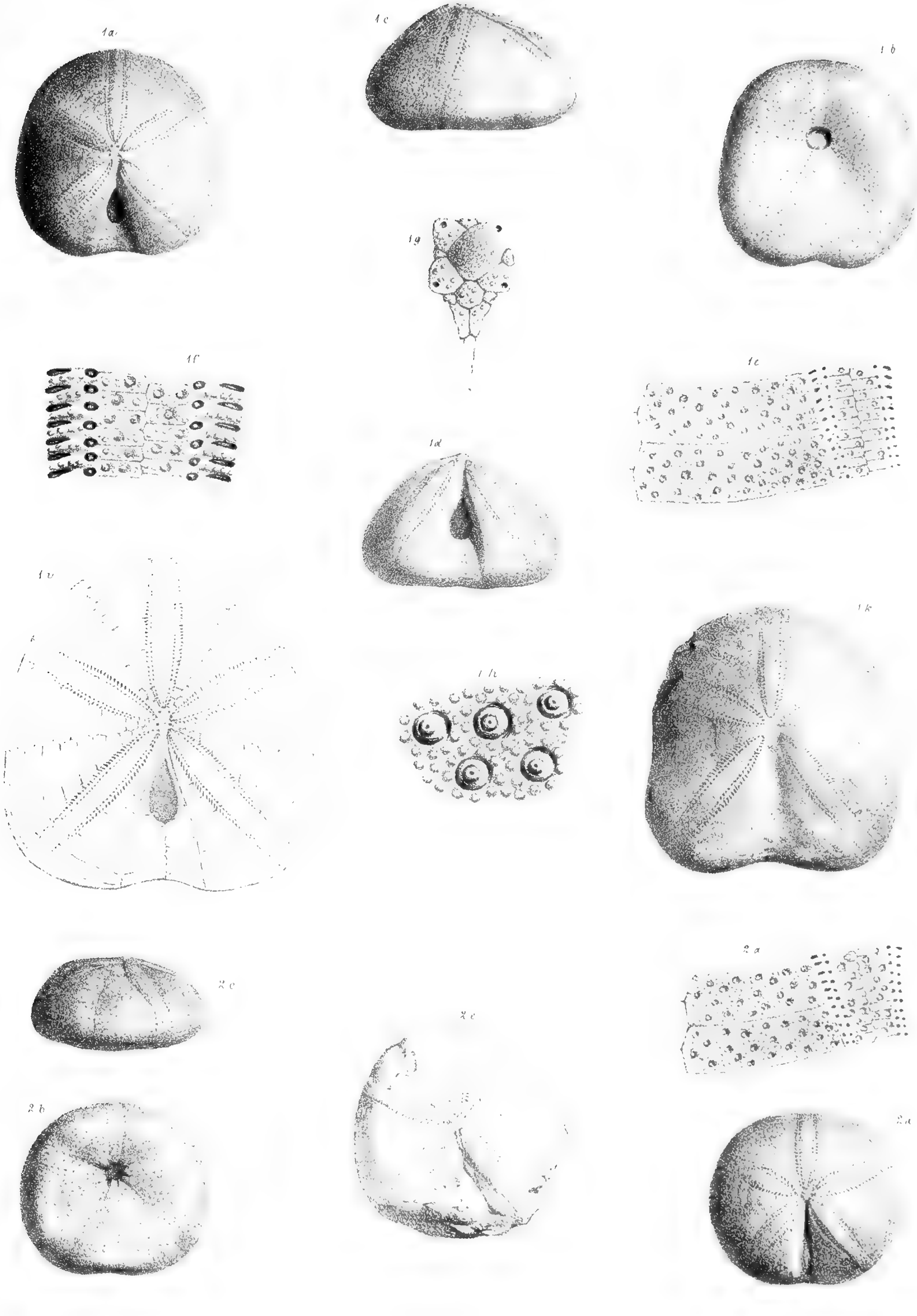

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PLATE XXV.

ECHINOBRISSI FROM THE GREAT OOLITE, AND CORNBRASH.

Great Oolite Species.

1 *a.* ECHINOBRISSUS GRIESBACHII, *Wright*, p. 340. Upper surface, natural size.
b. Upper surface of the same, magnified twice.
c. Under surface, natural size.
d. Ditto, magnified twice.
e. Lateral view of the test, natural size.
f. Ambulacral area, poriferous zones, and inter-ambulacral plates, magnified four times.

Cornbrash Species.

2 *a.* ECHINOBRISSUS ORBICULARIS, *Phillips*, p. 341. Upper surface, natural size.
b. Under surface of the same test, natural size.
c. Lateral view of ditto, showing the poriferous zones.
d. Apical disc, with its internal complementary plates, magnified five times.
e. Ambulacral area, poriferous zones, and inter-ambulacral plates, magnified thrice.
f. Lateral view of a conoidal variety of this species, from Northamptonshire.
g. Upper surface of another specimen, showing a greater eccentricity of the apical disc, a wider anal valley, and a larger vent.

Pl. XXV

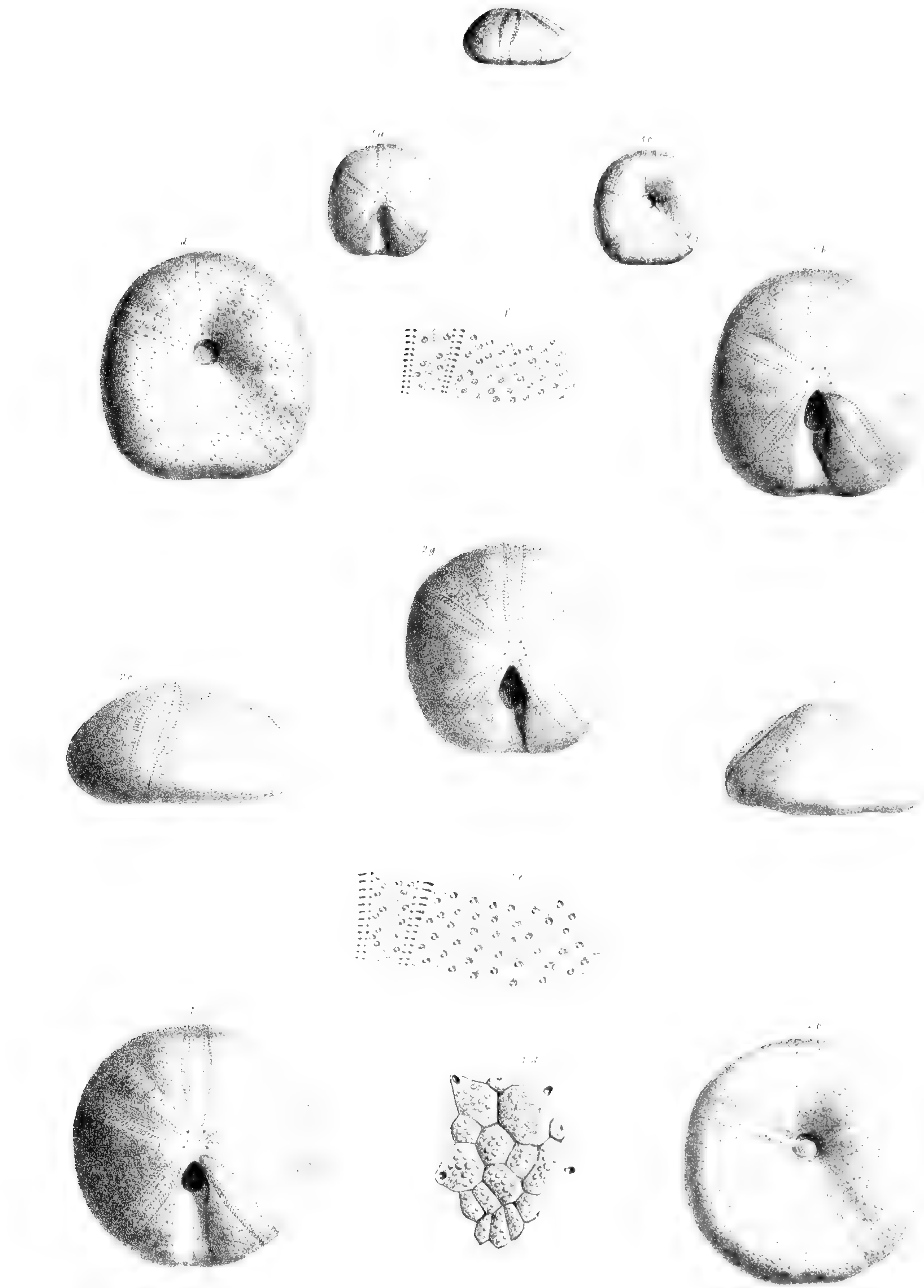

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PLATE XXVI.

ECHINOBRISSI FROM THE CORNBRASH, AND CORAL RAG.

Cornbrash Species.

1 *a*. ECHINOBRISSUS QUADRATUS, *Wright*, p. 344. Upper surface, natural size.
b. Under surface of the same test, natural size.
c. Lateral view of the same, showing the long dorsal slope of the posterior half.
d. Ambulacral area, poriferous zones, and inter-ambulacral plates, magnified four times.

Coral Rag Species.

2 *a*. ECHINOBRISSUS SCUTATUS, *Lamarck*, p. 346. Upper surface, natural size.
b. Under surface of the same test, natural size.
c. Lateral view of the same test, showing the tumidity of its sides.
d. Posterior view, showing the anal valley, and large vent.
e. Apical disc, magnified more than four times.
f. Ambulacral area, zones, and inter-ambulacral plates, magnified four times.

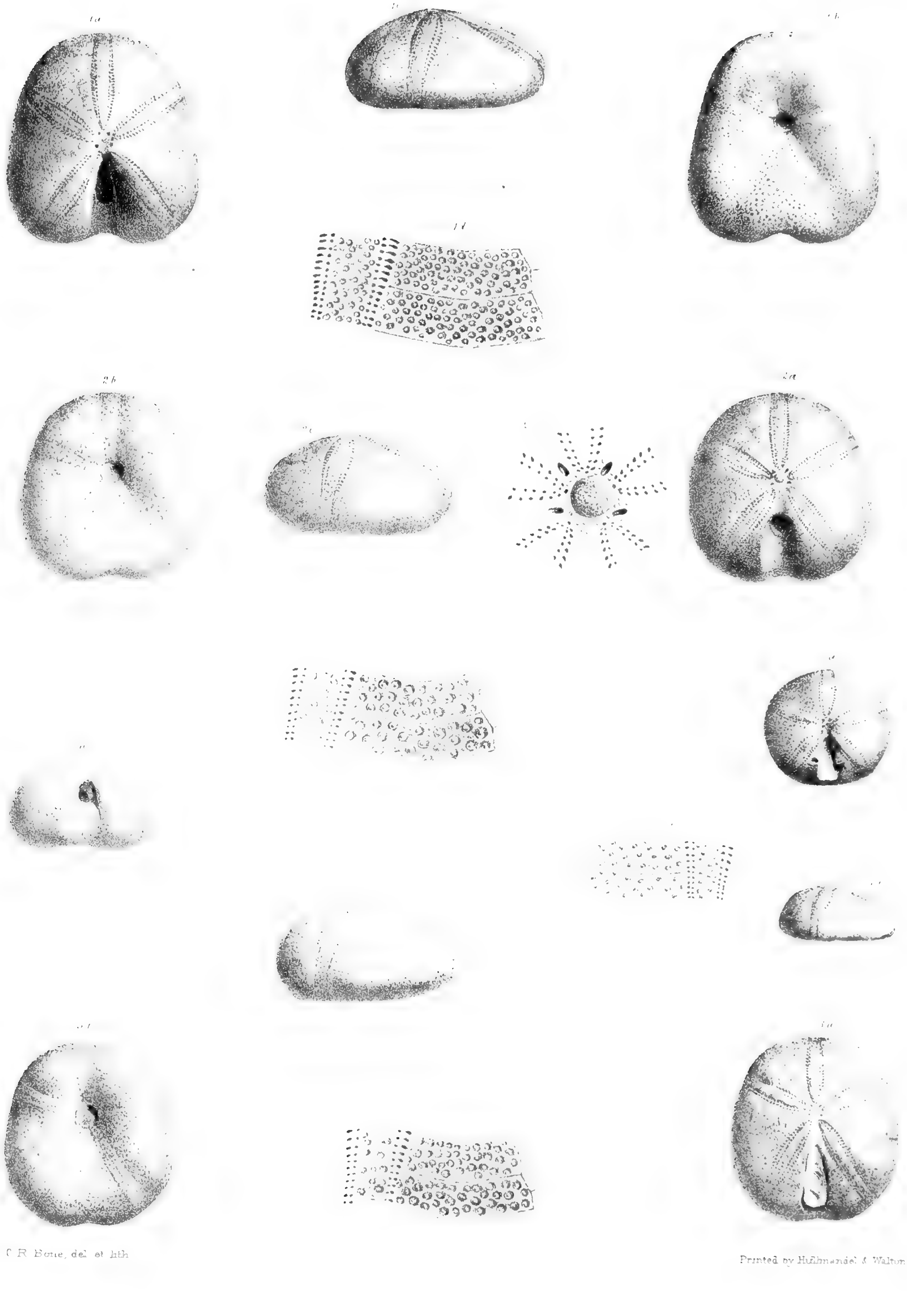
3 *a*. ECHINOBRISSUS DIMIDIATUS, *Phillips*, p. 350. Upper surface, natural size.
b. Under surface of the same test, natural size.
c. Lateral view of ditto, showing the great tumidity of its sides.
d. Ambulacral area, zones, and inter-ambulacral plates, magnified four times.

4 *a*. ECHINOBRISSUS SCUTATUS, *Lamk.* A small round variety.
b. Lateral view of this test.
c. Ambulacral area, zones, and inter-ambulacral plates, magnified four times.

Portland Oolite Species.

ECHINOBRISSUS BRODIEI, *Wright*, p. 353. See Pl. XXXV, fig. 1, *a, b, c, d, e*.

Pl. XXVI



C. R. Bone, del. et lith.

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PLATE XXVII.

Clypei from the Inferior Oolite.

1 *a*. Clypeus altus, *M'Coy*, p. 366. Upper surface, natural size.

b. Under surface of the same test, natural size.

c. Lateral view of ditto, showing the convexity of the dorsal surface, and the deep undulations of the border.

d. Posterior view, showing the structure of the inter-ambulacrum; the length, and narrowness of the anal valley, and the shape of the vent.

e. Ambulacral area, zones, and inter-ambulacral plates, magnified four times.

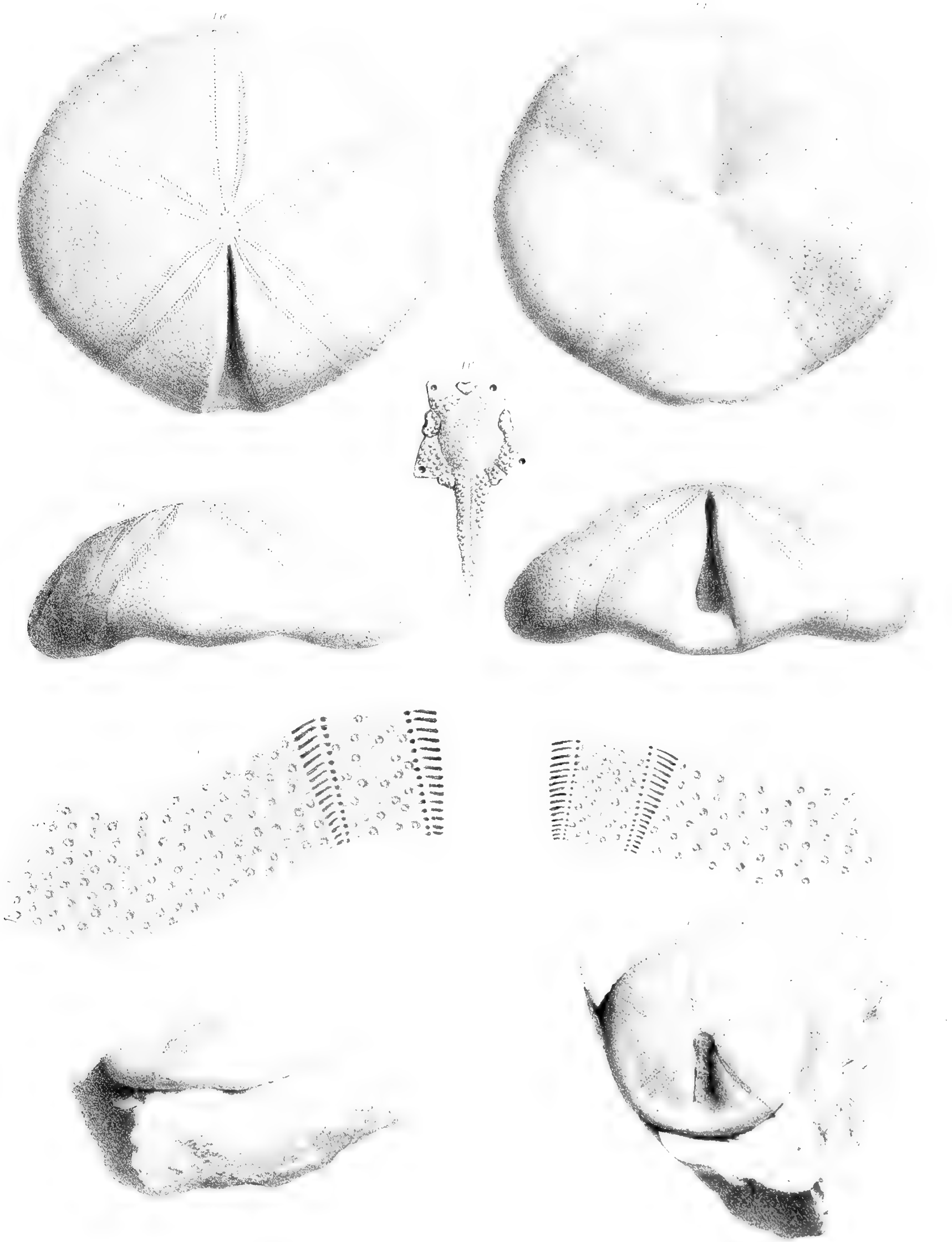
f. Apical disc, with the large madreporiform body, small ocular plates, and posterior complementary plates, magnified five times.

2 *a*. Clypeus Michelini, *Wright*, p. 369. Upper surface, natural size.

b. Lateral view of the same test, natural size.

c. Ambulacral area, zones, and inter-ambulacral plates, magnified five times.

This is a rare urchin, on a slab of Inferior Oolite limestone, from Whitwell, Yorkshire, where it was found associated with *Stomechinus germinans*, Phillips.



C. R. Bone, del et lith

PLATE XXVIII.

CLYPEUS PLOTII, *Klein*.

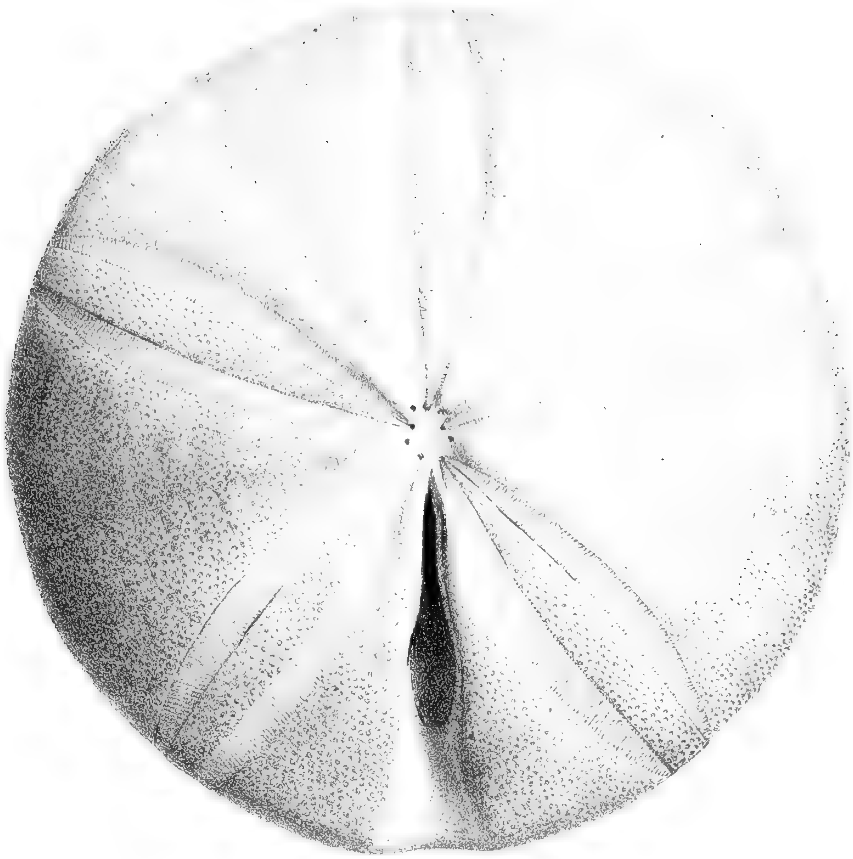
From the Inferior Oolite.

1 *a*. CLYPEUS PLOTII, *Klein*, p. 360. Upper surface, natural size.

b. Under surface of the same test, natural size.

PL. XXVIII

a



b

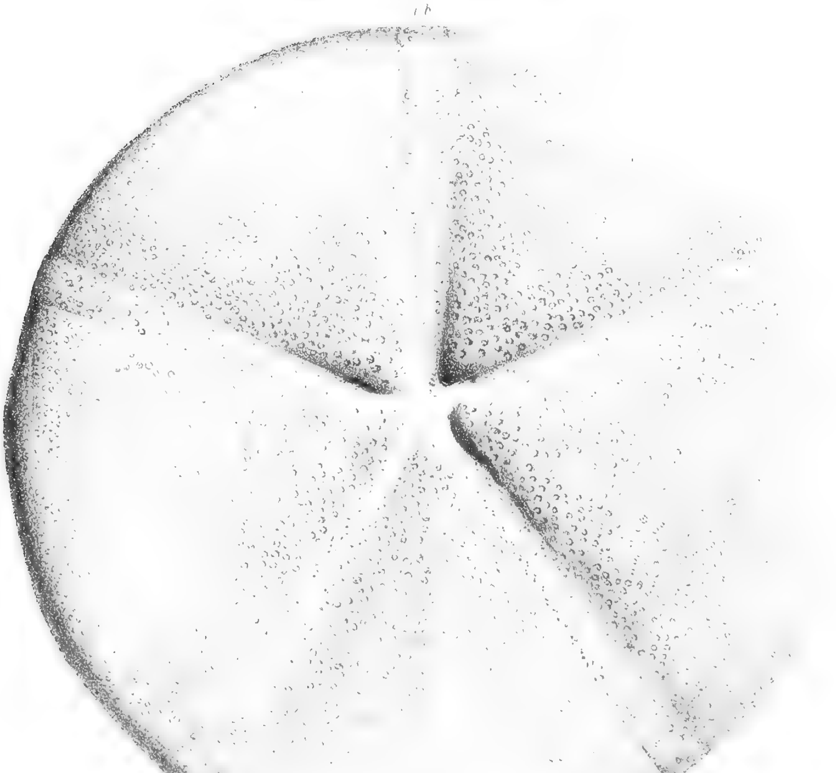


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PLATE XXIX.

CLYPEUS PLOTII, *Klein*.

From the Inferior Oolite.

1 *a*. CLYPEUS PLOTII, *Klein*, p. 360. Posterior view, showing the anal valley, oblong vent, and postero-lateral ambulacra.

b. Lateral view of the same test.

c. Ambulacral area, zones, and inter-ambulacral plates, magnified two-and-a-half times.

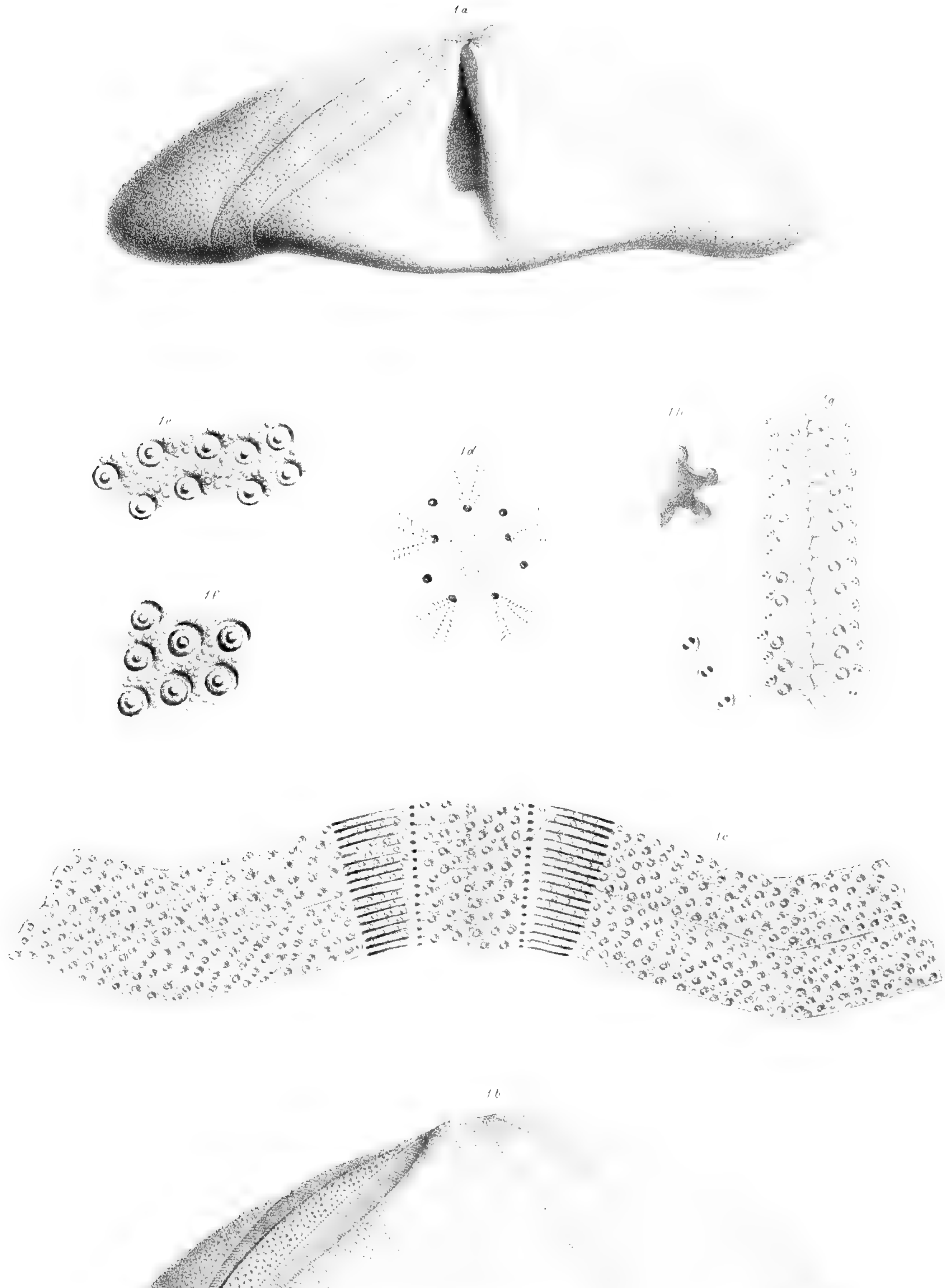
d. Apical disc, magnified two-and-a-half times.

e. Primary tubercles, and miliary granules, from the upper surface, highly magnified.

f. Ditto, from the base, ditto ditto.

g. Ambulacral area, and poriferous zones, at the base; magnified four times.

h. Mouth-opening, peristome, and oral lobes; magnified two-and-a-half times.



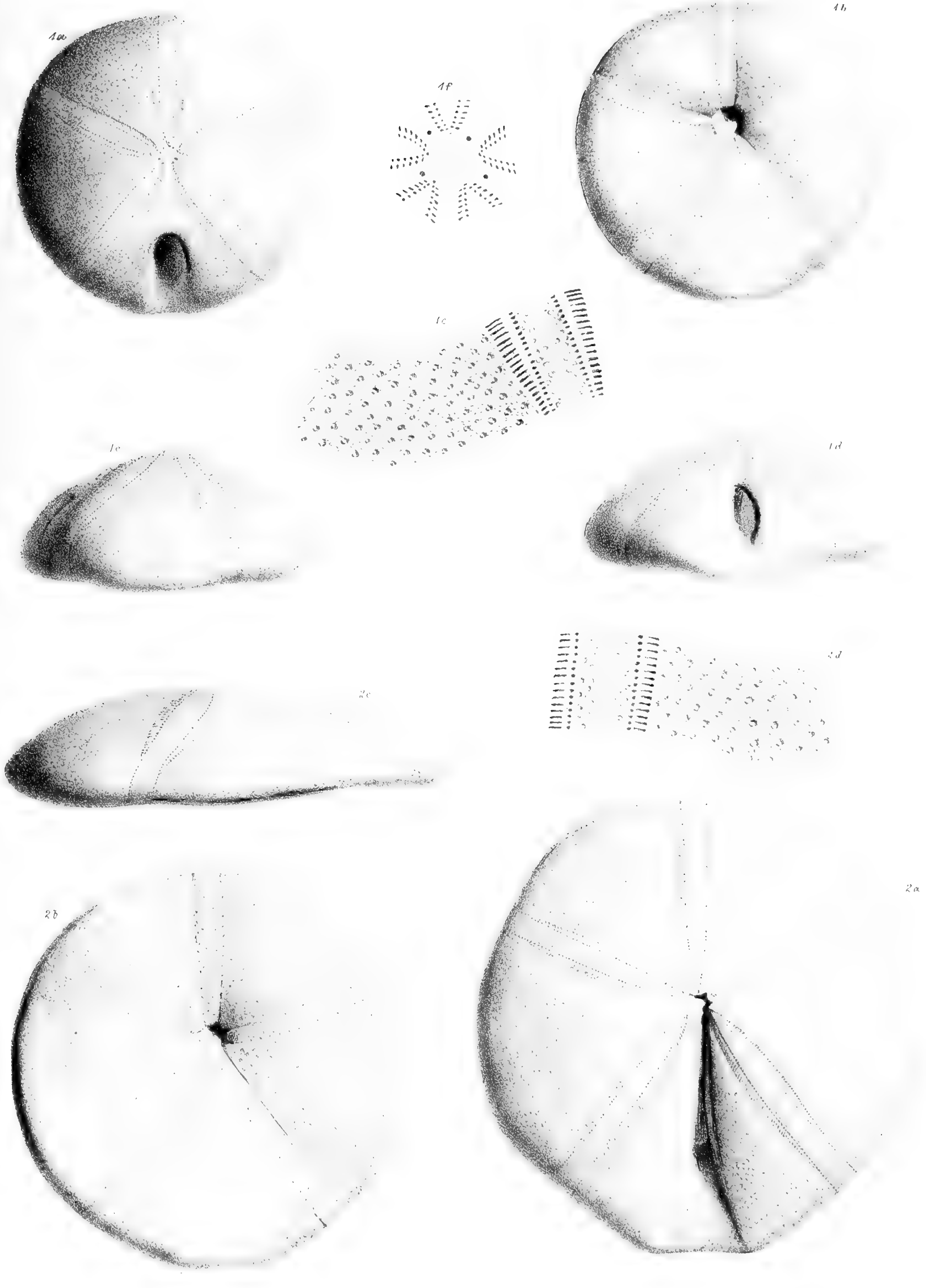
C. R. Bone, del. et lith.

PLATE XXX.

CLYPEI FROM THE INFERIOR OOLITE.

1 *a*. CLYPEUS HUGII. *Agassiz*, p. 375, upper surface, natural size.
b. Under surface of the same test, natural size.
c. Lateral view of the same test, ditto.
d. Posterior view of the same, showing the shortness of the anal valley, and the size of the vent.
e. Ambulacral area, zones, and inter-ambulacral plates, magnified thrice.
f. Apical disc, madreporiform body, and summits of the ambulacra, magnified.

2 *a*. CLYPEUS MICHELINI, *Wright*, p. 369. Upper surface, natural size.
b. Under surface of another test, natural size.
c. Lateral view of *a*, showing the obliquity of the posterior half of the dorsal surface.
d. Ambulacral area, zones, and inter-ambulacral plates, magnified thrice.



C. R. Bone, del. et lith.

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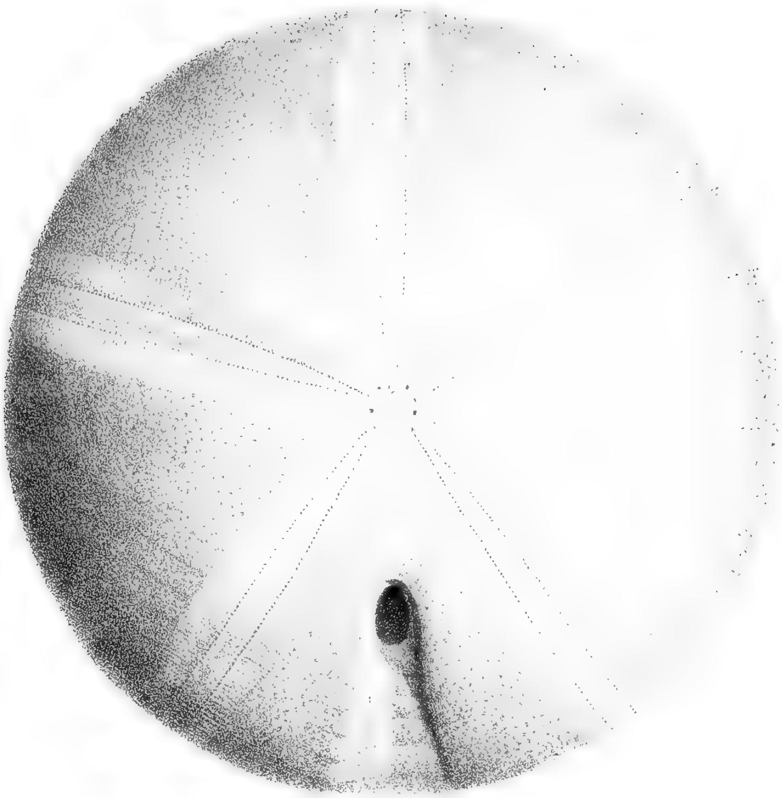
PLATE XXXI.

CLYPEUS AGASSIZII, *Wright.*

From the Inferior Oolite.

1 *a.* CLYPEUS AGASSIZII, *Wright*, p. 378. Upper surface, natural size.
b. Under surface of the same test, natural size.

a



b

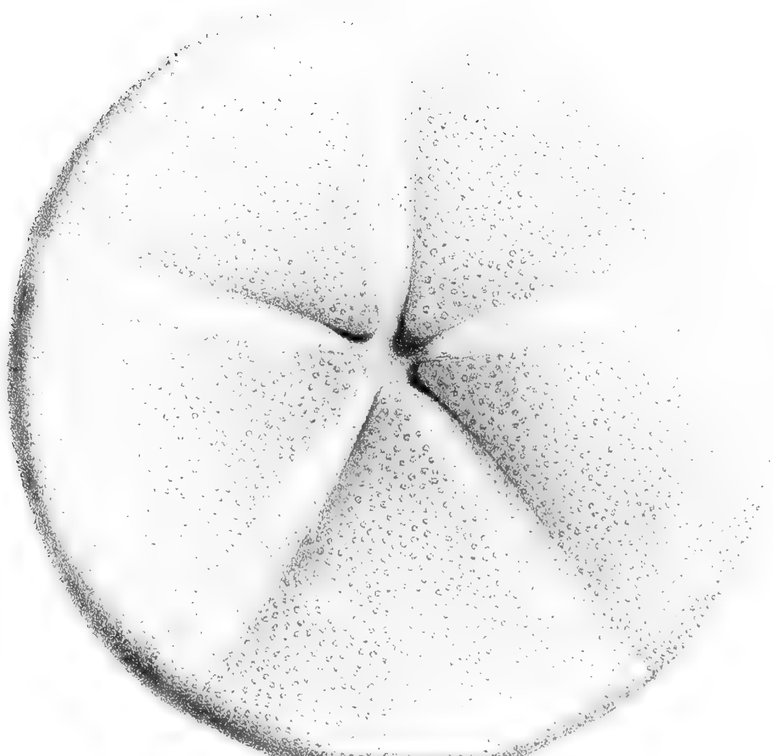


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PLATE XXXII.

Clypeus Agassizii, *Wright.*

From the Inferior Oolite.

1 *a.* Clypeus Agassizii, *Wright,* p. 378. Lateral view, natural size.

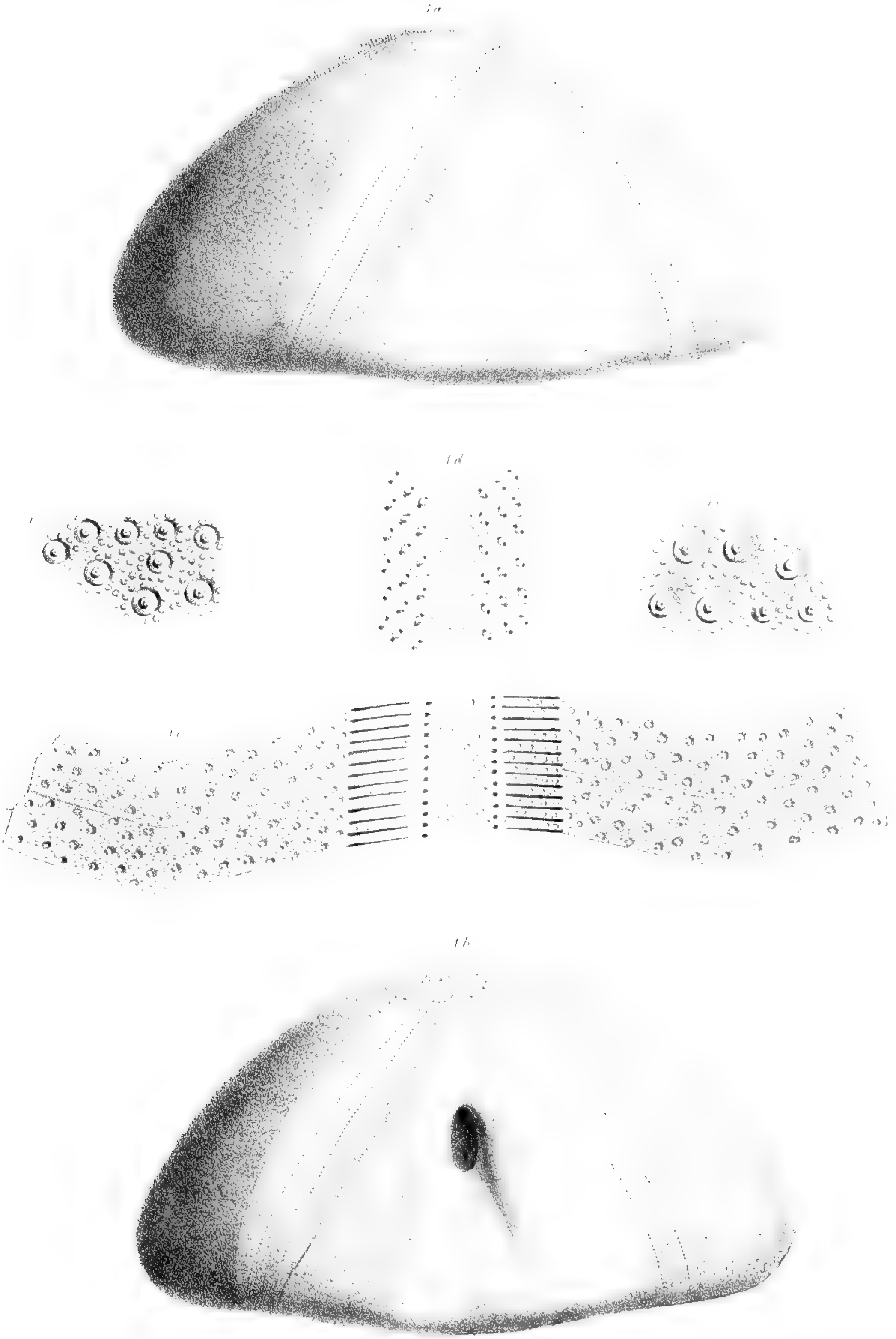
b. Posterior view, showing the shallow anal valley, and superficial oblong vent.

c. Ambulacral area, poriferous zones, and inter-ambulacral plates, magnified twice and a half times.

d. Portion of the basal ambulacral area near the mouth, showing the arrangement of the pores in triple oblique ranks, magnified four times.

e. Tubercles from the base, with miliary granules around them, magnified.

f. Tubercles from the upper surface, showing the regular disposition of the granules around the areolas, and on the intermediate surface.



Bone del et lith

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PLATE XXXIII.

Clypeus Mülleri, *Wright.*

From the Great Oolite.

1. Clypeus Mülleri, *Wright*, p. 371. Upper surface of a large specimen lying on a slab of forest marble, natural size. From Mr. Frederick Bravender's Collection.

2 *a*. Upper surface of a medium sized specimen from the Great Oolite, natural size.
b. Under surface of the same test, showing the central mouth-opening, natural size.
c. Lateral view of the same test, showing the shelving character of the posterior half of the upper surface.

3 *a*. Common variety of the species, having the apical disc very ex-central posteriorly, natural size.
b. Under surface of the same test, showing the mouth-opening and peristome, ditto.

4. Apical disc, showing the two pairs of large, triangular genital plates, the small oculars, the large madreporiform body, and single imperforate genital plate, magnified about four times.
5. Ambulacral area, poriferous zones, and inter-ambulacral plates, magnified four times.
6. Portion of a poriferous zone, showing the inner round holes, the external slit-like apertures, and the tubercles on the septa, highly magnified.

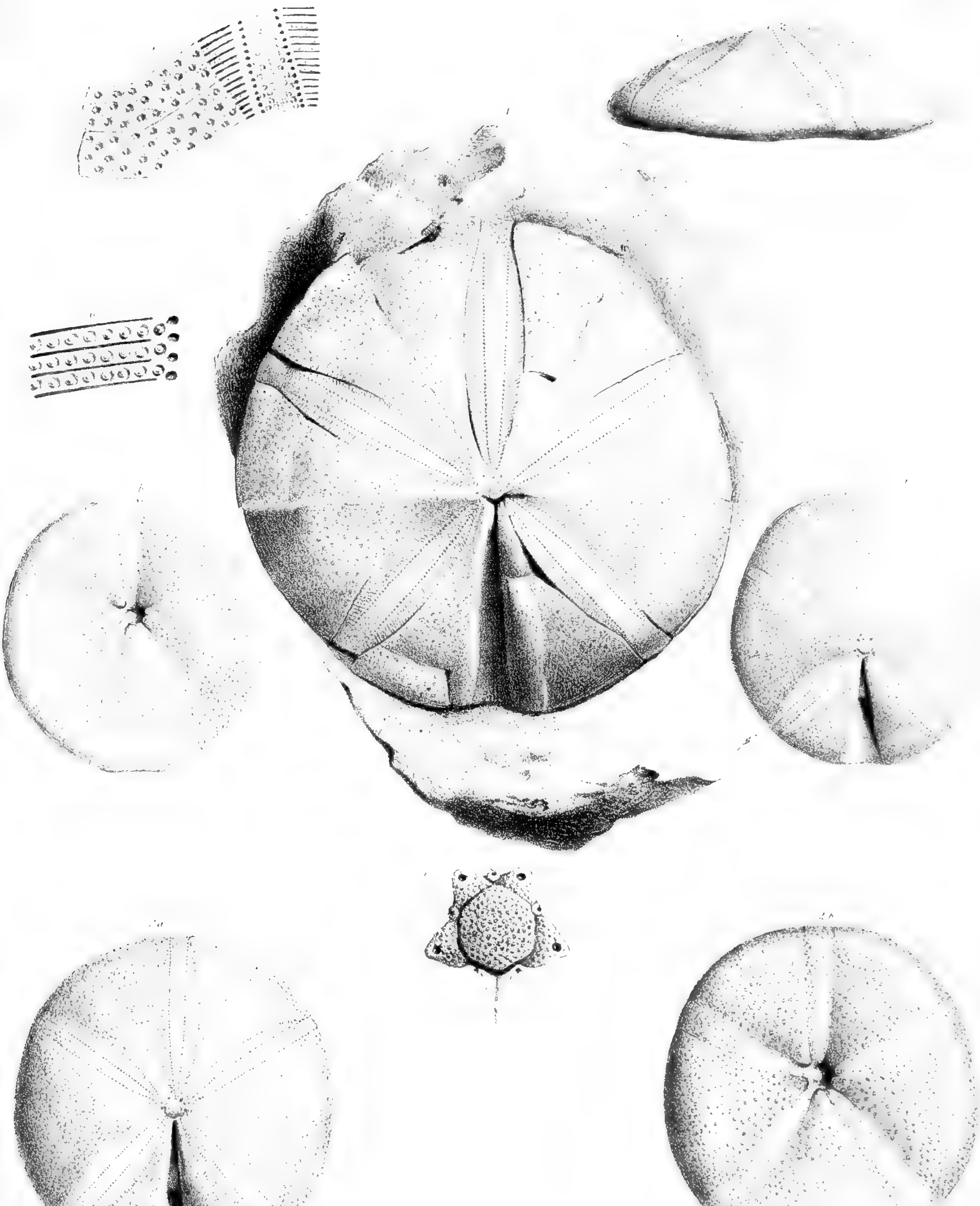

PLATE XXXIV.

CLYPEUS SUBULATUS, *Young and Bird.*

From the Coralline Oolite.

1 *a.* CLYPEUS SUBULATUS, *Young and Bird,* p. 382. Upper surface, natural size.
b. Under surface of the test *c,* slightly enlarged.
c. Lateral view of another test, showing the border, natural size.
d. Posterior view of the same test, showing the short anal valley and vent.
e. Ambulacral area, poriferous zones, and inter-ambulacral plates, magnified thrice.
f. Tubercles and miliary granules from the upper surface, magnified.
g. Apical disc, showing the madreporiform tubercle covering the other elements of the disc.

Pl. XXX.

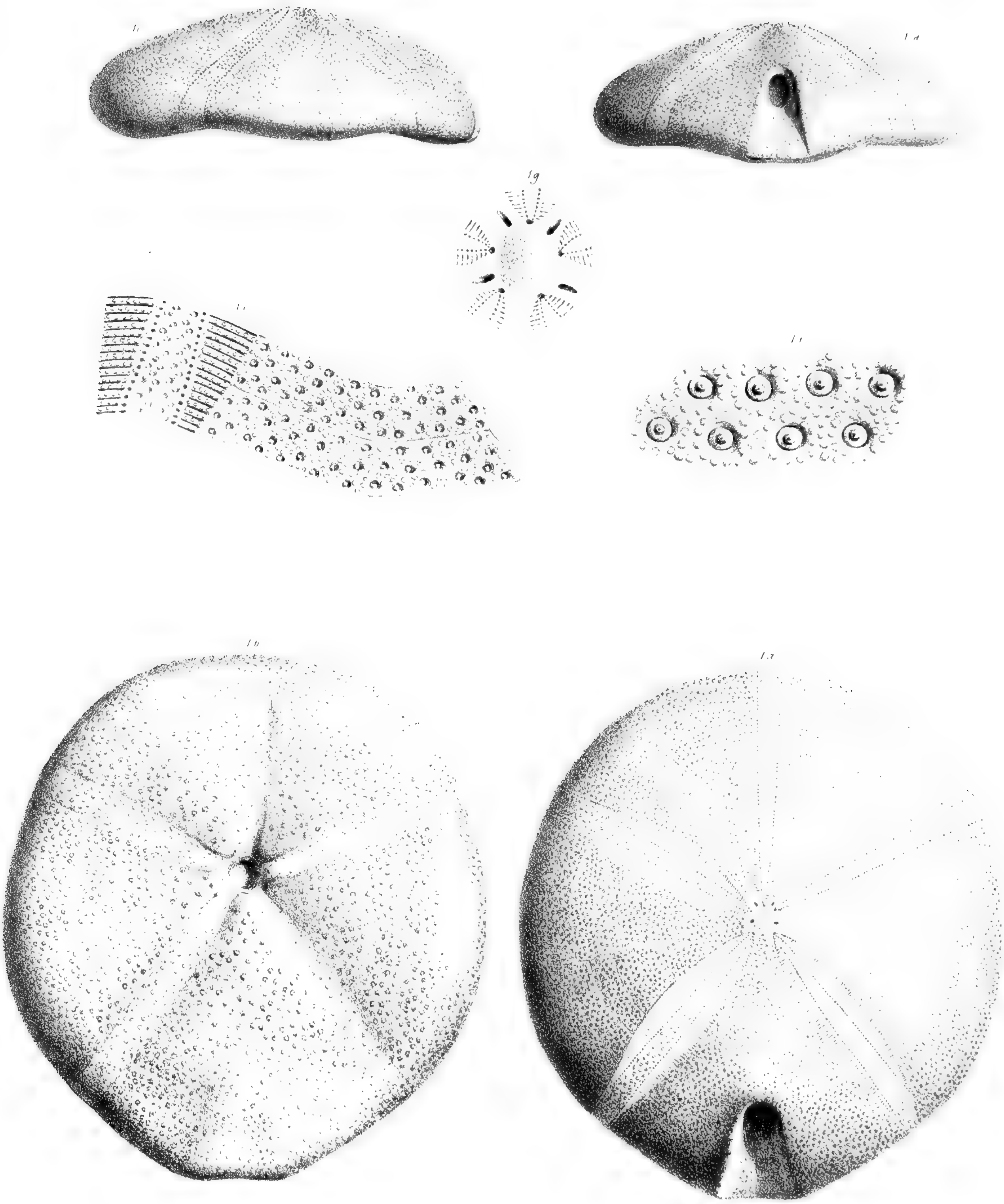

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PLATE XXXV.

ECHINOBRISSUS BRODIEI, *Wright.*

From the Portland Oolite.

1 *a.* ECHINOBRISSUS BRODIEI, *Wright,* p. 353. Upper surface, natural size.
b. Under surface of the same test, natural size.
c. Lateral view of the same test, ditto.
d. Posterior view of the same, showing the short anal valley, and large vent.
e. Basal tubercles, with hexagonal areolas, highly magnified.

PYGURUS MICHELINI, *Cotteau.*

From the Cornbrash.

2 *a.* PYGURUS MICHELINI, *Cotteau,* p. 392. Upper surface, natural size.
b. Under surface of the same test, showing the vent and its areola, natural size.
c. Posterior view of the same, showing the relative position of the vent, and border.
d. Lateral view of the same, showing the excentral position of the apical disc, and the shelving character of the posterior half of the upper surface.
e. Ambulacral area, poriferous zones, and ambulacral plates, magnified twice and a half times.
f. Apical disc, magnified four times.

3. Apical disc of the same species, copied from M. Cotteau's work. This figure shows the relative anatomy of the discal elements better than in our best specimen, and exhibits the magnitude of the large madreporiform body, which covers nearly all the other plates.

PL. XXXV

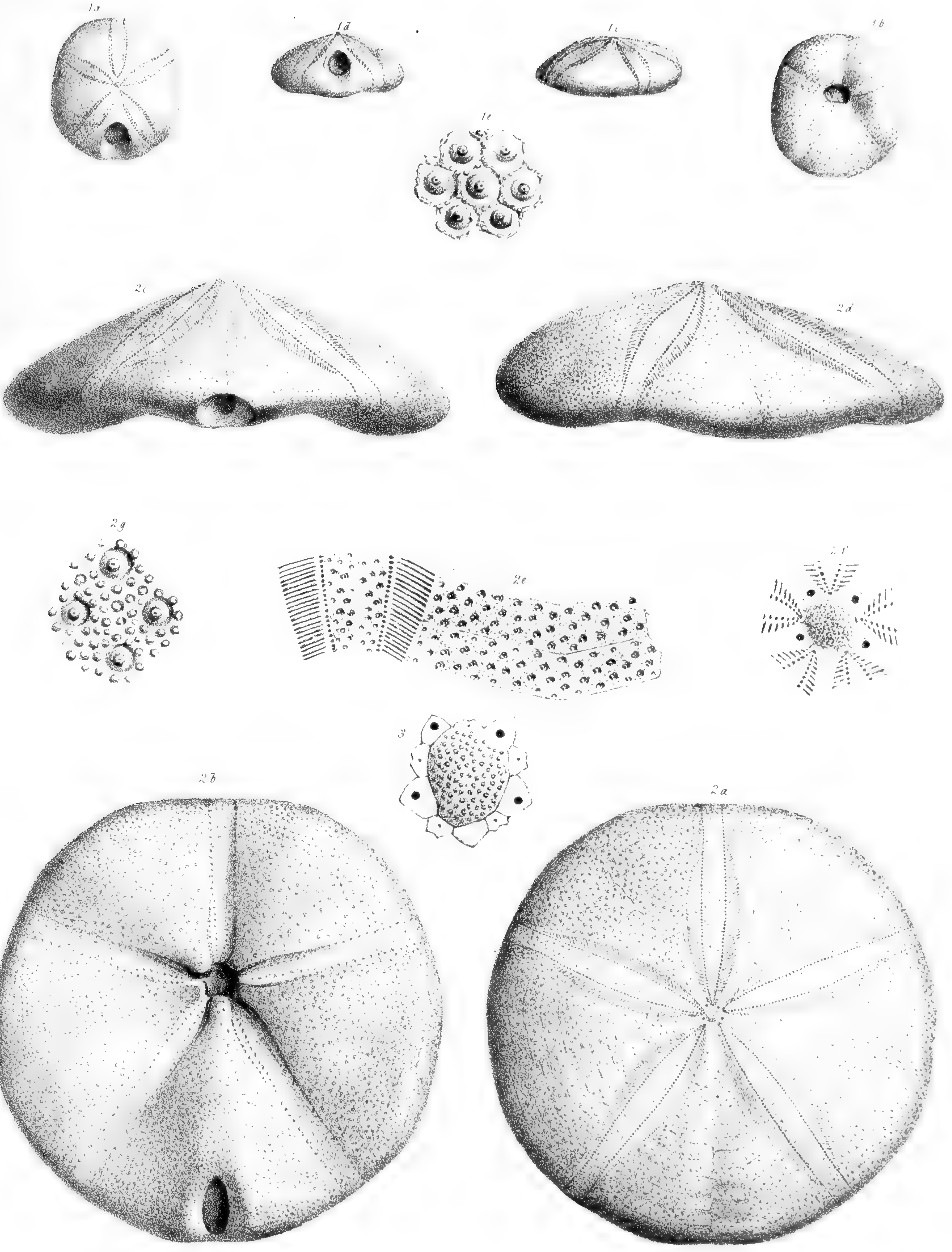

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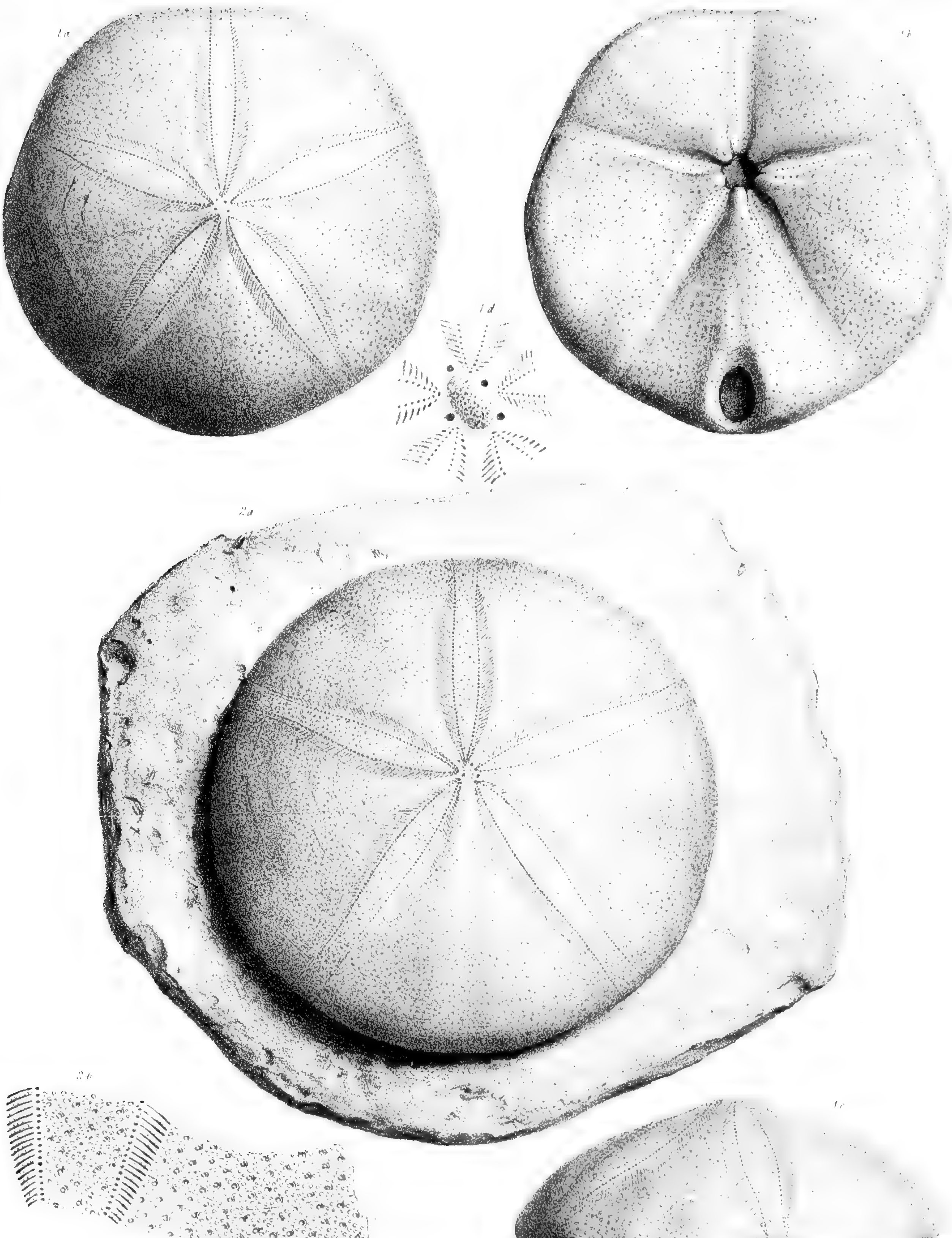
PLATE XXXVI.

PYGURUS PENTAGONALIS, *Phillips.*

From the Coralline Oolite.

1 *a.* PYGURUS PENTAGONALIS, *Phillips,* p. 394. Upper surface, natural size.
b. Under surface of the same test, natural size.
c. Lateral view of the same test, ditto.
d. Apical disc with madreporiform tubercle, magnified.

2 *a.* PYGURUS PENTAGONALIS, *Phillips.* A large specimen from the Coralline Oolite of Malton imbedded in a fragment of that rock. This beautiful fossil belongs to the Scarborough Museum.
b. Ambulacral area, poriferous zones, and inter-ambulacral plates, magnified twice and a half times.



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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLVIII.

A MONOGRAPH

OF

BRITISH

CARBONIFEROUS BRACHIOPODA.

BY

THOMAS DAVIDSON, F.R.S., F.G.S.,

ETC.

PART V.

SECOND PORTION.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1858.

J. E. ADLARD, PRINTER, BARTHOLOMEW CLOSE.

Obs. Although a description of Martin's *Anomites subconicus* is here appended, and which is taken from the original figure published in the 'Petrificata Derbiensia,' I am far from satisfied that the specific characters or claims of the species have been clearly established, and the more so since no other example could be discovered in our English collections. In 1843, Professor L. de Koninck described and represented *Sp. septosa*, Phillips, under the erroneous denomination of *Sp. subconicus*, Martin, from being at the time unacquainted with the British types of either species; but a few years later my friend had discovered his mistake, and he is now of opinion that Martin's figure may, perhaps, have been drawn from some exceptional specimen or variety of *Cuspidatus*. This may possibly prove a correct interpretation, although I am not at present acquainted with any example of the last-named species with quite so small a number of ribs, but we are all aware how much the specimens of the same species may vary in this particular. Martin observes that the difference between his two species is in the number of furrows or ribs, which in *Subconicus* are few and acute, the central rib or fold being angular instead of a rounded wave in the margin, and the beak of the conic valve is straight or not recurved, as in *Cuspidatus;* but had the author of the 'Petrificata Derbiensia' possessed a larger number of his own *Cuspidatus* he would soon have perceived the little real importance of the above distinctions.

Martin states that his fossil was found in the carboniferous limestone of Middleton, where the shell is said to be *very rare.*

SPIRIFERA TRIRADIALIS, *Phillips.* Plate IX, figs. 4—12.

SPIRIFERA TRIRADIALIS, *Phillips.* Geol. of York., vol. ii, p. 219, pl. 10, fig. 7, 1836.
— TRISULCOSA, *Phillips.* Ibid., pl. 10, fig. 6.
— SEXRADIALIS, *Phillips.* Ibid., fig. 7.
— TRISULCOSA = TRIRADIALIS, *De Koninck.* Descrip. des Animaux Fossiles de la Belgique, p. 266, pl. xvii, fig. 7, *a*, *b*, *c*, 1843.
— SEXRADIALIS, *M'Coy.* British Palæozoic Fossils, p. 421, 1855.

Spec. Char. Circular or longitudinally oval; dorsal valve slightly convex, mesial fold smooth and sharply defined with two, four, or six rounded ribs on either valve; but when two or four only the remaining unoccupied lateral space is smooth. Ventral valve much deeper than the opposite one, with a sinus extending from the extremity of the beak to the front; beak moderately produced; hinge line not longer than about half the width of the shell. Cardinal angles rounded; area small, triangular, with its margins not always sharply defined, so that the lateral portions of the beak are visible on either side; fissure large and partly covered by a pseudo-deltidium. Numerous concentric lines of growth cover the surface of either valve. The dimensions are very variable, those taken from four specimens have produced—

Length 10,	width $10\frac{1}{2}$,	depth 7 lines.	
" 9,	" 8,	" $6\frac{1}{2}$	"
" 6,	" $4\frac{1}{2}$,	" $4\frac{1}{2}$	"
" $5\frac{1}{2}$,	" 5,	" 4	"

Obs. This spirifer appears to have rarely exceeded the dimensions given above; and although the number of its ribs is variable, it appears to be in general a well-characterised and easily recognisable species. After an attentive comparison of the original types upon which Professor Phillips had founded his three species, as well as of numerous other specimens of the same in the British Museum, &c., Professor L. de Koninck and myself have arrived at the conclusion that *Sp. trisulcosa*, figs. 7, 10, 11, and 12, *Sp. triradialis*, figs. 8 and 9, and *Sp. sexradialis*, figs. 4, 5, and 6, are only different states, conditions, or varieties of a single species. It has appeared to us evident that in *Sp. trisulcosa* and in *Sp. triradialis* the smooth or unoccupied space on either valve is occasioned by the last ribs, having been either obliterated or not produced by the animal, for in many individuals they are clearly indicated, although not completely developed.

In a few exceptional specimens, as many as eight ribs have been distinctly counted on either valve, while in a few still more rare instances, such as in the type specimen of *Sp. trisulcosa*, fig. 12, none of the lateral ribs are clearly defined. It would, therefore, appear desirable as well as rational to retain but a single name for the different conditions presented by this variable shell, for otherwise we would be obliged to make as many as four species, based upon the number of ribs each specimen might possess. I have, therefore, retained the term *Sp. triradialis* in preference to the other denominations, simply because it represents the intermediate and most common condition in which the species is found; but, as a general rule, it is always objectionable to give names to species derived from the number of ribs some individual example may possess.

Loc. The different varieties of this species have been found by Professor Phillips, the late Mr. Gilbertson, and others, in the carboniferous limestone of Bolland. It has also been found in Derbyshire. I am not acquainted with any Irish specimen, but it has been obtained from the Carboniferous shales of Lanarkshire in Scotland. It is a rare fossil at Visé, in Belgium, where it has been discovered by Professor de Koninck.

SPIRIFERA PINGUIS, *Sowerby*. Plate X, figs. 1—12.

SPIRIFERA PINGUIS, *Sow.* Min. Con., vol. iii, p. 125, tab. 271, 1820.
— ROTUNDATA, *J. de C. Sow.* Min. Con., vol. v, p. 89, tab. 461, fig. 1, 1824 (not *Anomites rotundatus* of Martin).
— — *Sow.* Davreux, Const. Géogn. de la Province de Liege, p. 272, pl. 7, fig. 8, A, B, 1831.
— — *Sow.* Phillips, Geol. of Yorkshire, vol. ii, p. 218, pl. ix, fig. 17, 1836.

SPIRIFERA PINGUIS, *Sow.* Ibid., figs, 18, 19.
— — *Von Buch.* Ueber Delthyris, p. 38, 1837, and Mém. Soc. Géol. de France, vol. iv, p. 184, pl. 8, fig. 7.
— ROTUNDATUS, *Sow.* De Koninck, Animaux Fossiles de la Belgique, p. 263, pl. xiv, fig. 2, and pl. xvii, fig. 4, 1843.
— PINGUIS, *Sow.* Ibid, p. 661, pl. lvi, fig. 5, 1851.
— — *Morris.* Catalogue, p. 153, 1854.
— — *M'Coy.* British Palæozoic Fossils, p. 420, 1855.
— SUBROTUNDATA, *M'Coy.* Ibid., p. 423, 1855.

Spec. Char. Very variable in shape, dimensions, relative proportions, and degree of convexity. When full grown (under favorable circumstances) the shell is transversely oblong or oval. Sometimes as wide as long, very rarely longer than wide; hinge line rather shorter than the greatest width of the shell; cardinal angles rounded. Dorsal valve not so convex or deep as the opposite one, mesial fold wide, moderately raised, almost smooth, and divided along its middle by a shallow longitudinal depression or groove. Each valve is ornamented by from sixteen to thirty rounded or flattened ribs, which sometimes vary in their relative widths, a small rib being situated side to side by a larger one; they are also regular and simple in the larger number of individuals, but in some a few bifurcate or become more numerous by occasional intercalations. A narrow hinge area is likewise observable in this valve.

Dental or ventral valve at times very gibbous, beak of moderate dimensions, much incurved; area narrow, with a triangular fissure partially covered by a pseudo-deltidium. A sinus of greater or lesser depth extends from the extremity of the beak to the front, and is in general ornamented by two or more narrow longitudinal ribs of but small elevation. The spiral appendages are large, and occupy the greater part of the interior of the shell.

The relative proportions vary considerably, as will be perceived from the measurements taken from four adult individuals:

Length	2	inches	7	lines,	width	3	inches	8	lines,	depth	2	inches.
„	4	„	4		„	2	„	6		„	1	„ 9 lines.
„	1	„	4		„	1	„	6		„	1	„
„	1	„	6		„	1	„	$5\frac{1}{2}$		„	1	„ 4 lines.

Obs. How to deal with the innumerable variations in shape and proportions presented by this species seems to have been no easy matter. Sowerby and Phillips, while describing *Sp. pinguis* and *Sp. rotundata,* Sowerby, as distinct species, did not fail to observe that both were nearly allied forms, and that *Sp. pinguis* may be the young state or a simple variety of *Sp. rotundata,* Sowerby. In his work on the Belgian fossils, Professor de Koninck describes both as separate species, but now relinquishes that idea, and is of opinion that they should be combined under a single denomination. The illustrations I have selected for Plate X demonstrate in the most incontestable manner not only the affinity existing between these two shapes, but their complete specific identity, an opinion founded upon the minute inspection and comparison of two hundred or more individuals. In his work on 'British Palæozoic Fossils,' Professor M'Coy advocates the separation, and states that in *Sp. rotundata,* Sowerby (*Sub-rotundata,* M'Coy), "the depression of the sides or sharpness of the margins form the acute angles at which the valves meet each other, less gibbosity and greater proportional width distinguish specimens of all sizes from the little *Sp. pinguis* of Sowerby, with which in other characters it is identical." Therefore, according to Professor M'Coy, both *are identical in all their characters,* excepting those of size, gibbosity, and the angles at which the valves meet each other. Any one, however, who has studied a number of specimens will soon feel convinced that dimensions, gibbosity, and angles at which the valves meet cannot be considered of specific importance in this present case, since these characters vary in almost every individual; and that every link may be traced connecting the most extreme variations presented by either forms. In Plate X, figs. 1—7 represent Sowerby's *Sp. pinguis,* figs. 8—12 his *Sp. rotundatus;* but the first is indubitably either the young of that author's *rotundatus,* or aged specimens stinted in their regular development, and which is due, no doubt, to local or accidental circumstances, the shell having acquired greater thickness or depth in proportion to its length and width. Therefore, since *all the other and more important characters are identical,* we cannot do better than to follow Mr. Morris,[1] while retaining but one name (*Sp. pinguis*) for both of Sowerby's species.[2] It should likewise be observed that on many full-grown specimens of *S. rotundata* can be seen interruptions in development which agree exactly with the form known as *Sp. pinguis,* but which, on the shell resuming its growth, assumed the shape and proportions of *Sp. rotundata,* Sow. Sometimes also during the earlier portion of their development the ribs were all regular and simple, when, after a sudden interruption, a certain number suddenly bifurcated, as will be perceived in fig. 8. In some examples the ribs are regular and simple on one half of the valve, while on the other several became bifurcated or irregular in their respective widths.

In all well-grown specimens that have come under my observation, the length of the hinge line has been rather shorter than the greatest width of the shell; still, in a few dwarfed individuals, such as in fig. 5, the hinge line is as long as the greatest width of the shell, and the cardinal angles are not rounded; this and other exceptional appearances cannot be taken as the normal condition of the shell, and require to be viewed in the light of those malformations to which all species in the animal or vegetable creation are more or less subjected.[3]

[1] 'Catalogue,' p. 153.

[2] The laws of priority oblige us to make use of the term *pinguis,* that of **rotundata** having been applied to another species.

[3] Geometrical measurements have been resorted to in their descriptions by several naturalists, such as Professor M'Coy, Mr. Kocklin Schlumberger, and others, but the apical or other angles in a Brachiopod are so exceedingly variable in different specimens of a same species that they become of no value whatso-

At all ages *Sp. pinguis* presents a distinct, well-defined, and almost smooth mesial fold, longitudinally divided by a shallow depression or furrow, but no such character is exemplified in Martin's figure or description of his *anomites rotundatus*, which no doubt belongs to another species. In his work on the 'Carboniferous Fossils of Belgium,' Professor de Koninck has included *Sp. ovalis* and *integricosta* of Phillips among the synonyms of *Sp. rotundata*, Sow.;[1] but that distinguished author now admits the last two to be distinct and specifically separate from Sowerby's species. All three must, however, be considered as closely allied species, forming a well-defined group among the carboniferous species of the genus to which they belong.

Sp. pinguis is one of the most abundant fossils at Millecent, Little Island, Malahide, and other Irish mountain limestone localities. In England it occurs at Bolland, Castleton, and in the Isle of Man. I am not acquainted with any Scottish example. In Belgium it was found at Visé and Tournay, by Professor de Koninck, and occurs also in several other continental localities.[2]

SPIRIFERA OVALIS, *Phillips*. Plate IX, figs. 20—26.

SPIRIFERA EXARATA, *Fleming* (?) British Animals, p. 376, 1828.
— OVALIS, *Phillips*. Geol. of Yorkshire, vol. ii, p. 219, pl. x, fig. 5, 1836.
— ROTUNDATA, *Sow*. De Koninck, An. Foss. de la Belgique, p. 263, pl. xv, fig. 4, 1843.
BRACHYTHYRIS OVALIS, *M'Coy*. Synopsis of Carb. Foss. of Ireland, p. 145, 1844.
— HEMISPHERICA, *M'Coy*. Ibid, p. 145, pl. xix, fig. 10, 1844.
SPIRIFERA OVALIS, *Phil.*, = HÆMISPHERICA, *M'Coy*. British Palæozoic Fossils, p. 419, pl. 3 D, fig. 28, 1855.

Spec. Char. Marginally elongated or transversely oval; hinge line less than half the width of the shell, with rounded cardinal angles. Dorsal valve moderately convex and much less deep than the opposite one; mesial fold broad, smooth, and well defined at all ages; depressed or obtusely rounded. From eighteen to twenty simple flattened or rounded ribs ornament the surface of each valve. Ventral valve deep and gibbous; beak

ever as characters. As already stated, the measurements here given are those only of certain individual specimens remarkable for their dimensions, or to show how variable different examples are in their compative proportions.

[1] In his memoir 'Ueber die Fossilien Schlesischen Kohlenkalkes,' 1854, Von Semenow gives as synonyms of *Sp. rotundata*, Martin, *Sp. rotundata*, Sow., *S. ovalis*, *S. integricosta*, Phillips, *Sp. linguifera*, M'Coy, *Sp. hemisphericum*, M'Coy, *Sp. ostiolata*, V. Buch, and *Sp. exarata*, Fleming, but leaves out *Sp. pinguis*, Sow., which he considers to be a distinct species. This synonym is defective in several particulars.

[2] It is hardly necessary to observe that Baron Von Buch was decidedly in error while stating, at p. 184 of the French translation of his memoir on *Delthyrisis*, that *Sp. pinguis* had been found in the rocks of Dudley Castle and Wenlock Edge.

tapering, moderately produced and incurved; area triangular, wider than high; fissure large, partially covered by a pseudo-deltidium. The sinus is rather shallow; commencing at the extremity of the beak; it extends to the front, and is ornamented by one or two longitudinal ribs on each of its sides. There is also a small hinge area in the dorsal valve. Measurements taken from three specimens have produced—

Length 21,	width 20,	depth 13 lines.	
„ 20,	„ 24,	„ 14	„
„ 7,	„ 6,	„ 4	„

Obs. There is no doubt that the shell under description is closely allied to *Sp. pinguis*, but it may be distinguished by the shortness of its hinge line and area, the last being much more triangular and higher in proportion to its width than what is found in any of the numerous examples of *Sp. pinguis* that have come under my observation. The area in *Sp. ovalis* is also at times so small and narrow that the fissure occupies more than half of its entire surface. The dorsal valve is likewise generally not so deep or convex as in *Sp. pinguis*, so that the inequality in convexity of the valves becomes very perceptible; the mesial fold is also more uniformly convex, with rarely any trace of that mesial groove or depression so prevalent in all specimens and ages of the species last mentioned; but it must also be remembered, that although the fold is in general evenly smooth, some exceptional specimens possess a tendency to obscure or undefined plication[1] at all periods of growth. In *Sp. ovalis* the mesial fold is sharply defined (figs. 20—26), while in *Sp. integricosta* it is always distinctly ribbed, so much so, that in many young shells the position of the fold can hardly be distinguished from the lateral plications of the valves (figs. 13—19). All three, *Sp. pinguis, Sp. ovalis, Sp integricosta,* present the same peculiarity of being sometimes longer than wide, and at other times the reverse. And it was from a transverse variety of *Sp. ovalis* that, in 1844, Professor M'Coy founded his *Sp. hemisphærica*, but which name the author abandoned in 1855. It appears to me also very probable that *Sp. exarata*, Fleming, belongs to the same type as *S. ovalis;* but, as Dr. Fleming's shell was never figured, and that his description "Perforated valve with broad, smooth, flattened ribs divided by shallow narrow furrows; beak gibbous, incurved, hinge very short," might apply equally well to several other species, I should question the propriety of adopting that name in preference to the well-known one by Professor Phillips, and especially so as Dr. Fleming has further observed that although he has frequently found the perforated valve it was always mutilated and without the other valve, with which he was not acquainted, as will be perceived from the representation of the original example (fig. 24) kindly communicated by the author. Under any circumstance, the extreme tenuity of the area excludes the possibility of its having belonged to *Sp. rotundata*, Sow., with which it has been erroneously identified.

Sp. ovalis is not a very common fossil in the carboniferous limestone. In England it

[1] This is also the case with some examples of *Sp. pinguis*.

has been collected at Bolland, in the Craven district, at Malham Moor, Lowick, in the Isle of Man, and in several parts of Derbyshire. In Scotland it occurs at Corieburn (Campsie) at Westlothian and Bleith (Ayrshire). In Ireland, Mr. Kelly mentions Ballinacourty, Armagh, and Ballyduff. On the Continent, it has been found at Visé, in Belgium, by M. De Koninck, and at Keokuk, Iowa (America) by Mr. Worthen.

Spirifera integricosta, *Phillips.* Plate IX, figs. 13—19.

> Conchyliolithus anomites rotundatus (*Martin*)? Petrificata Derbiensia, tab. 48, figs. 11, 12, 1809.
> Spirifera integricosta, *Phillips.* Geol. of York., vol. ii, p. 219, pl. x, fig. 2, 1836.
> — rotundata (*Martin*), var. planata, *De Koninck.* Animaux Fossiles de la Belgique, pl. xvii, fig. 4 (not *Sp. planata*, Phillips).
> — paucicostata, *M'Coy?* (British Palæozoic Fossils, p. 420, pl. 3, d, fig. 26, 1855.

Spec. Char. Transversely or longitudinally oval, almost circular when young; hinge line shorter than the greatest width of the shell. The dorsal or dental valve is not quite so deep as the opposite one, and ornamented by from twenty-one to twenty-five simple or bifurcated rounded ribs, of which the three larger or central ones compose the mesial fold, which is but slightly elevated above the regular convexity of the valve, except in the vicinity of the front. Ventral valve convex, beak of moderate dimensions, proportions, and incurvation. The surface is ornamented by from twenty to twenty-four rounded ribs; the mesial sinus extending from the extremity of the beak to the front, and varying both in depth and width in different examples. Area wider than high, divided by a triangular fissure partially covered by a pseudo-deltidium. Measurements taken from three examples have produced—

Length 15, width $14\frac{1}{2}$, depth 11 lines.
„ 14, „ 18, „ 11 „
„ 9, „ 9, „ 5 „

Obs. As I have already had occasion to remark, the principal, and indeed only important difference between *Sp. integricosta* and *S. ovalis* consists in the mesial fold of the first being divided by three or five longitudinal ribs, while in *Sp. ovalis* the same portion of the shell is sharply defined, convex, and generally smooth, the contrast being especially apparent in young shells. It has also appeared to me probable that *Anomites rotundatus* of Martin,[1] was founded on a young specimen of the species under descrip-

[1] Martin describes his species as follows: "Suborbiculatus longitudinaliter sulcatus, margine sinu obsoleto. S. P. A fossil shell. The original an *Anomia.* Perforate valves convex, hinge straight, patulose short; foramen triangular. The general form of the shell somewhat orbicular and in a slight degree compressed, as the convexity of the valves does not equal that which is found in other Anomitæ of the same

tion;[1] but the figure is not sufficiently precise to warrant a decided assertion, and for which reason I have retained the name subsequently introduced by Professor Phillips. In his work on the 'British Palæozoic Fossils,' p. 423, Professor M'Coy justly observes that *Sp. rotundata*, of Martin, is quite distinct from *Sp. rotundata*, Sow.; but is decidedly in error while considering *Sp. planata*, of Phillips, a synonym of Martin's species, for a comparison, however slight, of the last-named shell (Pl. VII, figs. 28—36) with that of Martin, of which I have reproduced the original illustration (Pl. IX, fig. 27), will, I believe, convince any one of the greater probability of Martin's shell being that of a young specimen of *Sp. integricosta*, because, besides a difference in its general shape, the ribs of *Sp. planata* are always proportionately smaller and more numerous than in Martin's figure. *Spirifera paucicostata*, M'Coy,[2] of which I have reproduced the original drawings (Pl. IV, fig. 12), is, perhaps a variety of *Sp. integricosta*, but not of *Sp. pinguis*, as was erroneously printed in the description facing Pl. IV of the present monograph. The ribs on the mesial fold, as well as the general shape of the shell, are more those of Phillips's than of Sowerby's species. *Sp. integricosta* is not a very common species in the carboniferous limestone; it occurs at Bolland, in the Craven district, Northumberland, &c. It was also collected in the Isle of Man by the Rev. Mr. Cumming. In Ireland Mr. Kelly mentions Bundoran, Millecent, and Little Island. In Scotland it has been found at Gare, in Lanarkshire.

Spirifera fusiformis, *Phillips*. Pl. XIII, fig. 15.

Spirifera fusiformis, *Phillips*. Geol. of Yorkshire, vol. ii, p. 217, pl. ix, figs. 10, 11, 1836.

Spec. Char. Fusiform, about three times as wide as long, the beak and umbone

tribe. Valves longitudinally furrowed; margin obtusely crenate, with a scarcely distinguishable sinus. The beak of the larger valve incurved. A small and not a very common species. Limestone, Middleton.

[1] Professor De Koninck informs me that he is now of the same opinion.

[2] Professor M'Coy describes his species as follows:

"*Spec. Char.* Globose, or very broad-ovate; hinge line slightly shorter than the width of the shell; cardinal angles slightly obtuse, sides and front moderately rounded, very obtuse from the meeting of the valves at a large angle, front abruptly raised into a wide semi-elliptical sinus. Entering valve evenly convex; sides tumid, with six or seven strong, rounded, obtuse simple ribs on each side; mesial ridge broad, prominent, very strongly defined from the beak, having three ridges about the size of the lateral ones, each of which dichotomoses close to the margin. Receiving valve very gibbous, semicircularly arched from the beak to middle of front margin. Mesial sinus deep, strongly defined from the beak, having at first three, subsequently six, small obscurely marked ribs; beak very large, incurved; cardinal area moderately wide."

Length $7\frac{1}{2}$, width 9, depth 6 lines.

"This species is most nearly allied to *S. trigonalis*, from which it is distinguished by the more spheroidal form, the obtuse rounding of the sides, and the very small number of its lateral ribs. The distinctly ribbed mesial ridge (fold) separates it from *S. pinguis*, as well as its more depressed form, and the fewer and more prominent radiations. Not very uncommon in the carboniferous limestone of Derbyshire." ('British Palæozoic Fossils,' p. 420.)

almost upon a level. The dorsal valve not quite so deep or convex as the opposite one; mesial fold defined, but not much elevated above the level of the valve. In the ventral valve the sinus extends from the extremity of the small incurved beak to the frontal margin; hinge line and area as long as the greatest width of the shell, to which the lateral margins of each valve rapidly converge, producing acute terminations. The area is of moderate width, and divided by a small triangular fissure. External surface finely striated (?).

Length $4\frac{1}{2}$, width 14, depth 4 lines.

Obs. I am acquainted with but a single imperfect individual of this shell, the original type forming part of Gilbertson's collection now in the British Museum. Professor Phillips states the surface to be finely radiated; but the Museum specimen, which is deprived of almost all its shell, is nearly smooth, showing indications of radiating striæ, but at the umbone and in the vicinity of the cardinal edge; therefore, from such imperfect material, it is hardly safe to conjecture as to the condition of its external sculpture. It is, however, probable that in the perfect shell the surface may have been such as was described by Professor Phillips, and this opinion appears to be strengthened from the fact that an American mountain limestone Spirifer, collected at Clifton, Illinois, by Mr. Worthen, closely resembles in shape the shell under description, and the external surface of which is finely striated. *Sp. fusiformis* cannot be confounded with *Sp. convoluta*, Phillips, or *Sp. subconica*, Martin, on account of the difference in the character of its surface, which could not have been strongly ribbed.

Loc. Bolland.

Spirifera rhomboidalis, *M'Coy.* Pl. XII, figs. 6, 7.

Martinia rhomboidalis, *M'Coy.* Synopsis of the Carboniferous Fossils of Ireland, p. 141, pl. xxii, fig. 11, 1844.

Spec. Char. Rhomboidal, gibbous, slightly wider than long; hinge line much shorter than the width of the shell; cardinal angles rounded; beak of the ventral valve small, much incurved, with a deep wide, angular sinus extending from the extremity of the beak to the front; area small, fissure partially covered by a pseudo-deltidium. In the dorsal valve the mesial fold is prominent and almost angular from rapid slope of its lateral portions; surface of both valves ornamented with numerous small radiating obscurely-rounded ribs.

Length 9, width 10, depth 7 lines.

Obs. This shell does not appear to have often exceeded the dimensions above given, and is easily distinguished by its rhomboidal shape, almost angular elevated fold, deep linguiform sinus, and small undefined rounded ribs. Professor M'Coy's original example was derived from the Carboniferous limestone of Cork, and I possess another from

Millecent, in Ireland. No English or Scottish specimens appear to have been hitherto discovered.

Spirifera Urii, *Fleming*. Pl. XII, figs. 13, 14.

Spirifera Urii, *Fleming*. British Animals, p. 376, 1828, reference. *David Ure*, The Natural History, &c., of Rutherglen and Kilbride, p. 313, fig. 12, 1793.
— unguilicus, *Phillips*. Palæozoic Fossils, tab. xxviii, 119, according to Morris, Catalogue of British Fossils, p. 154.

Spec. Char. Suborbicular, rather wider than long; hinge line shorter than the greatest breadth of the shell; cardinal angles rounded. Dorsal or socket valve semicircular, slightly indented in front, with a narrow hinge area; nearly flat or but slightly convex, most so at the umbone, with a shallow mesial furrow commencing at a short distance from the umbone and extending to the front. Ventral valve much more convex and deep than the opposite one, with a lengthened incurved beak, and longitudinal furrow commencing at the extremity of the beak and extending to the front. The area is triangular and of moderate length and width, the fissure being partly closed by a pseudo-deltidium. The external surface is smooth in the generality of specimens; but, when perfect, was covered with small spinules. Dimensions variable; the largest British specimen I have seen measured—

Length 4, width $4\frac{1}{2}$, depth 2 lines.

Obs. This interesting little shell was noticed and figured for the first time by David Ure, but not named or described, an omission which was filled up by Dr. Fleming thirty-five years later, in his excellent work on 'British Animals.' Ure's illustration would convey the idea that the beak was not incurved; but in all the numerous examples I have been able to examine the shell possessed a gibbous lengthened incurved beak, as described by Dr. Fleming; but Ure did not fail to observe and represent an area on either valve. *Sp. Urii* does not appear to have ever attained proportions much exceeding those here given, and was in general a much smaller shell, for, out of many hundred examples collected by a zealous friend at Carluke, the largest did not exceed 4 by $4\frac{1}{2}$ lines in length and width. *Sp. Urii* closely resembles the Permian *Sp. Clannyana,* King, as I have already stated at p. 16 of my 'Monograph of British Permian Species;' and *Sp. unguiculus,* mentioned to occur in the Upper Devonian of Petherwin, Barnstaple, Pilton, and Brushford, is either the same or a closely allied species or variety.

Sp. Urii was stated by David Ure to be plentifully found in a lime quarry on the east bank of the Aven, a little below Strathaven. It abounds near Carluke, and has been found at Corieburn (Campsie) by Mr. J. Young. Dr. Fleming has it also from Westlothian, in Scotland. In England it does not appear to be so common a fossil. I have seen a specimen from Bolland, and some other examples were discovered at South Petherton by the late Mr. D. Sharpe, and form part of his collection.

On the Continent it has been discovered at Tournay, in Belgium, by Professor L. de Koninck, and where the shell attains rather larger dimensions than is common to our British individuals.

Although the external surface of all the specimens of *Sp. Urii* appeared smooth, by the help of the lens I was able to discern in some examples the broken base of numerous spinules, which must have covered its surface in the perfect condition.

SPIRIFERA CARLUKENSIS, *Davidson.* Pl. XIII, fig. 14.

Spec. Char. Shell minute, nearly circular, and smooth; valves almost equally deep. Dorsal valve regularly convex, most so at the umbone. Ventral valve convex, with a narrow mesial depression or furrow commencing at a short distance from the extremity of the beak and extending to the front, where it indents the margin of the opposite valve. Beak small, pointed, and but slightly incurved; hinge line much shorter than the greatest width of the shell, with its cardinal angles rounded; area small, triangular, with a comparatively large fissure.

Length 2, width $2\frac{1}{4}$, depth $1\frac{1}{4}$ lines.

Obs. This little shell, which I believe to be new, was discovered in the Carboniferous beds of Hill Head, Carluke parish, Scotland, by the same friend to whom I am indebted for so much information relative to the Lanarkshire species. It is easily distinguished from *Sp. Urii,* with which it is associated by the almost equal convexity of its valves, and by the absence of a mesial groove on the dorsal valve. The beak is likewise much smaller, more acute, and less incurved. *Sp. Carlukensis* does not appear to have been a very common shell in its locality, where a hundred or more of *Sp. Urii* may be collected for one of the species under description, nor am I acquainted with the shell from any other British or foreign locality.

SPIRIFERA GLABRA, *Martin.* Pl. XI, figs. 1—9; Pl. XII, figs. 1—5, 11, 12.

CONCHYLIOLITHUS ANOMITES GLABER, *Martin.* Petrif. Derb., pl. xlviii, figs. 9, 10, 1809.
SPIRIFER GLABER, *Sowerby.* Min. Con., vol. iii, p. 123, pl. cclxix, fig. 1, May, 1820.
— OBTUSUS, *Sowerby.* Ibid., p. 124, pl. cclxix, fig. 2.
— OBLATUS, *Sowerby.* Ibid., p. 123, pl. cclxviii.
— GLABER, *Davreux.* Const. Geogn. de la Province de Liege, p. 272, pl. vii, fig. 1, 1831.
TRIGONOTRETA OBLATA, *Bronn.* Leth. Geogn., i, p. 81, pl. ii, fig. 16, 1836.
SPIRIFERA GLABRA, *Phillips.* Geol. of Yorksh., vol. ii, p. 219, pl. x, figs. 10—12, 1836.
— LINGUIFERA, *Phillips.* Ibid., fig. 4.
— SYMMETRICA, *Phillips.* Ibid., fig. 13.

Spirifera decora ? Ibid., fig. 9.
Spirifer lævigatus, *V. Buch.* Mémoirs de la Soc. Geol. de France, vol. iv, p. 198, pl. x, fig. 25, 1840.
— glaber, *De Koninck.* Animaux fossiles de la Belgique, p. 267, pl. xviii, fig. 1.
Martinia glabra, *M'Coy.* Synopsis of Carb. Foss. of Ireland, p. 139, 1844.
— obtusus and oblatus, *M'Coy.* Ibid.
Spirifera glabra, *M'Coy.* British Palæozoic Fossils, p. 428, 1855.

Spec. Char. Very variable in shape and proportions; transversely oval, rarely as long or longer than wide. Valves almost equally convex, with a mesial elevation or fold in the dorsal, and a sinus in the ventral valve. Hinge line much shorter than the greatest width of the shell; cardinal angles rounded; beaks rather approximate, that of the larger or ventral valve prominent, incurved, and of moderate dimensions. A hinge area in the dorsal valve, that of the ventral one triangular and of moderate dimensions, with its lateral margins more or less sharply defined; fissure partially covered by a pseudo-deltidium. The mesial fold in the dorsal valve is either slightly and evenly convex, rising gradually from the lateral portions of the valve, or abruptly elevated, with a longitudinal depression along its middle, which is also at times reproduced in the sinus of the ventral one. The spiral appendages are large, and occupy the greater portion of the interior of the shell.[1] Surface of valves in general smooth, but sometimes a few obscure rounded ribs may be observed on their lateral portions. Dimensions taken from five examples have produced—

Length	32,	width	43,	depth	26	lines.
,,	31,	,,	36,	,,	21	,,
,,	24,	,,	34,	,,	13	,,
,,	24,	,,	25,	,,	19	,,
,,	14,	,,	13,	,,	8	,,

Obs. Martin's illustration of *Sp. glabra* is one of the many modifications assumed by this very variable species, and I feel disposed to agree with Professor De Koninck, while considering *Sp. oblatus* and *S. obtusus* (Sow.), *Sp. symmetrica*, *Sp. linguifera*, and *Sp. decora*, of Phillips, as simple varieties or variations in shape of Martin's shell. In the 'Synopsis of Carboniferous Fossils,' Professor M'Coy retained all the above-named shells as distinct species, but in his more recent work on 'British Palæozoic Fossils,' Sowerby's two shells are reduced to the rank of varieties of *glabra*, and there can exist no

[1] I have already had occasion to remark, at p. 81 of my General Introduction, that in p. 139 of his 'Synopsis,' Professor M'Coy has described and represented the spiral appendages of *Spirifera* (*Martinia*) *glabra* so small as only to occupy the rostral half of the shell, but this has been proved incorrect, for all the specimens obtained in which the spirals were preserved, have shown them to be as large as in any other species of the genus. Fig. 9 of my Plate XI is a representation drawn from the original example figured by Sowerby in tab. 268 of the 'Min. Con.,' thirteen years prior to the publication of M'Coy's 'Synopsis.'

possible doubt as to the close affinity or specific identity between *Sp. oblatus, Sp. obtusus*, and Martin's shell; those of Phillips, therefore, will alone require some further consideration.

The original specimen on which *Sp. symmetrica* was founded forms part of the Gilbertsonian collection in the British Museum, and has appeared to Professor De Koninck, as well as to myself, to be a variation of *S. glabra*, in which the mesial fold is but feebly elevated above the regular convexity of the valve, with also a slight longitudinal depression or groove along its middle (Pl. XI, fig. 6). Nothing seems to be more variable than the development of the mesial fold, for it is entirely absent in some young individuals, while in others of a similar age it becomes sharply defined.

Professor M'Coy has strongly urged the maintaining of *Sp. symmetrica* as a distinct species, probably from not having had sufficient opportunity of studying the original type, for otherwise he would have seen that it has not those distinctive features he so emphatically announces. "This beautiful and very distinct species varies very little in its characters; . . . . it is remarkable for the nearly regular rhomboic outline of the receiving valve; for the broad, often minutely notched, sinus in the front margin, producing scarcely any distinct mesial ridge; and for the strong, filiform subregular, distant radiating lines from the beak to the margin of the interior, often appearing on the external surface. Two specimens differ remarkably (one from Lowick and one from Derbyshire), by the hinge line being only $\frac{45}{100}$ as compared to the width; and one of them, by the length nearly equalling the width, and the shortness of the beak of the receiving valve, so strongly approximates to *S. decora*, that I suspect additional experience may unite these species. Both differ from all the varieties of *Spirifera* (*Martinia*) *glabra* by the strong threadlike, subregular, internal ridging from the beak to the margin." To this I would observe, that the length of hinge line and area in many indubitable examples of *S. glabra* is not more than a third of the breadth of the shell, and, in such cases, entirely agreeing with what we find in typical shapes of *Sp. decora*. The rhomboic outline, also, is not constant in the last-named shell, as a series of specimens from the Island of Man has completely confirmed; and it is rare to meet with specimens so strongly marked as the one represented (Pl. XII, fig. 12), for every passage or intermediate link will be found connecting it with the more common shapes of *glabra*. The double longitudinal groove observable along the middle of the sinus and in the mesial fold is likewise to be seen in many specimens of Martin's shell (Pl. XI, fig. 1), as well as the filiform, subregular, distant radiating lines mentioned by Professor M'Coy. I therefore agree with the last-named author, while considering *Sp. decora* intimately connected with *Sp. symmetrica*, but must also go a step further, by uniting the last-named shell to Martin's species.

It is worthy of remark, that although the surface of *Sp. glabra* is in general entirely smooth, in some exceptional cases there is a tendency to the formation of rounded ribs on the lateral portions of the valves (Pl. XII, fig. 3), and to this variation must be referred Professor Phillips's *Sp. linguifera*, of which fig. 4 is a representation, drawn from the original Gilbertsonian example in the British Museum, and from which it will be perceived that up to a certain age the shell was entirely smooth, but that after an interruption in its regular growth, some slightly marked ribs were suddenly produced (figs. 3—5). It will therefore be necessary to look upon these and similar specimens as exceptional shapes, as we would do for figs. 1 and 2 of the same plate.

Professor De Koninck has recently informed me that he feels disposed to separate those more flattened specimens with smaller beak and finer shell-texture (?) from *Sp. glabra* proper (Pl. XI, figs. 3, 4), by the name of *Sp. glaberrimus;* that in the last-named shell the mesial fold is at all ages uniformly and evenly convex, while in Martin's *S. glabra* it is divided by a longitudinal depression or furrow; but as I have not been able to convince myself that these characters have any real permanency, I must leave to other palæontologists to decide whether we can adopt the learned Professor's suggestion.

Sp. glabra has been mentioned as occurring in the Devonian rocks of several localities, and I possess small specimens from Barton, in Devonshire, which appear undistinguishable from some from the Carboniferous limestone.

Loc. Sp. glabra is one of the most abundant of Carboniferous limestone fossils. Martin's specimens were obtained at Chelmerton, Tideswell, and in several other localities in the gray limestone of Derbyshire. Sowerby mentions Scaliber, near Settle, in Yorkshire, and Axton Quarry, south-west of Llanasa, in Flintshire. It is abundant at Bolland, and in lower dark Carboniferous limestone of the Isle of Man, in that of Lowick, Northumberland, at Kendal, and in numerous other English localities. In Scotland it occurs at Harestanes and Hill Head, near Carluke, as well as at Beith, Ayrshire. In Ireland, Mr. Kelly furnishes us with the following localities: Malahide, Little Island, Carrownanalt, Clonea, Mullaghboy, Mullaghfin, Cornacarrow, Millecent, &c. On the Continent it is also a very common Carboniferous limestone fossil at Visé, Tournay, &c., in Belgium; at Ratingen; at Sablé, in France; and it has also been collected in Russia, America, &c.

SPIRIFERA LINEATA, *Martin*. Pl. XIII, figs. 1—13.

CONCHILIOLITHUS ANOMITES LINEATUS, *Martin*. Petrif. Derby., tab. xxxvi, fig. 3, 1809.
TEREBRATULA LINEATA, *Sow*. Min. Con., vol. iv, p. 39, tab. cccxliii, figs. 1, 2, March, 1822 (not tab. ccccxciii, fig. 1).
— IMBRICATA, *Sow*. Ibid., pl. cccxxxiv, fig. 3.
SPIRIFERA MARTINI, *Fleming*. British Animals, p. 376, 1828.
— LINEATA, *Phillips*. Geol. of Yorksh., p. 219, pl. x, fig. 17, 1836.
— ELLIPTICA, *Phillips*. Ibid., fig. 16.
— IMBRICATA, *Phillips*. Ibid., fig. 20.
— MESOLOBA, *Phillips*. Ibid., fig. 14.
— LINEATUS, *Von Buch*. Mémoirs de la Soc. Geol. de France, vol. iv, p. 199, pl. x, fig. 26, 1840.
— — *De Koninck*. Animaux fossiles de la Belgique, p. 270, pl. vi, fig. 5, and pl. xvii, fig. 8, 1843.

RETICULARIA RETICULATA, *M'Coy.* Synopsis of the Carb. Limestone Fossils of Ireland, pl. xix, fig. 15, 1844.
— IMBRICATA, *M'Coy.* Ibid., p. 143.
— LINEATA, *M'Coy.* Ibid.
MARTINIA STRINGOCEPHALOIDES, *M'Coy.?* Ibid., p. 141, pl. xxii, fig. 8.
SPIRIFERA ELLIPTICA, *M'Coy.* British Palæozoic Fossils, p. 427, 1855.
— IMBRICATA, *M'Coy.* Ibid., p. 429.
— LINEATA, *M'Coy.* Ibid.

Of this species two principal varieties may be distinguished.

1st. Var. *a*, LINEATA, Martin = *imbricata*, Sow. = *Martini*, Fleming = *reticulata*, M'Coy. Pl. XIII, figs. 1—13.

Spec. Char. Transversely oval, or sub-orbicular; hinge line much shorter than the width of the shell, cardinal angles rounded; beaks more or less approximate and considerably incurved. Ventral valve gently and evenly convex, rarely exhibiting any mesial elevation. Dorsal valve rather deeper than the opposite one, uniformly convex or presenting a shallow longitudinal depression, apparent only in the proximity of the front, or extending to the extremity of the beak. Area small, with lateral margins obscurely defined, fissure triangular, partially covered by a pseudo-deltidium. Surface of both valves marked by numerous and regularly imbricated lines, the radiating striæ being either so close that they can hardly be distinguished or varying in their degree of proximity, but rarely in any place more than a line apart. The concentric lines differ likewise in a similar manner, but are in general more widely separated, in some examples being barely distinguishable, while at other times they form strong, broad, flattened, or slightly rounded ridges. The spiral appendages occupy the greater part of the interior, and do not differ in detail from those of other species composing the genus. Two examples have measured—

Length 12, width 16, (Martin's type.)
,, 20, ,, 23, depth 13 lines.

2d. Var. *β*, ELLIPTICA, Phillips. Figs. 1—3.

Transversely elliptical, always wider than long, with an obtuse, slightly elevated mesial fold in the dorsal, and a defined longitudinal sinus in the ventral one; hinge line rather exceeding half the width of the shell; area triangular; fissure large, and partially closed by a pseudo-deltidium; beak rather small and incurved, but not contiguous to that of the opposite valve. Surface ornamented by small radiating striæ intersected by numerous small concentric ridges. A large specimen has measured—

Length 25, width 36, depth 18 lines.

Obs. A difference in opinion has been expressed as to the specific claims of the shells here combined under the single denomination of *Sp. lineata,* Martin; and I am aware that several authors still maintain *Sp. lineata*, *Sp. imbricata*, and *Sp. elliptica* to be specifically distinct; but, after a long and attentive examination of a very numerous series of all those shells, at different stages of growth and from various localities, I have discovered so many intermediate shapes that it has appeared to me impossible to arrive at any other conclusion but that they are all variations of a single species. This view was similarly expressed in 1843 by Professor L. de Koninck, but contested in 1855 by Professor M'Coy, who, having enumerated the specific characters of *Sp. elliptica*, observes—"I agree with Mr. Phillips in considering this quite a distinct species from *Sp. lineata* with which M. De Koninck has united it. At all ages and sizes it is more transverse, more depressed, the beaks are further apart, and, above all, the species is distinguished by the sinus in the front margin and the strong mesial hollow extending to the apex of the beak. It is only when the shell is removed that the comparatively strong radiating striæ figured by Phillips are seen. The reticulations exactly resemble that of *Sp. lineata*."

While speaking of *Sp. imbricata*, the same author further observes—"This species is very easily distinguished from *Sp. lineata*, with which some Continental authors unite it, by the great width and coarseness of the concentric lamellar ridges, and the much fewer, broad, obtuse, longitudinal fimbriations in a given space. It is also less wide, has generally some trace of mesial hollow, and has an unusually coarse fibrous tissue under the lens." And again, under *Sp. lineata*, he states—"This species, from the peculiar structure of the surface, and the slight divergence of the dental lamellæ with the strong mesial septum, was originally combined in my 'Synopsis' (of Carb. Foss.) with *Sp. imbricata*, *S. reticulata*, *S. microgemma*, &c., into a little group called *reticularia*. There is a fine submedian impressed line, apparently a fracture, visible in many specimens from the beak to the front margin."

From the statements here made it will be perceived that the most important distinctions Professor M'Coy can suggest between *Sp. elliptica* and the other two shells are that Phillips's species possesses "a sinus in the front margin and a strong mesial hollow extending to the apex of the beak;" but these distinctions lose much of their importance from the fact that in some specimens of true *Sp. lineata* and *imbricata* there also exists a sinus and mesial hollow extending to the apex of the beak. The beaks are likewise not always approximate in the last two shells, although more commonly so than in *Sp. elliptica*. All three are often extremely transverse, and, as admitted by Professor M'Coy, the reticulations of *Sp. elliptica* and *Sp. lineata* are exactly similar.

It will also be found that in different examples the radiating striæ and concentric lines or ridges vary in their degree of strength and proximity; in some (figs. 8 and 10) the decussating lines are so fine and so close that the shell appears almost smooth, while at other times the concentric ridges are much stronger and more separate than the radiating ones, which vary both in number and proximity, and thus constituting the only appreciable difference between the typical examples of *Sp. lineata*, figs. 4, 5, 6, 9, and *Sp. imbricata*, figs. 11 and 12, of authors.

Sp. mesoloba, Phillips, has been placed by Mr. Morris among the synonyms of *Sp. glabra* ('Catalogue,' p. 152); but the inspection of the original Gilbertsonian specimen in the British Museum has convinced both Professor de Koninck and myself that the shell in question will require to be considered as a variety of Martin's *Sp. lineata,* in which a small mesial elevation is somewhat unusually developed, but exaggerated in the original representation, of which fig. 10 of my Pl. XI is a reproduction.

I will only further remark that since the majority of authors seem inclined to maintain both *Sp. lineata* and *S. elliptica,* I have described them separately, but as varieties of a single species, and must leave for future observers to determine whether or not this is to be taken as a correct interpretation.

The specific claims of *Martinia stringocephaloides* are very uncertain, notwithstanding the lengthened description given by Professor M'Coy, at p. 141 of his 'Synopsis.' In Pl. XII, fig. 15, will be seen a reproduction of the author's original illustration, the specimen from Lisnapaste being no longer to be found in Mr. Griffith's collection. Fig. 16 is another example from Old Leighlin, in the Royal Dublin Society's Museum, and stated to have been so labelled by the author himself. In Professor Phillips's opinion, as well as in my own, these two shells bear so much external resemblance to some *S. lineata* that, until better evidence to the contrary arises, I have considered that it will be preferable to leave it with the last-named species, as it is always desirable to burden the nomenclature as little as possible. Professor M'Coy gives us the following specific character: "Suborbicular, gibbous; dorsal valve (our ventral one) produced in a lengthened acute beak; cardinal area narrow, acute, angular; no mesial fold; surface marked with regular concentric lines." The only objections that could be adduced against our interpretation is, that no radiating lines are mentioned, and that the beak of the larger valve is more produced or lengthened than is usually the case in Martin's shell; but this character is far from being constant, as seen by fig. 16. The radiating lines in certain examples of *Sp. lineata* are likewise so faintly marked and so minute that they may have become obliterated in the only two specimens that appear to have been found. Professor M'Coy states, moreover, that "this remarkable shell seems to conduct to the *Pentameræ* by means of *Stringocephalus;*" but I cannot perceive the gradation, for the shell in question possesses the spirals of a *Spirifer,* as represented by the author in his woodcuts (figs. 24 and 25) while *Pentamerus* and *Stringocephalus* have an entirely different internal arrangement; he would have been nearer the mark had he mentioned that by its external shape *S. stringocephaloides* conducted us to *Athyris.* The concentric lines or ridges in Professor M'Coy's species are also exactly similar to those observable in *S. lineata.*

Loc. *Sp. lineata* and its variety, *S. imbricata,* are among the most abundant of carboniferous limestone fossils. Martin found it at Castleton, Hope, Dovedale, and in other localities of the main carboniferous limestone of Derbyshire, in the Black Rock, Clifton, Bolland, and Settle, Kirkby Lonsdale, Crooklands, and the lower carboniferous limestone of Lowick, Northumberland, Malham Moor, about Berwick-on-Tweed, also in Pembrokeshire, &c. In Scotland, Dr. Fleming has collected the shell at Dreghorn and Ayr. Mr. H. Miller found it at Dryden, near Edinburgh, and Courland, near Dalkeith. It occurs also at Carluke and Balquarhage, near Campsie. In Ireland it is also very abundant. Mr. Kelly furnishes us with the following localities: Lisnapaste, Ardagh, Little Island, Millecent, Larganmow, Tornaroan, Armagh, and Bannaghagole.

The var. *elliptica* occurs in many localities along with the more common varieties of *lineata*, at Bolland and in the lower carboniferous limestone of Kendal, Westmoreland, at Millecent, in Ireland, &c.

Sp. lineata and its variety, *elliptica*, are also very common shells in many foreign carboniferous localities. Professor de Koninck names Visé, Males, near D'Ath, at Lives and Chockier, in Belgium; at Ratingen, &c. In the Geology of Russia, M. de Verneuil and Count Keyserling mention Podolie, Sterlitamach, Sarana, Simsk, Becheva, &c. In America it has been found in several localities, such as Keokuh, Iowa.

Sub-Genus—CYRTIA, *Dalman*, 1827, and CYRTINA, *Dav.*, 1858.

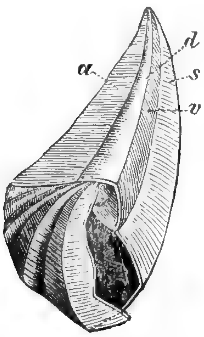
In the eighty-third page of my general introduction doubts are expressed as to the value of Dalman's CYRTIA, and his diagnosis is there stated to be unsatisfactory and equally applicable to several species of *Spirifer*.[1] In fact, the genus appears to have been created simply to receive those few species of Spirifer which possess a circular foramen in the deltidium of the larger valve, for the author did not furnish us with any information regarding the internal arrangements of his two named types, *C. exporrecta* and = *C. trapezoidalis*. Subsequently to 1827 several other species were added (by different authors) to the genus *Cyrtia*, and among these are some whose shell structure has been stated to be punctate, while that of Dalman's type is unpunctate, as in *Spirifer* proper, and although it has always appeared to me probable that a difference in shell structure would be accompanied by some important interior modification, it was not until very lately that I was enabled to discover some of the characters of the following species: 1, *C. exporrecta*; 2, *C. trapezoidalis*; 3, *C. Murchisoniana*; 4, *C. cuspidata*; 5, *C. heteroclyta*; 6, *C. Demarlii* and *C. septosa*.[2] The results of my examination will show that in the first four, which belong to Dalman's genus, the internal characters are similar, but different from the last three, which cannot be properly retained under the same generic denomination,

[1] As we progress with our investigations, and as obscure points are gradually made clear, it is sometimes necessary to correct or to modify conclusions which may have resulted from the study of imperfect or insufficient material.

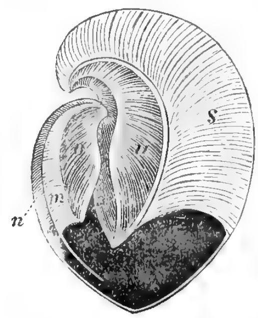
[2] As I have had no opportunity of studying the interior of the other species classed with *Cyrtia*, it will not be necessary to mention their names in the present instance.

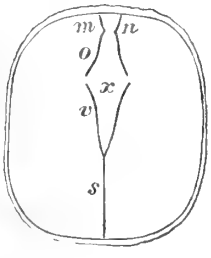
for it is evident that considerable dissimilarities in the arrangements of the plates of the ventral valve must have carried along with them some important difference in the soft portions of the animal, and I therefore propose at least provisionally to distinguish the little groups of spiriform shells of which *C. heteroclyta*, *C. Demarlii*, and *C. septosa* are examples under the generic or sub-generic appellation of CYRTINA,[1] and to leave that of CYRTIA to those shells which agree with Dalman's *C. exporrecta*, *C. trapezoidalis*, and *C. Murchisoniana*, &c.; but it is necessary to observe that the last-named genus is in itself of such little value that it will remain a question for further discussion whether it should be retained or added to the synonyms of Sowerby's *Spirifer*.

In CYRTIA a short hinge tooth is situated on either side at the base of the fissure, supported by vertical shelly plates which diverge and extend from the extremity of the beak forming the fissure walls and occupying about one-third of the length of the bottom of the valve, as may be perceived by a reference to the woodcut in page 45.[2] There exists in *Cyrtia* no median plate or septum, the arch-shaped deltidium which covers the entire fissure is generally, but not always, perforated by a circular foramen.[3] In the smaller valve the spiral appendages and their mode of attachment is exactly similar to what we find in *Spirifer*, and with which the plates in the ventral valve also very closely agree.



Cyrtina heteroclyta, slightly enlarged.





Pentamerus Knightii.

Fig. 2. Longitudinal section. Fig. 3. Transversal section.

s. Septum. *v.* Dental plates. *x.* V-shaped chamber. *m* and *n.* Diverging plates of the dorsal valve (in *Pentamerus*), to which are attached the curved plates *o.* *a.* Area. *d.* Deltidium.

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[1] The diminutive of *Cyrtia* is *Cyrtidium*, but I have preferred bad Greek to a long name.

[2] The position and extent of these dental or rostral plates may sometimes be observed on the exterior of the shell, and especially on slightly worn specimens, by two diverging lines departing from the extremity of the beak (Pl. VII, fig. 22, s). In the upper Llandovery rock of May Hill are found many internal casts of *C. trapezoidalis*, which exhibit in a very beautiful manner the slits produced by the diverging plates; but these may be at any time exposed by grinding a portion of the beak of the Wenlock or Gothland specimens.

[3] The foramen is sometimes tubular, and especially so in certain Chinese examples of *C. Murchisoniana.*

Therefore *Cyrtia*, of Dalman, presents no other feature by which it can be separated from *Spirifer* proper, than that of its deltidium and foramen, which are characters of hardly sufficient importance to warrant the creation of a separate genus.

In our British carboniferous rocks, the only two forms known to me that could be referred to Dalman's *Cyrtia* are the *S. cuspidata* and *S. distans*.

In CYRTINA, the diverging plates already described do not exist, but we find in the interior of the ventral valve (of *C. heteroclyta* and *C. septosa*), two contiguous vertical septa (Pl. XIV, figs. 6, 7, 8), which coalesce into one median plate, which extends from the extremity of the beak to within a short distance of the frontal margin and then diverges to form the dental plates, in a very similar manner to what we perceive in *Pentamerus*.

The fissure is covered by an arch-shaped deltidium; but, in *C. Demarlii*, Mr. Bouchard has remarked that the median septum is continued as far as the under surface of the deltidium, and the dental plates are fixed to the sides, instead of the upper edge as in *C. heteroclyta* and *C. septosa*. The arrangements in the smaller or more important valve are still unknown, notwithstanding the many efforts I have made to pry into their interior; and it is certain that no vestige of spiral coils have hitherto been noticed by any author. Therefore, although we possess no proof that these three species of *Cyrtina* were possessed of spirals, and consequently true SPIRIFERIDÆ, it will be necessary to pause before admitting the shells in question into the genus *Pentamerus*.

CYRTINA SEPTOSA, *Phillips*. Pl. XIV, figs. 1—10, and Pl. XV, figs. 1, 2.

SPIRIFERA SEPTOSA, *Phillips*. Geol. of Yorkshire, vol. ii, p. 216, pl. xi, fig. 7, 1836.
— SUBCONICUS, *De Koninck*. Animaux Fossiles de la Belgique, p. 255, pl. xii, *bis* fig. 5, *a*, *b*, *c*, 1843 (not *Anomites subconicus*, Martin, 1809).

Spec. Char. Very transverse, somewhat lozen-shaped; hinge-line as long as the greatest width of the shell; ventral valve moderately convex, subpyramidal, with a narrow sinus extending from the extremity of the beak to the frontal margin. Area very large, triangular, slightly curved upwards, and at an obtuse angle to the plane of the dorsal valve, the beak not protruding beyond or above the angular extremity of the area; fissure large, deltidium (?). Dorsal valve semicircular, convex, divided by a narrow, slightly elevated mesial fold, surface of both valves ornamented by from forty to seventy small angular ribs, which increase in number from bifurcation as well as intercalation as they proceed from the beaks to the frontal margin; six or seven of these form the mesial fold, and about a similar number that of the sinus, the radiating ribs being likewise intersected by numerous concentric lines or laminæ of growth.

In the interior of the ventral valve two large contiguous vertical plates or septa coalesce into one median plate, extending and augmenting in height from the extremity of the beak to nearly the margin of the shell, and separate to form the dental plates. Length and breadth very variable. One specimen measured—

Length 24, breadth 41, depth 15 lines; but some examples have attained rather larger proportions, and are not so very transverse.

Obs. This beautiful and very interesting species has sometimes been confounded with *Anomites subconicus* (Martin), but with which it bears no direct resemblance. Thus the last-named shell is described in the 'Petrificata Derbiensia' as differing from *Sp. cuspidata* "in the furrows, which are few in number and acute; in having a central angular fold instead of a rounded wave in the margin;" and it may be said to differ from *Sp. septosa* in the same particulars, for in Phillips's species the ribs are very numerous, small, "and divided into two, three, or four lesser ones towards the margin." There exists no acute mesial fold produced by a single prominent rib, that portion of the shell presenting a small, slightly convex, mesial elevation, composed of three principal ribs, but which from bifurcation become six or seven as they proceed towards the margin (Pl. XIV, figs. 1 and 2), and it would even appear that in certain individuals the fold is itself hardly distinguishable from the lateral portions of the valve. The sinus is also shallow; and, when perfectly shaped, margined on either side by a larger rib (Pl. XIV, fig. 4, and Pl. XV, fig. 2), between which may be seen a central and two smaller intercalated ones; in other specimens the sinus is composed of as many as seven (Pl. XV, fig. 1). The number of ribs is likewise very variable in different examples; thus from forty to seventy may be counted round the margin of each valve of *C. septosa*, while seventeen only can be seen in the representations given by Martin of *A. subconicus;* they are likewise very variable in their respective lengths and widths, which must be chiefly attributed to the intercalation of one or two smaller ribs next or between those first produced (Pl. XV, fig. 2).

The most important characters presented by this remarkable shell are, however, to be found in its interior arrangements, and these did not escape the notice of its first describer, who, after having briefly alluded to external appearances, pointedly remarks that "the septa in the lower (our ventral) valve divide it into three parts, as in *Pentamerus*, to which, *by this insufficient character*, it would be referred, but that many Spirifera exhibit less distinctly the same phenomenon."

Finding *S. septosa* to be a very rare species, but little understood or even known, the exterior of the ventral valve alone having been represented in the 'Geology of Yorkshire,' and those by Professor de Koninck being described under the mistaken denomination of *Sp. subconicus*, Martin, I did my best to assemble the few imperfect examples that were to be found in our English collections,[1] and to which my Belgian friend also kindly added

[1] No completely perfect adult specimens could be procured, the shell being generally found in separate valves.

the two or three fragments in his possession. This material has enabled me to satisfactorily develop and represent the internal details of the ventral valve (Pl. XIV, figs. 6, 7, 8); but all my efforts have hitherto proved ineffectual in making out those of the dorsal one.

Loc. *Cyrtina septosa* was discovered by Professor Phillips and by Mr. Salmond in the carboniferous limestone of Riddle Head, Burtonfell, Cumberland, and in the Museum of Practical Geology will be found a fine and instructive series of young and middle-aged specimens from the carboniferous limestone of Park Hill, Longnor, Derbyshire, as well as an internal cast (Pl. XIV, fig. 10), discovered in red dolometic limestone, at Ashby de la Zouch. The species has also been collected from the lower scar limestone of Settle, Yorkshire, by Mr. Burrow.

On the Continent, Professor De Koninck procured a few imperfect individuals in the carboniferous limestone of Visé, in Belgium, where the shell is, as in England, among the rarest species.

I am not acquainted with any Scottish examples, nor have any been hitherto discovered in Ireland, if *C. dorsata*, M'Coy, be not a variety of the shell under description.

CYRTINA DORSATA, *M'Coy*, &c. Pl. XV, figs. 3, 4.

CYRTIA DORSATA, *M'Coy*. Synopsis of the Carb. Limest. Fossils of Ireland, p. 136, pl. xxii, fig. 14, 1844.

Spec. Char. Subrhomboidal, nearly twice as wide as long; dorsal and ventral valves evenly convex; beak of the dorsal valve (our ventral) large, straight; cardinal angles very large, triangular, slightly concave; mesial fold indistinct or none; surface coarsely and regularly striated longitudinally.

"Length 2 inches, 4 lines; width 2 inches, 10 lines; height of cardinal angle 1 inch, 3 lines."—*M'Coy*.

Obs. As the original example figured by Professor M'Coy could no longer be found, and that the only other specimen, possessed by Mr. Griffiths, was in a very fragmentary condition, I could not determine to my entire satisfaction, the relationship of this form to *C. septosa*, but of which it may after all prove but a variety. The ribs seem, however, to be more numerous, simple, and of smaller proportions. The sinus and mesial folds are obsolete, and the general shape less transverse than in the specimens of Phillips's species that have come under my observation. I have therefore provisionally described *C. dorsata* under a separate head, where it had better remain until the discovery of more ample material will have confirmed or invalidated its specific claims.

Loc. The only two specimens hitherto recorded were obtained from the carboniferous limestone of Cork, in Ireland.

CYRTINA? CARBONARIUS, *M'Coy*, sp. Pl. XV, figs. 5—14.

PENTAMERUS CARBONARIUS, *M'Coy*. Annals and Mag. of Nat. Hist., vol. x, 2d series, and British Palæozoic Fossils, p. 442, pl. iii D, figs. 12—18, 1855.

Spec. Char. Very variable in shape, globose, or imperfectly oval, generally longer than wide, hinge line rather shorter than the greatest width of the shell. Dorsal valve semi-circular, moderately convex or gibbous, with its greatest depth about the middle; mesial fold narrow, of small elevation, regularly curved or with a longitudinal depression passing along its centre, and four or five smaller ribs originating near and extending to the margin. The lateral portions of the valve are furrowed by numerous angular ribs, which continue simple during their entire length, or become more or less subdivided from bifurcation or by intercalations originating at various distances from the margin. The ventral valve is moderately convex or gibbous, beak large, slightly or greatly incurved, with its extremity straight, or twisted more to the one or to the other side. Area large, at times higher than wide, generally concave, fissure triangular; deltidium (?). The sinus is shallow and extends from the extremity of the beak to the front, being margined by larger ribs, while smaller ones occupy the intermediate space, and the lateral portions of the valve are similarly ornamented to those in the dorsal one.

In the interior of the larger valve a hinge tooth is placed on each side at the base of the fissure, the dental plates converge, and after forming the fissure walls, become conjoined so as to produce a single median plate or septum, which extends along the bottom of the valve to within a short distance of the frontal margin. The internal details of the dorsal valve remain still to be determined.

Dimensions and proportions very variable.

Length	15,	width	16,	depth	13	lines (Professor M'Coy's type).
„	17½,	„	17,	„	14	„
„	16,	„	13,	„	10	„
„	15,	„	13,	„	7	„

Obs. This remarkable species has been minutely described by Professor M'Coy at p. 442 of his 'British Palæozoic Fossils,' under the generic and specific denomination of *Pentamerus carbonarius*, the author observing, moreover, that "some of the specimens so nearly resemble *Spirifers*, that it was not until he had made sections in various directions of several specimens, demonstrating the invariable presence of two narrow longitudinal sub-parallel septa in the smaller valve, and the wide, extremely long, mesial septum in the ventral one, with its internal divaricating portions flanking the triangular opening in the cardinal area, perfectly agreeing with *Pentamerus,* as well as the absence of spiral appendages, that he was convinced of its true genus." I must however observe that, without wishing to deny the possibility of the correctness of Professor M'Coy's conclusions, that the study of several specimens of this interesting species has not enabled me to arrive at so decided an opinion, and I am therefore still uncertain as to the propriety of classing the species in question with *Pentamerus.*

Professor M'Coy's illustrations of the interior (figs. 13, 14 of my plate) are, as he has himself admitted, evidently imperfect, for the dental plates are not represented extending so far as the inner upper extremity of the large mesial septum, which my preparations (figs. 11, 12) so completely exhibit. The appearance also of the internal cast of the dorsal valve of a specimen preserved in the Museum of Practical Geology (fig. 6), would lead me to infer that in the smaller valve there existed but a single median plate,[1] instead of two sub-parallel septa, as described and imperfectly represented in the work above quoted (fig. 14), and we have no certain evidence that the internal details of this valve were exactly similar to those of *Pentamerus*; on the contrary, there exists between the shell under description and *C. septosa* so much resemblance, both in external appearances as well as in the interior details of the ventral valve, that I have deemed it preferable (or at least so provisionally) to locate both Phillips's and M'Coy's species into my sub-genus *Cyrtina*, and from which the last-named author's shell may be hereafter removed should the discovery of the internal details of the dorsal valve determine the necessity.

It is possible that these *Spirifera*-shaped shells were not provided with spiral appendages, and that they formed a kind of passage between *Spirifer* and *Pentamerus;* but this must for the present remain an unsettled question.

A large area, similar to that seen in *C. carbonarius,* is not a character of *Pentamerus,* but it is necessary to remember that rudimentary areas occur in both *Pentamerus lens* and *P. liratus,* and nothing can be more variable than the extent and dimensions of the internal plates in different species of the genus. It is, therefore, to be hoped that ere long the discovery of some suitable specimens of *C. carbonarius* will enable us to determine the characters of the smaller valve, which are so important in the determination, not only of the genus, but also of its position in the classification of the group.

The figures I have selected for illustration will convey a good idea of the extreme variability in shapes presented by this species. In some examples the beak of the larger valve is so incurved as to come into contact with that of the smaller valve (fig. 5), while it assumes every degree of incurvature from this extreme condition to that in which the area is almost flat (figs. 9, 10). In relative width, breadth, as well as in degree of convexity, great differences are perceptible, as may be inferred from the measurements taken from four examples above noted. The ribs also vary considerably both in width and in the number of bifurcations, trichotomisings, or intercalations they may assume, from twenty to thirty being counted round the margin of each valve in different specimens; they are also at times much distorted, and, as mentioned by Professor M'Coy, "their surface is rather rugged and very coarsely granulo-punctate or minutely pustular under the lens;" but this

[1] A single median slit is observable in the cast (fig. 6). Had two sub-parallel septa existed, two slits would have been visible on the cast.

character is but rarely exhibited in the generality of specimens, on account of their external surface being considerably worn, so that the appearance can be detected only on those portions of the shell which are in their perfect condition.

Loc. Professor M'Coy's specimens were derived from the impure lower Carboniferous limestone of Kendal, Westmorland, where the species does not appear very rare.

Having now completed the description and illustration of all the species of *Spirifera*, *Spiriferina*, and *Cyrtina*, that are known to me as positively occurring in the carboniferous strata of Great Britain, it will be seen that not more than about thirty-one or two have been retained out of one hundred and seventeen that had been described or mentioned by various authors. A searching investigation has led me to infer that about eighty-six of the published names are made up of synonyms, of species not *positively* known to occur in Great Britain, or of Carboniferous shells erroneously identified with Devonian species, as well as of specimens belonging to other genera.[1]

1 The following is a list of 117 so-termed British Carboniferous Spirifera; the *species* adopted in this work are printed in roman type, the synonyms, &c., in italic letter, and a point of interrogation is placed before the more doubtful species:

? Spirifera acuta, Martin.
— *attenuata*, Sow.
— *aperturata*, Schloth. Not carboniferous.
— *arachnoida*, Phil. Strophomena.
— bisulcata, Sow.
? — bicarinata, M'Coy.
— *Bouchardii*, Murch. Not carb.
— carbonarius, M'Coy.
— *Crispa*, Linnæus. Not carb.
— *costata*, Sow. Not carb.
— *connivens*, Phil. Orthis.
— *clatharata*, M'Coy.
— *calcarata*, G. Sow. Not carb.
— convoluta, Phil.
? — crassa, De Koninck.
— cuspidata, Martin.
— *choristites*, V. Buch.
— carlukiensis, Dav.
— *crenistria*, Phil. Strophomena.
? — decemcostata, M'Coy.
— *decora*, Phil.
— distans, Sow.
? — dorsata, M'Coy.
— duplicicosta, Phil.
— *disjuncta*, Sow. Not carb.
— *elongata*, Phil.
? — exarata, Fleming.

Spirifera *expansa*, Phil. Athyris.
— *elliptica*, Phil.
— *extensa*, Sow. Not carb.
— *fasciculata*, M'Coy.
? — fusiformis, Phil.
— *furcata*, M'Coy.
— *ficiger*, Keyserling.
— *filiaria*, Phil. Orthis.
— glabra, Martin.
— *globularis*, Phil. Athyris.
— grandicostata, M'Coy.
— *glabristria*, Phil. Athyris.
— *gigantea*, Sow. Not carb.
— *grandæva*, Phil. Not carb.
— *heteroclytus*, Def. Not carb.
— *histericus*, Schloth. Not carb.
— humerosa, Phil.
— *hemisphærica*, M'Coy.
— *incisa*, Goldf.
— *imbricata*, Sow.
— insculpta, Phil.
— integricosta, Phil.
— *inornata*, Sow. Not carb.
— *Kleinii*, Fischer.
— *Koninckiana*, D'Orb.
— lineata, Martin.
— *linguifera*, Phil.

I must also state that notwithstanding the lengthened examination I have made of the Carboniferous *Spiriferæ*, there are a few even among those here retained that will still require some further investigation in order to ascertain whether or not they may be varieties of some of those already described, and among these I will mention *Sp. crassa*, De Kon., *Sp. grandicostata*, M'Coy, *Sp. minima*, Sow., *Sp. mesogonia*, M'Coy, and *Sp. fusiformis*, of Phillips. To these we must likewise add a few other doubtful forms, such as *Sp. transiens*, M'Coy, *Sp. partita*, Portlock, *Sp. decemcostata*, M'Coy, *Sp. bicarinata*, M'Coy, *Sp. subconicus*, Martin, *Sp. dorsata*, M'Coy, *Sp. rotundatus*, Martin, *Sp. exarata*, Fleming, *Sp. elongata*, Phil., and *Sp. similis*, M'Coy, whose relations or affinities could not be ascertained or established in a satisfactory manner from the absolute want of sufficient material, for not a single specimen or even fragment of some could be procured, and the descriptions and illustrations of the authors were not such as to lead to any satisfactory results. It is therefore probable, nay certain, that the larger number (if not all)

Spirifera laminosa, M'Coy.
— *mesoloba*, Phil.
— *microgemma*, Phil. Not carb.
— *megaloba*, Phil. Not carb.
? — mesogonia, M'Coy.
? — minima, Sow.
— *Martini*, Fleming.
— *macroptera*, Hall.
— *mesomala*, Phil. Not carb.
— mosquensis, Fischer.
— *nuda*, Sow. Not carb.
— octoplicata, Sow.
— *oblata*, Sow.
— *obtusa*, Sow.
— ovalis, Phil.
— *ornithorhyncha*, M'Coy.
— *ostiolata*, Steing. Not carb.
— *plebeia*, Phil. Not carb.
— *protensa*, Phil. Not carb.
? — *partita*, Portlock.
— pinguis, Sow.
— planata, Phil.
— *planicosta*, M'Coy.
— *paucicostata*, M'Coy.
— *princeps*, M'Coy.
— *pulchella*, Sow. Not carb.
— *phalæna*, Phil. Athyris.
— *prisca*, Eichw. Not carb.
— *papilionacea*, Phil. Chonetes.
— *recurvata*, De Kon. Not British.
— *reticulata*, M'Coy.
— *rotundata*, Sow.

? Spirifera *rotundata*, Martin.
— *rhomboidea*, Phil.
— *rudis*, Phil. Not carb.
— *Roemeri*, De Kon. Said to occur in Ireland. (?)
— Reedii, Dav.
— *radialis*, Phil. Strophomena.
— *resupinata*, Martin. Orthis.
— *semireticulata*, Phil.
— septosa, Phil.
— *sexradialis*, Phil.
— *Sowerbii*, Fischer.
— *similis*, Phil.
— striata, Martin.
— *striatella*, M'Coy. Not a Spirifer.
— *stringocephaloides*, M'Coy.
? — subconica, Martin.
— *subrotundata*, M'Coy.
— *symmetrica*, Phil.
— *senilis*, Phil. Streptorhynchus?
— *speciosa*, Schloth. Not carb.
— *semicircularis*, Phil.
— *simplex*, Phil. Not Dev.
— *spirifera*, Lam.
— *squamosa*, Phil. Athyris.
— *transiens*, M'Coy.
— triangularis, Martin.
— *trisulcosa*, Phil.
— trigonalis, Martin.
— *tricornis*, De Kon.
— triradialis, Phil.
— Urii, Fleming.

the above-named doubtful species will be found to be synonyms of some of the thirty already described, and that even three or four of this number may require, upon more extended examination, to be reduced to the rank of varieties.

The species of British *Spirifera, Spiriferina,* and *Cyrtina* at present known might perhaps be arranged in the following order.

1. SPIRIFERA STRIATA, *Martin,* sp. Pet. Derb., tab. xxiii, 1809; Dav. Brit. Foss. Brach., part v, pl. ii, figs. 12—21; pl. iii, figs. 2—6 = *Spirifera,* Lamarck = *attenuata,* J. de C. Sow. = *princeps,* M'Coy = *Clatharata,* M'Coy.

2. — MOSQUENSIS, *Fischer de Waldheim.* Programme sur les Choristite, p. 8, No. 1, 1837; and Dav., pl. iv, figs. 13, 14, and pl. xiii, fig. 16 = *Sowerbyi* and *Kleinii,* Fischer = *incisa,* Goldfuss = *Choristites,* V. Buch. = *priscus,* Eichwald.

3. — HUMEROSA, *Phillips.* Geol. York., vol. ii, pl. xi, fig. 8, 1836; and Dav., pl. iv, figs. 15, 16.

4. — DUPLICICOSTATA, *Phillips.* Geol. York., pl. x, fig. 1, 1836; and Dav., pl. iii, figs. 7—10; pl. iv, figs. 3, 5—11 = *faciger,* Keyserling = *fasciculata,* M'Coy.

? 5. — CRASSA, *De Koninck.* An. Foss. de la Belgique, pl. xv *bis,* fig. 5, 1843; and Dav., pl. vi, figs. 20—22; pl. vii, figs. 1—3 = *planicosta,* M'Coy.

N.B. By some this shell is placed among the synonyms of *Sp. duplicicostata,* by others among those of *Sp. bisulcata.*

6. — PLANATA, *Phillips.* Geol. of York., pl. x, fig. 3, 1836; and Dav., pl. vii, figs. 25—36.

? 7. — FUSIFORMIS, *Phillips,* pl. ix, figs, 10, 11; Dav., pl. xiii, fig. 15.

Of this only a single imperfect specimen has been discovered, so that the characters and value of the species cannot be considered finally established.

8. — TRIANGULARIS, *Martin,* sp. Pet. Derb., pl. xxxvi, fig. 2, 1809; and Dav., pl. v, figs. 16—24 = *ornithorhyncha,* M'Coy.

9. — TRIGONALIS, *Martin,* sp. Pet. Derb., tab. xxxvi, fig. 1, 1809; and Dav., pl. v, figs. 25—34.

10. — BISULCATA, *Sow.* M. C., tab. ccccxciv, figs. 1, 2, 1825; and Dav., pl. v, fig. 1; pl. vi, figs. 1—19; and pl. vii, fig. 4 = *semicircularis,* Phillips = *calcarata,* M'Coy = *transiens,* M'Coy?

11. — CONVOLUTA, *Phillips.* Geol. York., pl. ix, fig. 7, 1836; and Dav., pl. v, figs. 2—15 = *rhomboidea,* Phillips.

12. — GRANDICOSTATA, *M'Coy.* Brit. Pal. Fossils, pl. iii, D, fig. 29, 1855; and Dav., pl. v, figs. 38, 39, and pl. vii, figs. 7—16.

N.B. All these species are closely allied, and it may remain a question for further consideration whether they should be *all* specifically separated. It is possible that *Sp. convoluta* may after all be nothing more than a very transverse and exceptional condition of *Sp. bisulcata.*

13. — LAMINOSA, *M'Coy.* Synopsis, pl. xxi, fig. 4, 1844; and Dav., pl. vii, figs. 17—22 = *tricornis,* De Koninck.

14. SPIRIFERA CUSPIDATA, *Martin*, sp. Trans. Lin. Soc., pl. iii, figs. 1—6, 1796; and Dav., pl. viii, figs. 19—24; pl. ix, figs. 1, 2 = *simplex*, M'Coy, not of Phillips.

15. — DISTANS, *Sow.* M. C., tab. 494, fig. 3, 1825; and Dav., pl. viii, figs. 1—17.

16. — MESOGONIA, *M'Coy*. Synopsis, pl. xxii, fig. 13, 1844; and Dav., pl. vii, fig. 24.

This is said by Professor De Koninck to be a very good species, but I have never had an opportunity of studying the shell.

DOUBTFUL SPECIES.

? — *bicarinata, M'Coy.* Synopsis, pl. xxii, fig. 10; and Dav., pl. viii, fig. 18.

? — *decemcostata, M'Coy.* Ibid., fig. 9; and Dav., pl. vii, fig. 23.

? — *subconica, Martin.* Pet. Derb., tab. xlvii, figs. 6—8, 1809; Dav., pl. ix, fig. 3.

17. — REEDII, *Dav.*, pl. v, figs. 40—47.

18. — TRIRADIALIS, *Phillips.* Geol. York., pl. x, fig. 7; and Dav., pl. ix, figs. 4—12 = *trisulcosa* and *sexradialis*, Phillips.

19. — PINGUIS, *Sow.* M. C., tab. cclxxi, 1820; and Dav., pl. x, figs. 1—12 = *rotundata*, Sow. (not Martin) = *subrotundata*, M'Coy.

20. — OVALIS, *Phillips.* Geol. York., pl. x, fig. 5; Dav., pl. ix, figs. 20—26? = *exarata*, Fleming = *hemisphærica*, M'Coy.

21. — INTEGRICOSTA, *Phillips.* Geol. York., pl. x, fig. 2; Dav., pl. ix, figs. 13—19? = *rotundatus*, Martin? = *paucicostata*, M'Coy.

N.B. The species forming this little group are all very nearly connected.

22. — RHOMBOIDALIS, *M'Coy.* Synopsis, pl. xxii, fig. 11, 1844; Dav., pl. xii, figs. 6, 7.

23. — GLABRA, *Martin*, sp. Pet. Derb., pl. xlviii, figs. 9, 10, 1809; and Dav., pl. xi, figs. 1—9, and pl. xii, figs. 1—5 = *obtusus*, Sow. = *oblatus*, Sow. = *linguifera, symmetrica,* and *decora*, Phillips.

24. — URII, *Fleming.* British Animals, p. 376, 1828; and Dav., pl. xii, figs. 13, 14.

25. — CARLUKENSIS, *Dav.*, pl. xiii, fig. 14, 1857.

26. — LINEATA, *Martin*, sp. Pet. Derb., tab. xxxvi, fig. 3, 1809; and Dav., pl. xiii, figs. 1—13 = *imbricata*, Sow. = *reticulata*, M'Coy = *elliptica* and *mesoloba*, Phillips.

27. SPIRIFERINA CRISTATA, *Schloth.*, var. OCTOPLICATA, Sow., M. C., tab. dlxii, figs. 2—4, 1827; Dav., pl. vii, figs. 37—47.

28. ? INSCULPTA, *Phillips.* Geol. York., pl. ix, figs. 2, 3, 1836; Dav., pl. vii, figs, 48, 55 = *crispus*, De Kon. (not of Linnæus) = *quinqueloba*, M'Coy.

29. ? MINIMA, *Sowerby.* M. C., tab. ccclxxvii, fig. 1, 1822; Dav., pl. vii, figs. 56—59, uncertain species.

DOUBTFUL SPECIES.

? ? *partita, Portlock.* Report on the Geol. of the County of Londonderry, &c., pl. xxxviii, fig. 3, 1843; and Dav., pl. vii, figs. 60, 61.

N.B. It has not yet been perfectly ascertained whether *Sp. insculpta* and *Sp. minima* have a perforated shell structure.

30. CYRTINA SEPTOSA, *Phillips.* Geol. York., pl. xi, fig. 7, 1836; Dav., pl. xiv, figs. 1—10, and pl. xv, figs. 1, 2.

31. — CARBONARIUS, *M'Coy.* British Palæozoic Fossils, pl. iii D, figs. 12—18, 1855; and Dav., pl. xv, figs. 5—14.

— *dorsata, M'Coy.* Synopsis, pl. xxii, fig. 14, 1844; and Dav., pl. xv, figs. 3, 4.[1]

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[1] The still imperfect knowledge we possess of the exact geological position or vertical range of several of the species of the Carboniferous system, renders every well-determined fact of considerable interest.—

Genus—Athyris, *M'Coy*, = Spirigera, *D'Orbigny*.

See article *Athyris*, 'Monograph of British Permian Brachiopoda,' Part IV, pp. 20—22, 1857.

Athyris ambigua, *Sowerby*. Pl. XV, figs. 16—22.

Spirifer ambiguus, *Sowerby*. Min. Con., vol. iv, p. 105, tab. ccclxxvi, Nov., 1822 (*Atrypa* of the index).
Terebratula ambigua, *Phillips*. Geol. of York., p. 221, pl. xi, fig. 21, 1836.
? — pentaedra, *Phillips*. Ibid., pl. xii, fig. 3.
Atrypa sublobata, *Portlock*. Report on the Geology of the Coast of Londonderry, &c., p. 567, pl. xxxviii, fig. 2, 1843.
Terebratula ambigua, *De Koninck*. Animaux Fossiles de la Belgique, p. 296, pl. xx, fig. 2, 1843.
— — *M. V. K.* Geol. of Russia, vol. ii, pl. ix, fig. 12, 1845.
Spirigera ambigua, *D'Orbigny*. Prodrome, vol. i, p. 151, 1849.
Athyris ambigua, *M'Coy*. British Palæozoic Fossils, p. 432, 1855.

Spec. Char. More or less obscurely pentagonal, rather wider than long, moderately convex; beak not much produced, incurved; foramen small, circular, contiguous to the umbone of the opposite valve; a longitudinal, somewhat angular sinus extending from the extremity of the beak to the frontal margin. Dorsal valve almost evenly convex, or obscurely trilobed, the central lobe or fold being more often broad, and longitudinally divided by a narrow mesial groove; front deeply undulated. External surface smooth, marked only by a few concentric lines of growth. Shell structure not perforated. In the interior the spiral appendages are directed outwards, filling the larger portion of the shell. Dimensions very variable; three examples have measured—

Length	14,	width	12,	depth	8	lines.
,,	10	,,	11	,,	7	,,
,,	$10\frac{1}{2}$	,,	$10\frac{1}{2}$	,,	8	,,

Obs. This species varies considerably in the details of its external shape. It is sometimes nearly equally and evenly convex (especially in young shells), with hardly any definite mesial elevation in the dorsal valve (figs. 21, 22, 23), while at other times the appearance of the shell is obscurely trilobed, and when the furrow along the middle of the fold is strongly marked it sometimes resembles certain examples of the Jurassic *Terebratula quadri-*

Mr. J. H. Burrow, to whom I am greatly indebted for much valuable and liberal assistance, has informed me that he has found the following Spirifers in the *Lower Scar Limestone* of Settle, in Yorkshire: 1. *Sp. striata*; 2. *S. duplicicostata*; 3. *Sp. crassa*; 4. *Sp. planata*; 5. *Sp. fusiformis*; 6. *Sp. triangularis*; 7. *Sp. trigonalis*; 8. *Sp. bisulcata*; 9. *Sp. convoluta*; 10. *Sp. grandicostata*; 11. *Sp. cuspidata*; 12. *Sp. triradialis*; 13. *Sp. pinguis*; 14. *Sp. ovalis*; 15. *Sp. integricosta*; 16. *Sp. glabra*; 17. *Sp. lineata*; 18. *Sp. octoplicata*; 19. *Sp. insculpta*; 20. *Sp. Reedii* and *C. septosa*.

fida, Lamarck, (figs. 15, 16, 17). Sowerby states that "the produced beak and three-angular-sided front give the shell a five-angled contour, although the sides are rounded." In the degree of convexity of its valves, different specimens vary to a very great extent, and it ha appeared to me probable that the *Terebratula ambigua* of Phillips, "pentagonal, depressed, surface undulated, front and sides emarginate, perforation of the beak minute," (fig. 25,) is only a more flattened condition of Sowerby's species. (?)

Atrypa sublobata, Portlock, has already been correctly identified with Sowerby's *Sp. ambiguus*, for it is stated by Professor M'Coy, at p. 432 of his 'British Palæozoic Fossils,' "I have at length succeeded in tracing, in the most gradual manner, the passages of all the forms figured by General Portlock under the name of *Atrypa sublobata*, into each other, and in the ordinary types of the present species. When decorticated, a few straight pallial ridges are seen near the beak, radiating towards the front margin. General Portlock notices the resemblance of some of the varieties to *S. unguiculus* of Sowerby, but the want of area between the beaks and hinge-line separate the species." It is also possible that *Athyris trilobata*, M'Coy, may require to be added to the synonyms of Sowerby's species, but from such insufficient data as the simple dorsal valve represented in Tab. XX, fig. 21, of the 'Synopsis,' it would be hardly safe to offer any decided opinion.

The presence of spiral appendages in this species did not escape the observing eye of Sowerby, who in 1822 appears to have even hinted at the propriety of establishing a new genus for its reception, for we find him stating, that "in general appearance it does not agree with most species of *Spirifer*, but approaches nearer the smooth Terebratulæ; its having a perforated beak, and little or no hinge-line, still further distinguishes it; but the actual existence of spiral appendages seems to confirm it a Spirifer, *unless its combining the characters of both genera should render it desirable to construct a new genus of it.* But as the appendages within the Terebratulæ are very variable, it will be well to wait until more of them are known."[1]

I have been informed that it was for the reception of *T. ambigua* and other similarly organised forms, that in 1841 Professor Phillips created his *Cleiothyris*, which he described with a "cardinal area obsolete, beak incurved over a minute perforation, which is often obtect, or merely serves to receive the beak of the smaller valve;" but as the author inadvertently and unfortunately omitted to mention any known species as an example, Professor M'Coy subsequently proposed the name *Athyris*[2] for similar kinds of shells.

[1] Professor de Koninck remarks, at p. 297 of his 'Animaux Fossiles de la Belgique,' "that the spiral arms are formed of nine or ten coils, and are placed in an opposite direction; that it is solely on this last character, which is nevertheless common to many species of Terebratulæ, that Mr. De Buch has relied for expressing the opinion that *T. ambigua* and some others must be placed among the Spirifers, and insinuates at the same time that the circular foramen might perhaps not be the work of nature. We can affirm that this aperture is not due to chance, and that it is to be found on all well-preserved examples; moreover, that Mr. Deshayes builds upon the characters of this species to combat the establishment of the genus Spirifer, to which Sowerby had at first referred the species."

[2] Sowerby's *Spirifer ambiguus* has received no less than six different generic appellations—*Spirifer*,

Loc. Sowerby states he obtained his specimens from decomposed mountain limestone (rotten stone), near Bakewell. The shell is far from rare in the lower Carboniferous limestone of Derbyshire; the Isle of Man; Lowick, Northumberland; at Bolland, &c. In Scotland it is rather common in the Carboniferous limestone and shales of the Clydeside basin, at Carluke, Lowrieston,[1] at Westlothian; Beith, Ayrshire; and Berwick-on-Tweed. In Ireland it is mentioned as occurring at Millecent, Kilcummin, and Ballintrillick. On the Continent M. De Koninck states it to be rather rare at Visé, in Belgium; and M. de Verneuil and Count Keyserling mention Peredki and Valdai as Russian localities. In the United States it has been discovered at Chester, Illinois; and in other localities.

ATHYRIS LAMELLOSA, *L'Eveillé*. Pl. XVI, fig. 1, and Pl. XVII, fig. 6.

SPIRIFER LAMELLOSUS, *Leveillé*. Mémoires de la Soc. Géol. de France, ii, p. 39, figs. 21—23, 1835.
— SQUAMOSA, *Phillips*. Geol. of Yorks., ii, p. 220, pl. x, fig. 21, 1836.
TEREBRATULA LAMELLOSA, *De Koninck*. An. Foss. de la Belgique, p. 299, pl. xx, fig. 5, *a*, *b*, *c*, 1843.

Spec. Char. Transversely elliptical, or obscurely pentagonal; valves moderately convex, somewhat depressed; cardinal line nearly straight. The mesial fold is of small elevation and at times slightly concave along its middle. In the ventral valve a sinus of moderate depth extends from the extremity of the small incurved beak to the frontal margin; foramen small, circular, and contiguous to the umbone of the opposite valve. Surfaces of both valves ornamented by from twelve to fifteen nearly parallel concentric lamelliform expansions. In the interior the spiral coils fill the greater portion of the shell.

Length 14, width 21, depth 8 (without the expansion).

Obs. This species was correctly described and illustrated by L'Eveillé and Professor De Koninck, who observe that its principal character resides in the presence of strong concentric lamelliform expansions; but this peculiarity is also common to other species of *Athyris*, such as *A. planosulcata*, to which L'Eveillé's species sometimes nearly approaches.

Terebratula, Atrypa, Cleiothyris, Athyris, and *Spirigera!* and it is to be regretted that those who were discussing Professor Phillips's name on his half-announced views, had not inquired from the author why he had conceived the group and name. On the Continent, D'Orbigny's term *Spirigera* is generally preferred to that of *Athyris,* and I would myself have adopted the French author's denomination, since it is freed from the incorrect derivation the term *Athyris* conveys, had I not found that English authors were so much disposed to prefer M'Coy's name on account of its priority of date.

[1] It may remain a matter of some uncertainty whether the representation given by David Ure, in pl. xvi, fig. 9, of his 'History of Rutherglen' (1893), was intended for *Ter. hastata* or for the shell under description; but from the greater abundance of Sowerby's *Ambiguus* in the district, I should almost feel disposed to refer the figure above mentioned to the last-named species.

Loc. In England *A. lamellosa* has been found in the Carboniferous limestone of Settle, Yorkshire; Dovedale, Derbyshire, &c.; Professor Phillips mentions Kendal and Florence court. It occurs also at Hook Point, in Ireland. I am not acquainted with any Scottish examples. Professor De Koninck states he has found but a single example in the Carboniferous limestone of Visé, but that it is more abundant in the clay of the same formation of Tournay, in Belgium. In America it has been found by Mr. Worthen in the mountain limestone of Keokuk, Iowa.

Athyris planosulcata, *Phillips.* Pl. XVI, figs. 2—13, 15.

Spirifera planosulcata, *Phillips.* Geol. of York., vol. ii, p. 220, pl. x, fig. 15, 1836.
Terebraluta de Roissyi, *De Verneuil.* Bulletin de la Société Geol. de France, vol. xi, p. 259, pl. iii, fig. 1 *a,* 1840 (not *Sp. de Roissyi,* L'Eveillé, 1835).
Atrypa planosulcata, *J. de C. Sowerby.* Min. Con., vol. vii, p. 15, pl. dcxvii, fig. 2, 1840.
— oblonga. Ibid., fig. 3.
— planosulcata, *De Koninck.* An. Foss. de la Belgique, p. 301, pl. xxi, fig. 2, 1843.[1]
Actinoconchus paradoxus, *M'Coy.* Synopsis of Carb. Foss. of Ireland, pl. xxi, fig. 6, 1844.
Atrypa obtusa, *M'Coy.* Ibid., pl. xxii, fig. 20.
Athyris paradoxa, *M'Coy.* British Palæozoic Fossils, p. 436, 1855.

Spec. Char. Obscurely pentahedral or nearly orbicular; valves equally deep, and either moderately or evenly convex, without sinus or fold, or with a slight mesial depression towards the front in one or both valves. The beak is small or incurved, with a minute circular foramen placed close to the umbone of the opposite valve. Surface of both valves ornamented at intervals of less than a line, with numerous large, concentric, parallel, semicircular, lamelliform expansions, each plate being flat and longitudinally striated at about half a line apart. Interiorly the spiral appendages, which are each composed of from twelve to fifteen coils, fill the larger portion of the shell.

The following measurements of the same specimens, with and without their expansions, will convey some idea of the relative proportions.

Without expansions.		The same.	With expansions.
Length $11\frac{1}{2}$,	width 11,		length 20, width $24\frac{1}{2}$ lines.
,, $8\frac{1}{2}$,	,, 12,		,, 15, ,, 21 ,,
,, 14,	,, 15,		,, 25, ,, 33 ,,
,, $19\frac{1}{2}$,	,, 21,	depth 13,	extent of expansions not known.
,, 12,	,, $10\frac{1}{2}$,	,, 8,	ditto.

[1] *Sp. fimbriata* and *S. expansa,* Phillips, mentioned by Professor De Koninck, will require to be excluded from the synonyms of *A. planosulcata.*

PLATE IX.

(Carboniferous Species.)

1. Spirifera cuspidata (?), *Martin*. Internal cast of a ventral valve. This specimen denotes the existence of a tubular perforation (*f*) in the deltidium of the larger valve; from the Magnesian Limestone of the Carboniferous period of Breedon Hill. British Museum. Fig. 1*a* is from a gutta percha impression from the same, to show the position of the dental or rostral plates.

2. — — Bolland. Collection of Professor Phillips.

3. — subconica, *Martin*, sp. From the 'Petrif. Derb.,' tab. xlvii, figs. 6, 7, 8. Middleton, Derbyshire.

4, 5, 6. — triradialis, var. *sexradialis*, Phillips. Bolland. British Museum.

7. — — A large example. From the same locality and collection.

8. — — Ibid. Collection of Professor Phillips.

9. — — Ibid. Museum of Practical Geology.

10. — — Ibid. Collection of Professor Phillips.

11. — — Ibid. Collection of Mr. E. Wood.

12. — — var. *trisulcosa*, Phillips. 'Geol. of York.,' vol. ii, pl. x, fig. 6.

13—18. — integricosta, *Phillips*. Craven district. Collection of Mr. E. Wood.

19. — — A young shell, closely resembling Martin's representation of *Anomites rotundatus*.

20. — ovalis, *Phillips*. A very large and fine example from the Wensleydale district. Collection of Mr. E. Wood. Another almost similar is to be seen in the British Museum.

21. — — From Derbyshire. Cambridge Museum.

22. — — An imperfect example. From Coricburn, Campsie, Sterlingshire.

23. — — A young shell. From Bolland.

24. — — ? *exarata*, Fleming. From the original fragment in the collection of the late Dr. Fleming. West Lothian, Scotland.

25, 26. — — = *hemisphærica*, M'Coy. Craven district. Fig. 25 from the collection of Mr. Reed, of York.

27. — integricosta ? *Anomites rotundatus*, Martin. From the original figure in the 'Petrif. Derb.,' tab. 48, fig. 11, 12. Middleton.

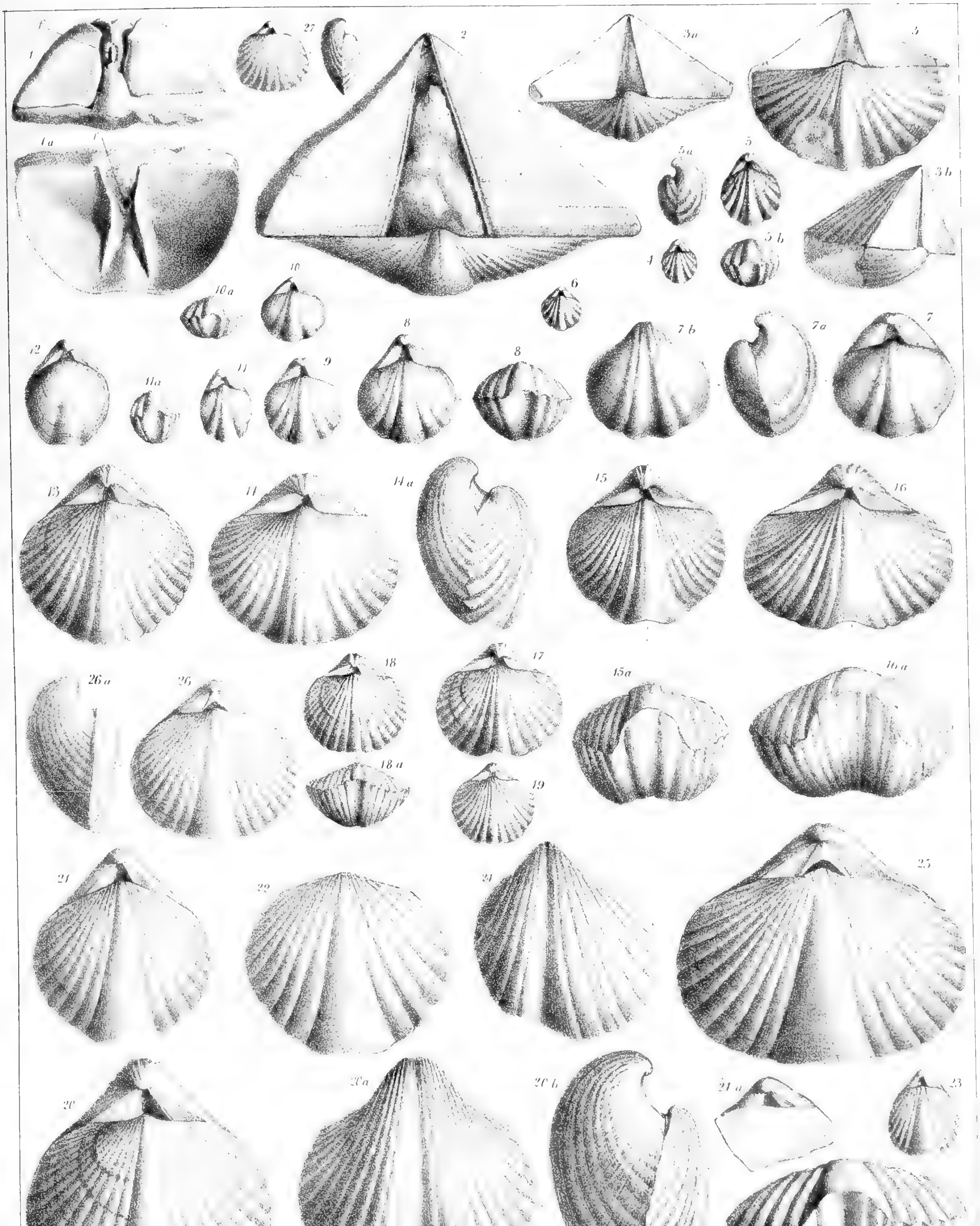

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PLATE X.

(Carboniferous Species.)

1—7. Spirifera pinguis, *Sowerby*. Different specimens and ages. From Millecent, Ireland.

8—12. — — var. *rotundata*, Sow. (not Martin) = *subrotundata*, M'Coy. From Millecent, Ireland, fig. 9. From Yorkshire.

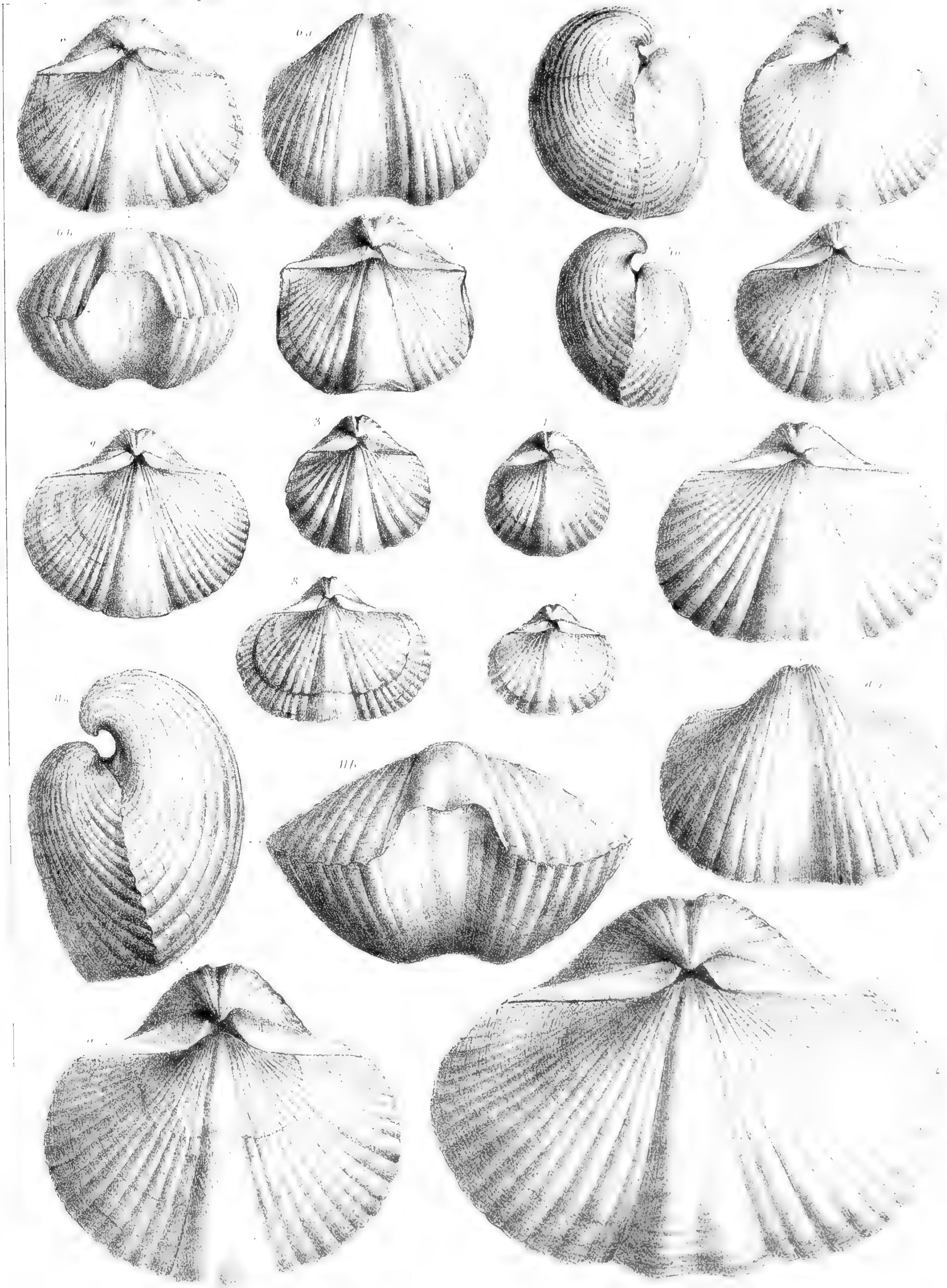

PLATE XI.

(Carboniferous Species.)

1—2.	Spirifera	glabra,	*Martin*. Very large specimen. From the Wensleydale district, in the collection of Mr. E. Wood.
3.	—	—	From Millecent, Ireland.
4, 5.	—	—	Young shells. From Bolland.
6.	—	—	var. *symmetrica*, Phillips.
7.	—	—	From Hill-head, Carluke parish, Lanarkshire, Scotland.
8.	—	—	= var. *oblata*, Sow. From the original specimen in the collection of Mr. J. de C. Sowerby.
9.	—	—	Fragment, showing the dimensions of the spiral appendages. From the original specimen represented under another aspect in the 'Min. Con.,' tab. 268, fig. 1.
10.	—	lineata,	*Martin* = Sp. *mesoloba*, Phillips. This illustration is copied from pl. x, fig. 14, in the 'Geol. of Yorkshire.'

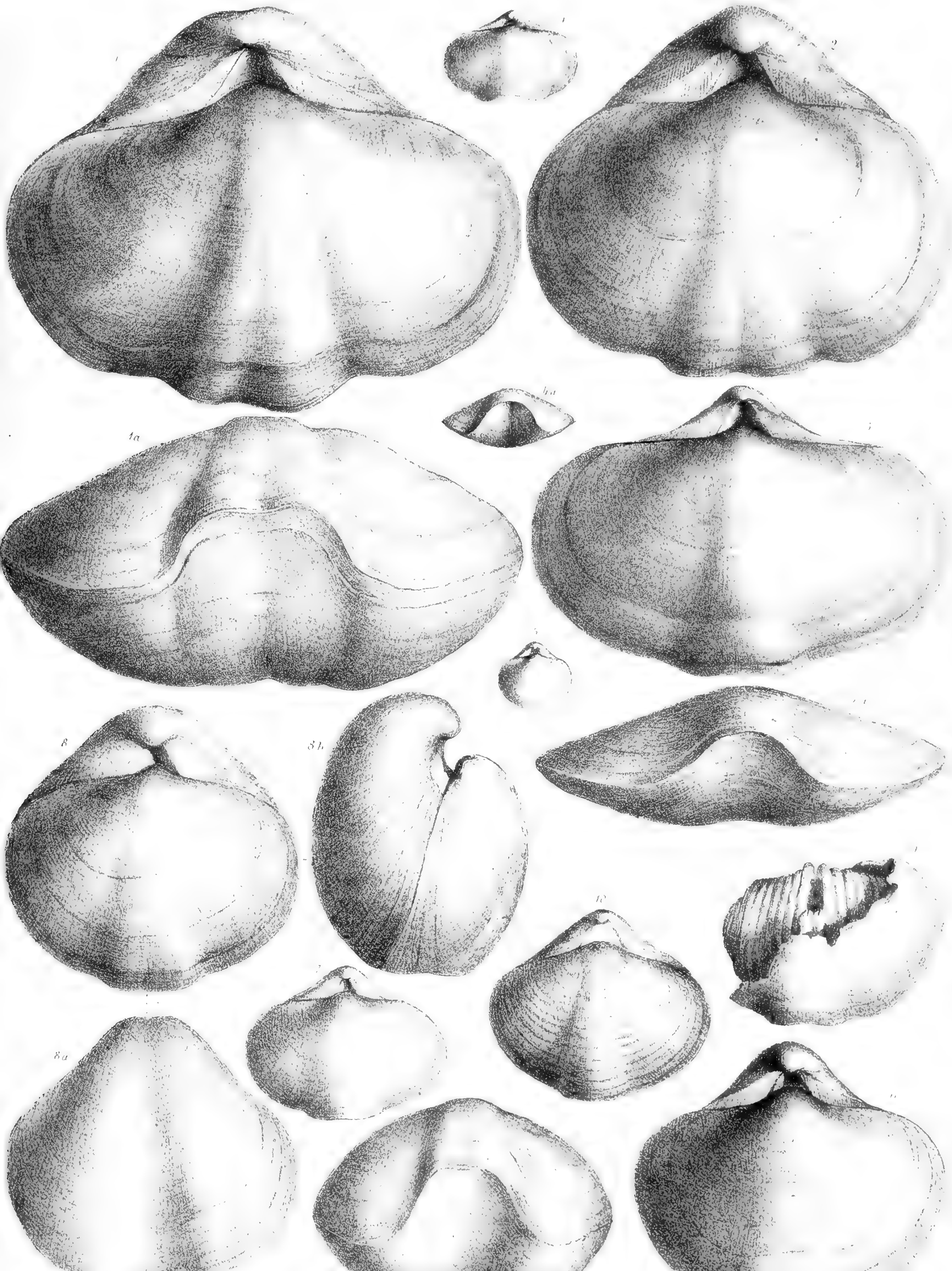

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PLATE XII.

(CARBONIFEROUS SPECIES.)

1, 2. SPIRIFERA GLABRA, *Martin*. Unusual varieties from Bolland. In the collections of Messrs. J. de C. Sowerby and Muschen.

3. — — Var. with obscurely marked ribs on the lateral portions of the shell. Bolland.

4, 5. — — Var. *linguifera*, Phillips. Fig. 4, from the original specimen represented in the 'Geology of Yorkshire,' and now in the British Museum; 5, from the cabinet of Professor Phillips.

6, 7. — RHOMBOIDEA, *M'Coy*. Fig. 6, from the original specimen figured in the 'Synopsis,' coll. of Mr. Griffith; 7, from Millecent, Ireland.

8, 9. — GLABRA, ? Var. from Lowick. Fig. 9, in the collection of Mr. Tate, of Alnwick.

10. — ? From Yorkshire, in the cabinet of Mr. E. Wood. Figs. 8, 9, 10, are very unusual shapes, and it is with considerable hesitation that they are referred to. *Sp. Glabra*, of Martin.

11, 12. — — Var. *decora*, Phillips. Fig. 11 is taken from the representation published in the 'Geology of Yorkshire;' 12, from a very fine specimen from Bolland, in the collection of Mr. Muschen, of Birmingham, and every variation in shape may be found connecting this specimen to the normal shape of *Sp. glabra*.

13, 14. — URII, *Fleming*. From the carboniferous shales of Carluke, Lanarkshire. 14 *a*, *b*, *c*, *d*, *e*, are enlarged representations.

15, 16. — STRINGOCEPHALOIDES, *M'Coy*. Fig. 15, from the representation published in the 'Synopsis;' 16, from Leighlin, Ireland, in the Museum of the Royal Dublin Society. It is probable that these specimens belong to exceptional varieties of *Sp. lineata*, Martin.

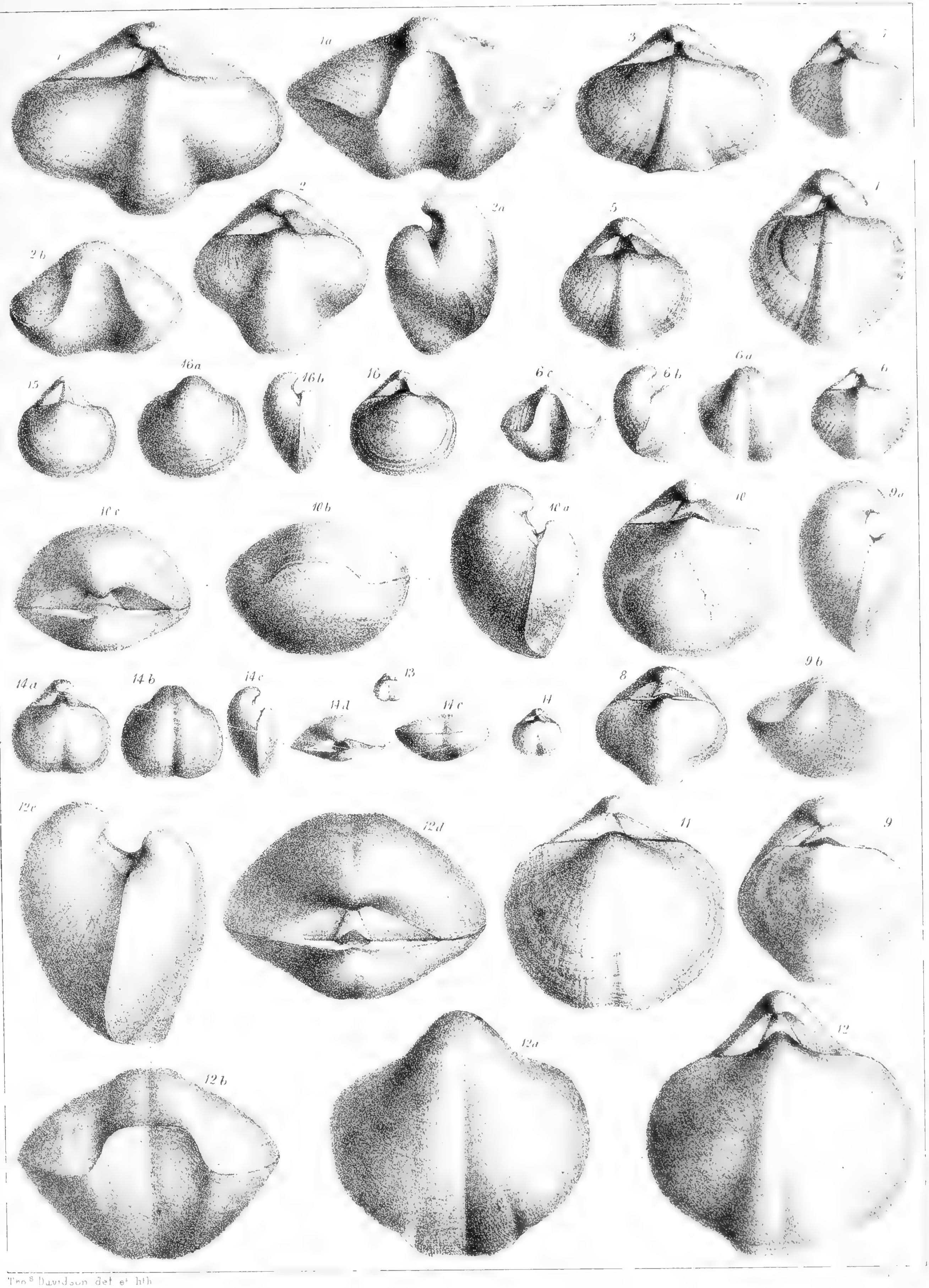

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PLATE XIII.

(Carboniferous Species.)

1, 2, 3. Spirifera elliptica, *Phillips.* Ireland. Fig. 1, from the original specimen in the British Museum; 2, from the collection of Mr. Rose, of Edinburgh; 3, a young shell from Millecent.

4. — lineata, *Martin.* From the original representation in the 'Petrificata Derbiensia.'

5. — — From Dryden, near Edinburgh.

6—10. — — Different ages. Fig. 6, from Millecent; 7, Lowick; 8, a specimen very finely reticulated, Craven district; 9, a very large example from Dovedale, Derbyshire, Museum of Practical Geology; 10, profile view of an aged individual from Bolland, collection of Mr. Muschen.

11—12. — — var. *reticulata,* Sow. Fig. 11, from Millecent, Ireland; 12, Dovedale, Derbyshire, Museum of Practical Geology.

13. — — var. *reticulata,* M'Coy. From the original figures in the 'Synopsis.'

14. — carlukiensis, *Dav.* From the Carboniferous shales of Carluke, Lanarkshire. 14, natural size; 14 *a, b, c,* enlarged.

15. — fusiformis, *Phillips.* From the original specimen in the British Museum. Bolland.

16. — mosquensis, *Fischer.* A fine specimen. From Ragreagh, Limerick. in the Museum of Geological Survey of Ireland.

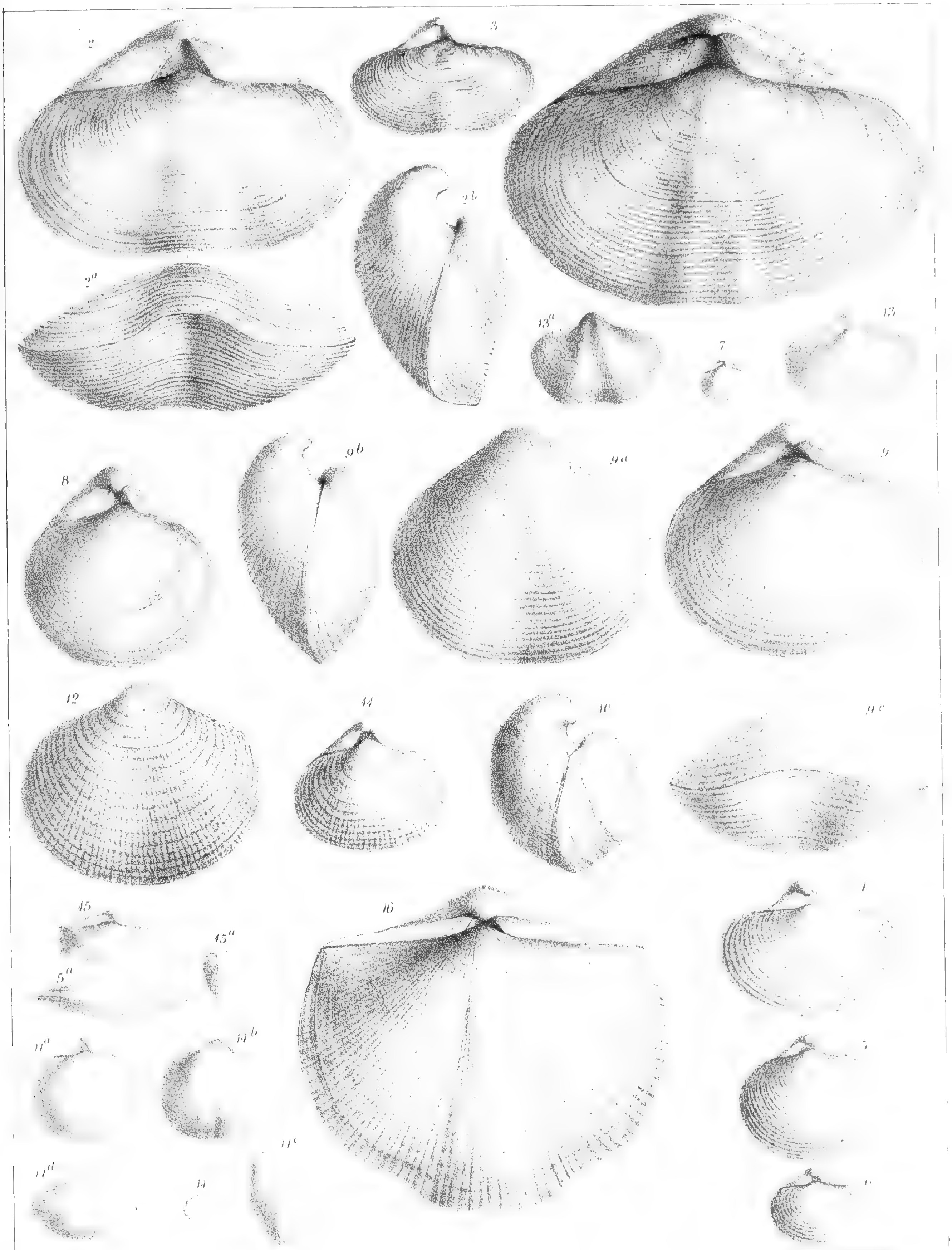

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PLATE XIV.

(CARBONIFEROUS SPECIES.)

1—5. CYRTINA SEPTOSA, sp. *Phillips.* From Park Hill, Longnor, Derbyshire. In the Museum of Practical Geology.

6. — — Interior of the ventral valve.

7. — — Specimen from which a portion of the shell has been removed so as to expose the combined mesial septa (s) and dental plates (R) seen in profile.

8. — — Fragments of the ventral valve of a specimen from Ribble Head. In the collection of Professor Phillips. To show the position of the conjoined septa (s), and dental plates (R).

9. — — Another fragment of the same valve in the cabinet of Mr. Reed, of York, (s) conjoined septa.

10. — — An internal cast of the ventral valve in red dolomitic limestone. From Ashby de la Zouch. Museum of Practical Geology.

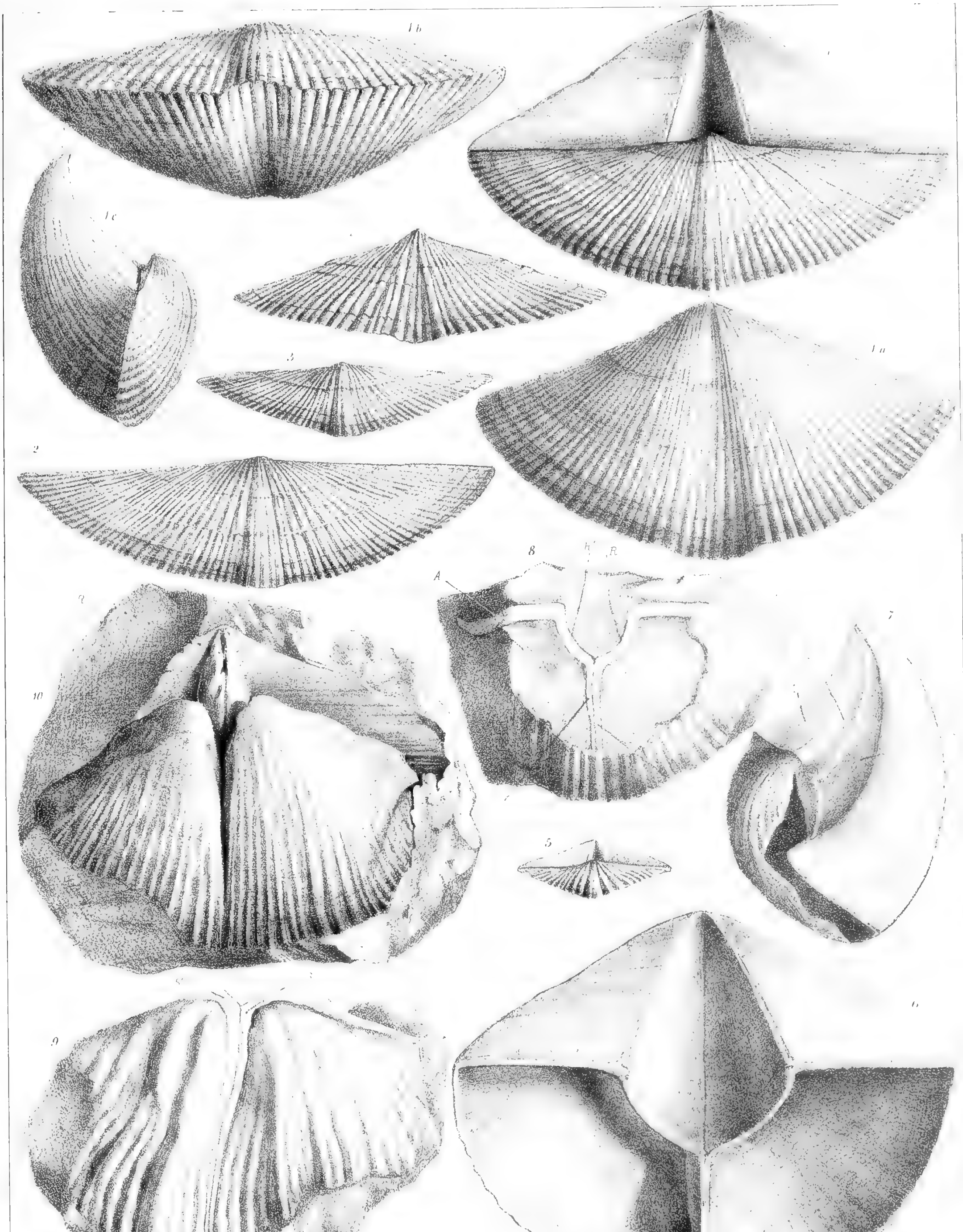

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PLATE XV.

(CARBONIFEROUS SPECIES.)

1. CYRTINA SEPTOSA, *Phillips*. From the original representation in the 'Geology of Yorkshire.'

2. — — A fragment of ventral valve from Visé, Belgium, in the collection of Professor L. de Koninck, to show the inequality in width of the ribs.

3. — DORSATA, *M'Coy*. From the original figure in the 'Synopsis.'

4. — — These figures are partly restored from a fragmentary specimen from Cork, Ireland, in the collection of Mr. Griffith.

5. ? CARBONARIUS, *M'Coy*. From the figures in the work on 'British Palæozoic Fossils.'

6. — — A specimen from Kendal, in the Museum of Practical Geology. A portion of the shell of the dorsal valve being removed, a single median slit is observable in the cast, and not two, as would be the case in a true *Pentamerus*.

7, 10. — — Different specimens from Kendal.

11, 12. — — Interior of the ventral valve; 12, section of the same. Kendal.

13, 14. — — Two sections, one horizontal the other transversal, published by Professor M'Coy, in his work on 'British Palæozoic Fossils.'

15—26. ATHYRIS AMBIGUA, *Sow*. Fig. 15 from Bolland, British Museum; 16, 17, in the collection of Professor Phillips; 18—24, from the Carboniferous shales of Carluke, Lanarkshire; 25 = *Ter. pentaëdra*, Phillips; 26 = *A. trilobata*, M'Coy, from the figure in the 'Synopsis.'

27, 28. ? GREGARIA, *M'Coy*. Fig. 27, from the figure in the 'Synopsis.' Ireland; 28, another specimen in the cabinet of Mr. Griffith.

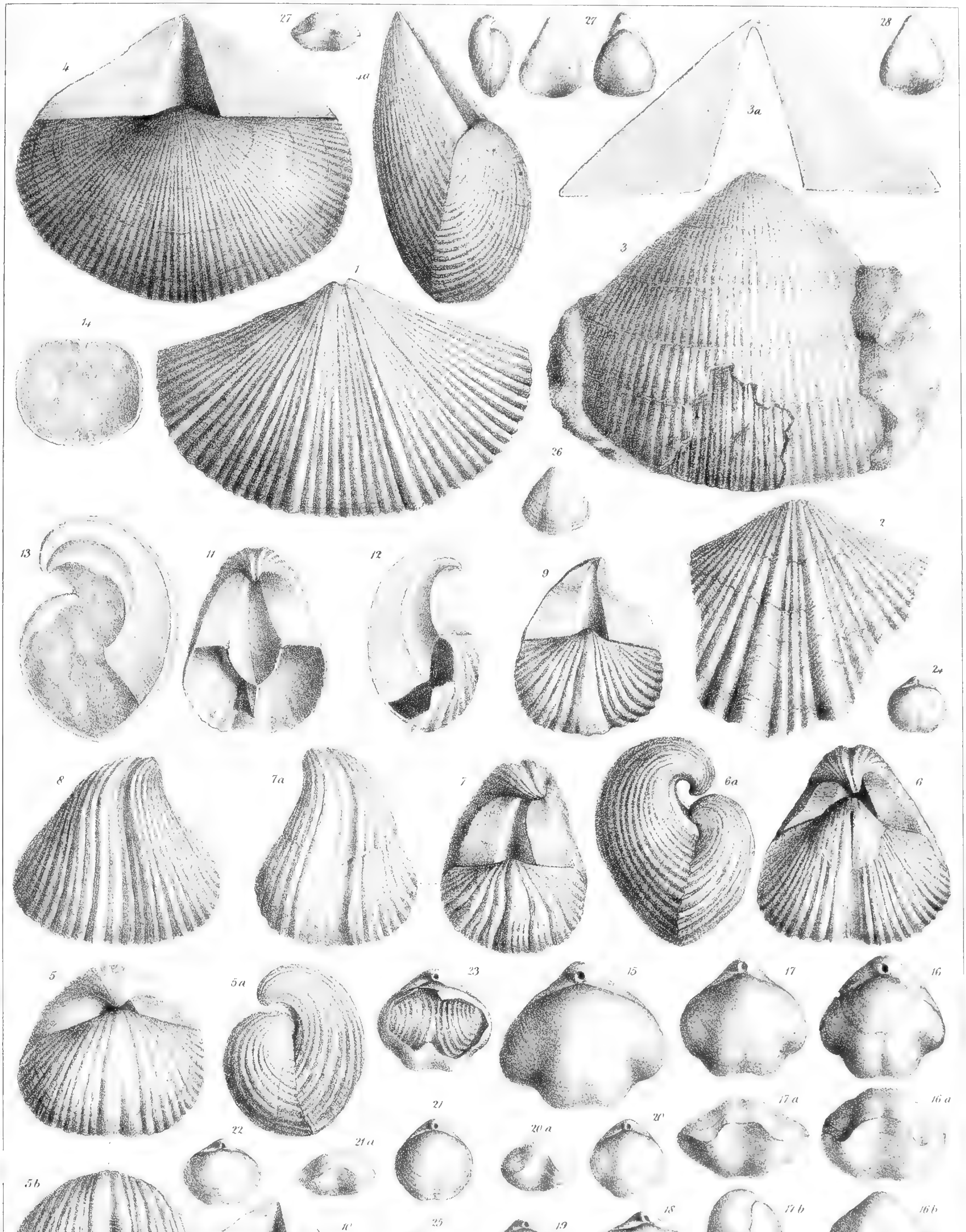

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PLATE XVI.

(CARBONIFEROUS SPECIES.)

1. ATHYRIS LAMELLOSA, *L'Eveillé* = *squamosa, Phillips,* from Dovedale, Derbyshire. Museum of Practical Geology.

2. — PLANOSULCATA, *Phillips,* from the original illustration in the 'Geology of Yorkshire.'

3. — — Ventral valve with marginal expansions, entire. From Preston. British Museum.

4, 5, 6. — — Specimens from Bolland without their expansions, fig. 4. Collection of Mr. E. Wood. Fig. 5, from Longnor, Derbyshire. Museum of Practical Geology.

7, 8, 9. — — Specimens with portions of their expansions, 7, showing the spiral appendages and marginal lamellæ, Derbyshire. Fig. 9, from Longnor. Museum of Practical Geology.

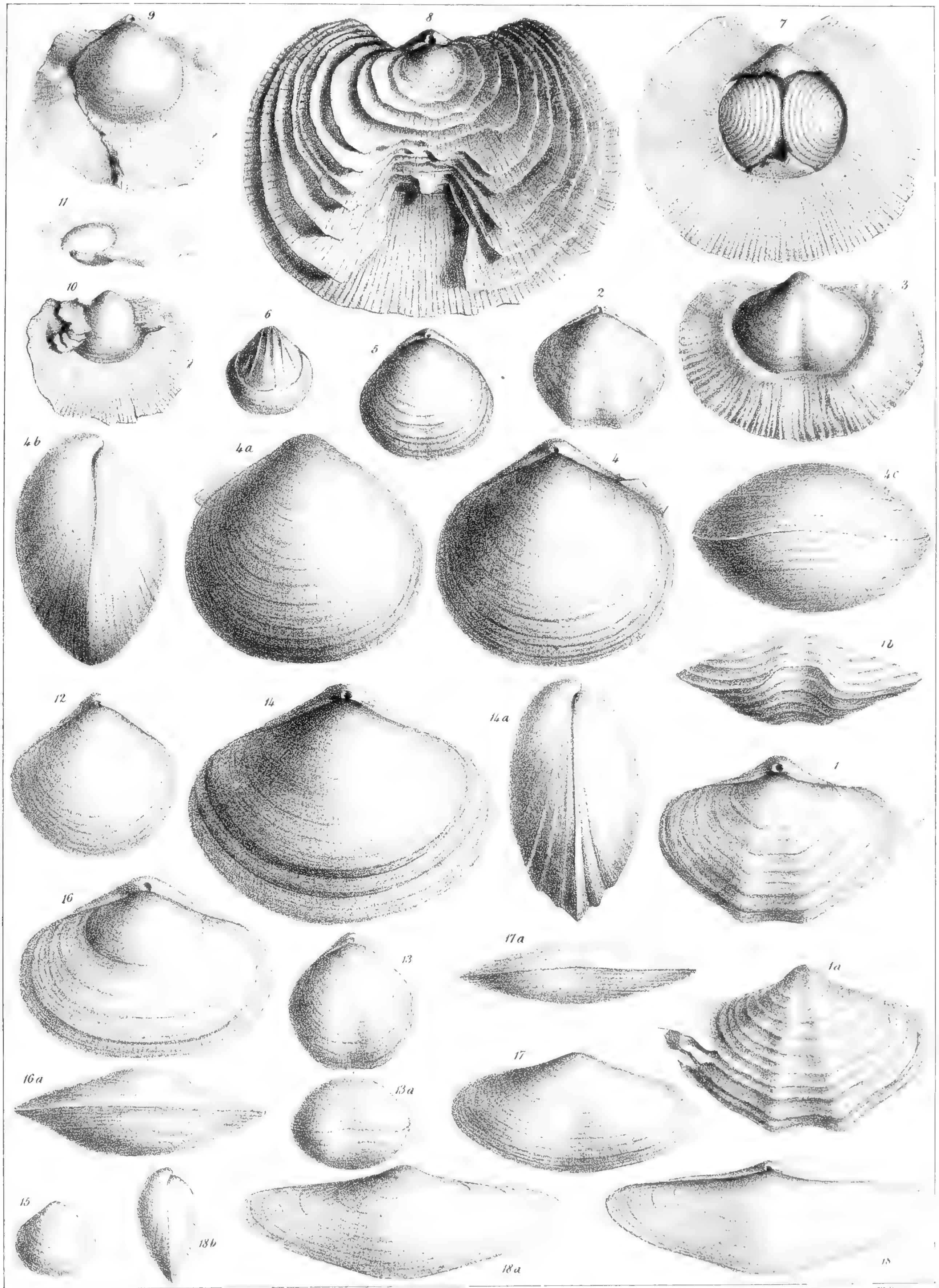
10, 11. — — From Ireland. Fig. 11, is one of Professor M'Coy's representations of his *Antinoconchus paradoxus,* (fig. 6, of the 'Synopsis.')

12. — — var. *obtusa,* M'Coy. From the figure in the 'Synopsis.'

13. — — var. *oblonga,* Sow. From the figure in the 'Mineral Conchology.'

15. — — From Lanarkshire, Scotland.

14, 16, 18. — EXPANSA, *Phillips.* From Kendal. Figs. 14, 16, 17, from the collection of the late Mr. D. Sharpe; now forming part of the Museum of the Geological Society. Fig. 18, in the cabinet of Mr. Reed, of York.



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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

ISSUED FOR 1857.

LONDON:

MDCCCLIX.

MONOGRAPH

ON

THE FOSSIL REPTILIA

INCLUDING

SUPPLEMENT No. I.

CRETACEOUS PTEROSAURIA,

AND

WEALDEN CROCODILIA.

BY

PROFESSOR OWEN, F.R.S., F.L.S., F.G.S., &c.

LONDON:
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.
1859.

J. E. ADLARD, PRINTER, BARTHOLOMEW CLOSE.

SUPPLEMENT (No. I)

TO THE

MONOGRAPH

ON

THE FOSSIL REPTILIA

OF

THE CRETACEOUS FORMATIONS.

ORDER—*PTEROSAURIA*, Owen.

Genus—PTERODACTYLUS, *Cuvier*.

IN the 'Monograph of the Fossil Reptilia of the Chalk Formations,' p. 103,* the occurrence of remains of a large Pterodactyle in the Green-sand formation near Cambridge, was noticed, and portions of the wing-bones were figured in Tab. XXXII, figs. 6—8.†

The Woodwardian Museum of the University of Cambridge has subsequently been enriched by successive acquisitions of fossils, obtained, chiefly through the exertions of LUCAS BARRETT, Esq., F.G.S., from the same stratum of 'Upper Green-sand,' near Cambridge, where I had the opportunity of inspecting them last year. All those belonging to the *Pterosauria* have since been liberally transmitted to me by my friend PROFESSOR SEDGWICK for description and illustration in the Monographs of the Palæontographical Society, and I have subsequently received a few highly interesting additional examples of Pterodactyle remains from sources which will be duly acknowledged in the sequel.

* Volume of the Palæontographical Society, 4to, 1851. † Ib.

Pterodactylus Sedgwickii, *Owen.* Jaws and teeth, Tabs. I and III.

The specimen (Tab. I, fig. 1, *a*, *b*, *c*, *d*) is the fore part of the upper jaw, containing the first seven sockets of the teeth, in a few of the anterior of which the base of the tooth is retained. The first two sockets open upon the obtuse extremity of the jaw (fig. 1, *c*), and have a direction showing that their teeth projected obliquely forward, so as to prolong the prehensile reach of the jaw; the second and third sockets are the largest, and cause a slight transverse swelling (fig. 1, *b*); the fourth is suddenly smaller, and the three following retain nearly the same size, or show a slight increase as they pass backward. The apertures of the sockets are elliptic, with the long axis extending obliquely from before outward and backward, not parallel with the axis of the jaw; the plane of the outlet inclines slightly outward (fig. 1, *c*). The interval between two sockets is about half the long diameter of each. On one side of the figured specimen the fifth socket is obliterated. The anterior termination of the jaw is obtuse; the sides are smooth, flat, converging at an acute angle to what almost forms a ridge above (fig. 1, *c*, *d*); the jaw gradually increases in vertical diameter as it proceeds backward, the upper contour being straight as far as it can be traced in the fossil. The palatal surface is entire, narrowest between the second sockets, suddenly broader and flat between the third pair, retaining about the same breadth, but with a slight convexity and feeble indication of a median ridge in the rest of its extent, the ridge not being so strongly marked as it appears in fig. 1, *b*.

The Pterosaurian nature of this fossil is shown by the extreme thinness of the compact bony wall of the jaw; its relation to the genus *Pterodactylus*, as contradistinguished from the *Rhamphorhynchus*, V. Meyer, is proved by the terminal position of the sockets; and sufficient of the outer side wall of the jaw is preserved to show that the nostril did not advance so far forward as in *Dimorphodon*—the generic form of Pterodactyle from the Lower Lias.

By its size and true or proper Pterodactyle affinities the present specimen most resembles *Pterodactylus Cuvieri* of the Chalk, (Monog. cit., Tab. XXVIII); but it offers the following well-marked differences: a greater proportional size of the anterior sockets, with a corresponding expansion of the fore part of the jaw; a greater number and closer arrangement of the sockets; a greater depth of the jaw, in proportion to the breadth of the palate. The extent of the jaw, *e. g.*, containing the first seven sockets, in *Pterodactylus Sedgwickii*, is 2 inches 9 lines; but in *Pterodactylus Cuvieri* it is 3 inches 6 lines: the depth of the jaw, above the third socket, in *Pter. Sedgwickii*, is 14 lines; in *Pter. Cuvieri* it is 8 lines; whilst the breadth of the palate between the third pair of sockets is only 1 line less in *Pter. Cuvieri* than in *Pter. Sedgwickii.* It needs only to compare the fore part of the jaw of the Great Chalk

Pterodactyle (Monog. cit., Tab. XXVIII, figs. 1—4) with the same part of the still larger species from the Green-sand (Tab. I, figs. 1 and 2), to be convinced of their specific distinction.

The difference is still more marked between *Pterodactylus Sedgwickii* and *Pterodactylus compressirostris* (Tab. XXVIII, figs. 8, 9, 10). The rapid increase of depth as the jaw extends backward, in *Pter. giganteus*, Bk. (ib., Tab. XXXI, fig. 1), shows that that comparatively small species cannot be the young of the present truly gigantic Pterodactyle of the Upper Green-sand. I have no hesitation, therefore, in basing on the above-described fossil a new species, at present the largest known in the order of Flying Saurians, which I propose to dedicate to the Woodwardian Professor of Geology in the University of Cambridge, who for forty years has discharged the duties of that office with exemplary zeal and a rare eloquence, has almost created the museum still called (Woodwardian,) and has enriched geological science by original researches which have thrown light on its most obscure and difficult problems.

The next fossil selected from the Pterosaurian series of Green-sand fossils for present description is the fore part of the jaw figured in Tab. I, figs. 2, *a*, *b*, *c*, *d*. This contains about the same number of sockets in the same extent of jaw as in fig. 1; and the last four sockets present about the same extent of interspace, with the same diminution of size, as compared with the two preceding sockets. But the walls of these sockets form no lateral expansion, the depth of the jaw is less, and the flat sides converge to a sharper ridge, fig. *c*; the aspect of the sockets is also more obliquely outward, the interspace between the pairs is narrower, and this is traversed by a median groove $\frac{1}{8}$th of an inch across, fig. *b*. Were this specimen a part of an upper jaw, it would indicate a distinct species from *Pterodactylus Sedgwickii*, as exemplified by fig. 1; but I regard fig. 2 as being the fore part of a lower jaw, and consequently as most probably belonging to the same species. The minor depth of the bone accords with the proportions of the lower jaw in *Pter. giganteus* (Monog. cit., Tab. XXXI, figs. 1 and 2); and the sockets are directed more obliquely outward, as they likewise are in the lower jaw of *Pter. giganteus*, as compared with the upper one of the specimen of that species, in which both jaws of the same head have been preserved. In the belief, therefore, that fig. 2, *a*, *b*, represents part of the under jaw of *Pterodactylus Sedgwickii*, the median groove on the upper or oral surface of the prolonged 'symphysis mandibulæ' (fig. 2, *b*) suggests that it may have served to lodge a long filiform tongue, perhaps bifurcate at the end, as in the Leptoglossal Lizards of the present day. The same thin outer wall, and capacious cavity filled by matrix, and probably in the living reptile by air, characterise the lower (fig. 2, *c*), as they do the upper, jaws of *Pterodactylus Sedgwickii*. In one of the sockets of the lower jaw part of the hollow base of an old tooth is preserved, with the sharp slender point of a new tooth projecting from the inner side of the socket (Tab. I, fig. 2, *d*), showing the same relative position of the matrix of the successional tooth, as may be observed in the existing Crocodile.

Pterodactylus Fittoni, *Owen*. Jaws and teeth, Tab. I, figs. 3, 4, 5.

Figure 3, *a*, *b*, &c., shows the fore part of the upper jaw of a Pterodactyle, with the first and second pairs of alveoli. In the minor depth of the jaw, compared with its basal breadth, in its more obtusely rounded upper surface, and in the greater extent of space between the alveoli of the same size, this maxillary fragment indicates a very distinct species from the *Pterodactylus Sedgwickii*, but one probably not much inferior in size. I propose to dedicate it to my friend, Dr. Fitton, F.R.S., one of the founders of the Geological Society of London, and who may be regarded as the discoverer of the system now called "Neocomian," which includes the Green-sand matrix of the Flying Reptiles under consideration. The sockets in the fragment (fig. 3) may answer to the second and third in fig. 1, though there scarcely seems room for a pair in advance of the foremost in the specimen figured; be that as it may, the distance between the first and second socket in the specimen of *Pterodactylus Fittoni* is, relatively to the size of the socket, greater than the interval between the second and third sockets in *Pterodactylus Sedgwickii*, and much greater than that between the second and third sockets. The outer wall of the largest anterior socket in *Pter. Fittoni* is much less prominent than in *Pter. Sedgwickii*, and the lateral expansion of the fore part of the upper jaw must have been relatively less; the form of the bony palate is different, there being a distinct though shallow longitudinal groove on each side a low obtuse median ridge. The diastema between the second and third tooth is shown to exceed the long diameter of the second socket, recalling the proportion of the interspaces in *Pterodactylus Cuvieri* (Monog. cit., Tab. XXVIII, fig. 4), but the jaw is broader in proportion to its height in *Pterodactylus Fittoni*.

Figure 4, *a* and *b*, is a fragment of one side of the fore part of the upper jaw, showing three alveoli, and agreeing in general proportions with the *Pterodactylus Fittoni*.

Fig. 5 is the fragment of a jaw, showing a single elliptical socket, 5 lines in long diameter (*a*), and with the plane inclined a little outward, as at *b*. The widely open cancellous structure of the bone is well shown on the inside of this fragment, as at *c*.

Pterodactylus. Sp. inc.

Tab. I, fig. 6, is a portion of an upper jaw, including a part of two sockets, in one of which the root of the tooth remains. Three views of this fragment are given, of the natural size: *a* showing the alveolar border, *b* the broken margin exposing the tooth, and *c* the outer wall of the jaw. This part of the wall is nearly flat, very slightly convex below, and as slightly concave above, vertically; the upper margin showing no indication of any bend or inclination to the upper border of the jaw, the height or vertical diameter of which remains conjectural; that it was, at least, one third more than the portion preserved, may be estimated from the extent of the socket of the tooth being equal with the preserved part of the wall (fig. 6, *b*). A coat of roughish 'cæmentum,' one third of a line thick, is preserved upon the upper half of the tooth-root; below this is seen the smooth dentine; and where it is broken, the pulp-cavity is exposed, filled by the Green-sand matrix. The length of the implanted part of this tooth is 1 inch 4 lines, the long diameter of the transverse fracture at the base of the crown is $\frac{1}{2}$ an inch, the short diameter is $4\frac{1}{2}$ lines. Estimating the length of the exserted enamelled crown to equal that of the inserted cemented base of the tooth of a Pterodactyle—and I have known it more in the long anterior laniariform teeth—we may assign a length of 2 inches 8 lines to the teeth implanted in the part of the upper jaw here described. The interspace between the two sockets is $3\frac{1}{2}$ lines, or half that of the long diameter of the socket; the plane of the opening of the socket, and the interspace, present the same obliquity as they do in *Pterodactylus Sedgwickii* (fig. 1); and as the proportion of the interspace to the socket is also the same, the present fragment has most probably belonged to a larger individual of the same species. Since the outer border of the sockets does not swell out beyond the outer wall of the jaw, the fragment has been part of jaw behind the anterior swelling caused by the proportionally large prehensile teeth; and as, from the analogy of known Pterodactyles, the teeth succeeding those anterior ones are not of larger size, but are usually smaller, at any posterior part of the jaw, we may, therefore, with due moderation, frame an idea of the Pterodactyle to which the maxillary fragment (fig. 6) belonged, as surpassing in size that to which the portion of jaw (fig. 1) belonged, in the proportion in which the socket in fig. 6, *a*, exceeds the last socket in fig. 1, *b*. Such an idea impels to a close scrutiny of every character or indication of the true generic relation of the present fragment in the Reptilian class; but the evidence of the large and obviously pneumatic vacuities, now filled by the matrix, and the demonstrable thin layer of compact bone forming their outer wall, permit no reasonable doubt as to the pterosaurian nature of this most remarkable and suggestive fossil. All other parts of the Flying Reptile being in proportion, it must have appeared, with outstretched pinions, like the soaring Roc of Arabian romance, but with the demoniacal features of the leathern wings with crooked claws, and of the gaping mouth with threatening teeth, superinduced.

The last portion of jaw of Pterodactyle from the Cambridge Green-sand which will here be described, is that figured in Tab. I, fig. 7, *a*, *b*, *c*, *d*. It is part of the lower jaw, and indicates a smaller individual of *Pterodactylus Sedgwickii* than the specimens, figs. 1 and 2. In a longitudinal extent of $2\frac{1}{2}$ inches, six successive sockets are shown, but with only the two middle pairs perfect. Their orifices have the same obliquity as in fig. 2; and the surface of the bone between the right and left sockets shows the same median longitudinal groove. Opposite the middle sockets the sides of the jaw are preserved nearly to the median inferior ridge, as shown in fig. 7, *c*; these sides being flat and straight, and giving the transverse section shown at fig. 7, *d*. The intervals of the sockets are a little wider, proportionally, than in some of those in fig. 2, but not more than a hinder position in the jaw would account for, without having recourse to a distinction of species to explain it.

Two species, however, are satisfactorily established, both of them distinct from any of the known large Pterodactyles of the Chalk, by the portions of jaws from the Upper Green-sand near Cambridge, viz., *Pterodactylus Sedgwickii,* with more approximated alveoli (Tab. I, figs. 1 and 2, with probably 6 and 7); and *Pterodactylus Fittoni* (ib., figs. 3, 4, and 5).

To which of these large species the teeth and bones next to be described belong is not satisfactorily determinable, but indications of their appertaining to more than one such species now and then occur with more or less significancy.

Teeth.

Various teeth, but few quite entire, have been rescued by the care and perseverance of Mr. Lucas Barrett from the rubbish of fragmentary fossils accumulated during the diggings for phosphatic nodules in the Green-sand deposits near Cambridge. Guided by the proportions of length to breadth, by the elliptic section, and the concordance of the minute markings on the crown and base with those on the portions of teeth, as in Tab. I, fig. 2, *d*, and 6, *b*, remaining in the jaws of *Pterodactylus Sedgwickii,* many of the above detached teeth can be satisfactorily referred to the genus, if not to that particular species.

The base or implanted part of one of the largest of these teeth is figured of the natural size in Tab. I, fig. 10. It has belonged to a Pterodactyle as large as that represented by the fragment of jaw (fig. 6), if not to the same individual; it presents the same elliptical transverse section as the implanted base of the tooth in fig. 6, *b*; shows a widely excavated pulp-cavity at the base, and gradually tapers to the crown; the cement, about $\frac{1}{3}$d of a line in thickness, is roughened by longitudinal grooves, not continuous for any great length, but uniting, or bifurcating, in an irregular reticulate pattern, forming long and very narrow meshes, the raised interspaces being equal in breadth to the grooves. In a few teeth the base shows an oblique depression, evidently due to the pressure of a successional tooth, as shown at Tab. I, fig. 8, *o*; in these the basal pulp-cavity is more or less filled up by ossification of the pulp. The enamel of the crown seems smooth and polished, and, under the lens, shows only extremely delicate, slightly and irregularly wavy, longitudinal, but often interrupted or confluent, ridges. The crown is straight in a few teeth, as at Tab. I, fig. 9, but more commonly it is bent, as it is in the tooth of the great Pterodactyle from the Chalk figured in the above-cited 'Monograph on Cretaceous Reptilia,' Tab. XXVIII, fig. 5. In general, the transverse section of the crown is less truly elliptical than that of the base, owing to its being a little flattened on one side. The smaller teeth, probably from the back part of the dental series, are rather more curved than the larger ones (Tab. III, figs. 16—20).

Vertebræ of Pterodactylus. Tab. I, figs. 11—14. Tab. II.

The most instructive specimens from the Cambridge Green-sand are those which have afforded the precise and hitherto unknown characters of certain vertebræ of *Pterodactylus*. Viewed as indicative of the generic character of these bones, they give the earliest known example of the "procoelian" type of vertebræ* in the Reptilian class, being the first cup-and-ball vertebræ, with the "cup" at the fore part of the centrum, met with in the ascending order of strata. It cannot be doubted that this structure prevails in the moveable vertebræ of the neck and back of all *Pterosauria*, and must be predicated of the *Dimorphodon*† of the Lias as well as of the *Pterodactylus* of the Green-sand, in which the structure is now clearly demonstrated. The chief difference which the Pterodactyle presents in this respect from modern Lizards is, that both the cup and ball are of a more transversely extended elliptical shape in most of the vertebræ of the flying Saurian.

Amongst the numerous vertebræ submitted to me were specimens of united, or partly united, "atlas and axis."

The atlas consists of a centrum (Tab. I, figs. 11 and 12, *c*), of two slender styliform neurapophyses (ib., *n*), and of a very small discoid neural spine. The centrum is so short as to be discoid; it is flat where it joins and becomes anchylosed to the axis (*x*), and is concave for the occipital tubercle: this cup is circular; its depth is shown in the section of the anchylosed atlas and axis, fig. 12. The neurapophyses (*n*), resting on each side of the upper half of the centrum of the atlas, converge and articulate above with two small tubercles, as shown in fig. 13, on the fore part of the neural arch of the axis; the neurapophyses almost meet, but do not unite above the neural canal.

The body of the axis is eight times longer than that of the atlas; it expands posteriorly, and terminates by a transversely elliptical ball (*b*) at the upper part of that end, and in a pair of thick, short, obtuse, diverging apophyses (*p*), at the lower part. There is a rudimental hypapophysial ridge, fig. 12, *h*, from the middle and toward the fore part of the under surface of the centrum; the extent to which this surface

* 'Monograph of Fossil Reptilia of the London Clay,' 4to, vol. for 1850, p. 11.

† 'Reports of the British Association,' 1858.

descends below the hinder ball, and between the apophyses (*p*), is shown at Tab. I, fig. 12, *x*.

The centrum of the axis vertebra is confluent with the neural arch, fig. 11, *n*, *x*; at the middle of the side, apparently crossing the line of junction, is a large subcircular aperture, which leads directly into the widely cancellous structure of the bone, below the neural canal. This vacuity (fig. 11, *o*) answers to the " foramen pneumaticum" in the vertebræ of birds, and doubtless admitted a production from the air-cells extending along the neck of the Pterodactyle into the cancelli of the osseous tissue. The neural arch rests upon the three anterior fourths of the centrum ; it expands as it passes backward ; and there, also, as it rises, until it sends off from each posterior angle the zygapophysis (Tab. I, fig. 11, *z*), which has a tubercle above, and a flat articular surface below, looking downward and a little outward and backward. The small tubercles at the fore part of the neural arch, shown in fig. 13, to which the neurapophyses of the atlas are ligamentously connected, may be the stunted homologues of anterior zygapophyses. The neural spine begins by a low ridge between those tubercles, increasing rapidly in thickness behind; but it has not been preserved in its full height in any specimen.

In the small atlas and axis figured in Tab. II, figs. 1—4, the line of suture between the bodies of these two vertebræ is distinct. In a somewhat larger specimen, the centrum of the atlas was separable by a smart blow, and showed the true anterior surface of that of the axis, as shown in Tab. I, fig. 13 ; this surface is very slightly concave, with a submedian prominence. The neural canal expands at its posterior outlet.

The small atlas and axis (Tab. II, figs. 1—4) not only differ in size from the specimen (figs. 5 and 6), but also in the smaller relative size of the articular surface of the zygapophysis, and the greater relative expansion of the back part of the centrum : the specimen belongs to another species of Pterodactyle. On comparing the atlas and axis of the Pterodactyle with that of the bird, the Ostrich for example, the atlas in the bird is represented by the neurapophyses, which have coalesced below with a hypapophysis, forming an irregular ring of bone. The centrum has coalesced with that of the axis, forming a small prominence, convex anteriorly, and filling up the vacuity at the upper part of the cup excavated in the fore part of the hypapophysis ; the neurapophyses are broad in the bird, and overlap the anterior zygapophyses in the axis ; they meet above the neural canal, but long retain the separating fissure there, in the Ostrich ; the centrum of the axis is broader before than behind. A short process, like a connate pleurapophysis, from the fore part of the centrum, unites with a diapophysis from the neural arch to form an arterial canal. The pneumatic foramen is behind the diapophysis, and conducts to the cancellous tissue of the neural arch. The centrum is produced into a strong hypapophysis below the posterior articular surface ; but not expanded laterally into transverse processes, answering to parapophyses, in the Pterodactyle. The hinder articular surface of the centrum of the axis in the bird is convex transversely, but concave vertically, not simply convex, as in the Pterodactyle; thus a portion of the vertebra of that reptile, notwithstanding its pneumatic structure, might be distinguished from the vertebra of a bird.

In the ordinary neck-vertebræ of the Pterodactyle the centrum is oblong, subdepressed, slightly compressed at the middle, subcarinate (Tab. II, figs. 11, 12, *h*), or with a low obtuse hypapophysis (fig. 18) at the fore part of the under surface, which expands laterally to join the base of the anterior zygapophyses (ib. *a*). The back part of the centrum expands and bifurcates into the short, thick, obtuse parapophyses (figs. 11 and 18, *b*), the anterior concavity (fig. 10, *c*) is a long transverse oval, with the upper border somewhat produced: the hinder ball (fig. 8) has a similar transversely extending elliptical figure, directed a little upwards; it appears to be tilted up by the curve of the under surface of the centrum, above the level of the terminal tuberous parapophyses (*p*). A large pneumatic foramen (figs. 7, 13, 15, *o*) of an elliptic form, opens upon the middle of each side of the centrum, close to the anchylosed base of the neurapophysis. The texture of the centrum (fig. 19) presents a few very large cancelli, which communicated by the pneumatic foramen with the cervical air-cells. The smooth outer wall of the centrum is a very thin but compact plate of bone: it becomes a little thicker where it forms the articular cup and ball.

The neural arch, between the notches of the nerve-outlets, is not quite two thirds the length of the centrum. The hinder notch is the deepest; the arch is low, broad exteriorly, less concave on each side than it is before and behind (Tab. II, fig. 17), with the four angles somewhat produced, and supporting the articular surfaces, of which the two anterior (fig. 18, *a*) look upward and inward, the two posterior (fig. 16, *z*) downward and backward. The sides of the neural arch extend outward so as to overhang those of the centrum (fig. 18). The posterior zygapophyses (*z*), do not extend so far back as the articular ball of the centrum.

Figs. 7 to 11 give five views of the natural size of a middle cervical vertebra, which, according to the proportions of *Pterodactylus suevicus*, Qnstd.,* may have belonged to a Pterodactyle with a first phalanx of the wing-finger of about one foot in length. In fig. 12 the under surface of the centrum is well preserved; it differs from that of the larger cervical vertebra (figs. 7—11) in being flatter from side to side, and in being concave instead of convex from before backward; the concave contour being due to the median production, gradually extending into the obtuse hypapophysis (*h*) at the fore part. This difference indicates that the present vertebra had a more advanced position in the cervical series than fig. 7, which may probably have been the sixth. The superior breadth of the neural arch over the centrum is well shown in fig. 12; and the relative positions of the zygapophysis (*z*), the articular ball (*b*), and the parapophysis (*p*), at the hinder end of the vertebra, are seen in fig. 13, which is a side view of the same vertebra.

* Quenstedt, 'Ueber *Pterodactylus suevicus*,' 4to, 1855.

Figs. 14, 15 and 16 show a smaller cervical vertebra, of a more depressed form, not due to crushing. The centrum is much depressed; the pneumatic foramen (fig. 15, *o*) partakes of the same modification of form, and is a longer ellipse than in the vertebra (fig. 7); the neural canal retains its normal cylindrical shape, with slightly expanded outlets. The form of the posterior zygapophysis is perfectly preserved on one side, in fig. 11, *z*, and the articular surfaces on both sides in fig. 16, *z*; they are relatively larger than in fig. 11. In fig. 15 more of the base of the neural spine remains than in most other specimens.

Figs. 17 and 18 are of a rather shorter and probably more advanced cervical vertebra, but of very similar proportions; in it the neural arch (fig. 17) is more entire than in most specimens, the anterior (*a*) as well as posterior (*z*) zygapophyses being preserved; the more frequent loss of the anterior pair is due to their being more slender and more produced. The under surface of the centrum (fig. 18) shows no rising of the middle part, the hypapophysis having a less extended base than in the vertebra, (fig. 12.) The inner surface of the anterior zygapophysis (fig. 18, *a*), is divided by a notch from the border of the articular concavity of the centrum.

Fig. 19 gives a view of a section of a mutilated cervical vertebra, nearly equal in size with fig. 7, and similar in form. The shape of the neural canal, the large cancelli, and the thin superficial compact crust of the bone, are well shown in this section.

At the base of the neck, or beginning of the back, the vertebræ suddenly decrease in length; the hypapophysis disappears, or is represented only by a slight production of the lower border of the anterior cup; the parapophyses are less produced, the lower surface of the centrum is flattened, and presents the quadrate form shown in figure 20. There is now a considerable development from the fore part of each side of the neural arch and contiguous part of the centrum, and thereby the last cervical or first dorsal vertebra of the Pterodactyle more resembles the corresponding vertebra of the bird. The parapophysis, diapophysis, and rudimental rib coalesce around the vertebraterial foramen; an oblique ridge is continued from the upper border of the anterior articular cup upon the parapophysis; a parallel oblique ridge is continued from the anterior zygapophysis downward and outward upon the pleurapophysis; the diapophysis makes a low obtuse projection above the pleurapophysis and behind the zygapophysis. Above these developments the neural arch contracts from before backward, to an extent of 5 lines, as compared with a total vertebral breadth, anteriorly, of 1 inch 8 lines; it then rapidly expands, rising vertically at its fore part, and developing at its back part the posterior zygapophyses, the articular facets of which look more directly outward than in the long cervical vertebræ; the superincumbent tubercle (fig. 22, *c*) is more distinct from the facet (ib., *z*); the posterior zygapophyses are also much more approximated than in those vertebræ; they are separated behind by a semicircular concavity; the base of the neural spine in the vertebra here described measured 6 lines in length by 3 in breadth. The pneumatic foramina are at the back part of the base of the diapophysis, as I have seen them in the cervical vertebra of a *Dinornis*. The articular surfaces of the centrum retain the transversely extended form, and are simply concave before and convex behind, which at once distinguishes the Pterosaurian hind-cervical vertebra from that of the bird.

In the dorsal region the vertebral centrum (fig. 24), retaining its shortness, gains in depth, and presents the more usual proportions of cup-and-ball reptilian vertebræ. The under surface (fig. 20) is smooth and even, very slightly concave lengthwise, convex transversely. The parapophysis disappears, and the diapophysis, which alone supports the rib, after the first or second dorsal, is sent off from a higher position in the neural arch (fig. 25).

Sacrum.

Fig. 26, Tab. II, shows parts of the bodies of three anchylosed sacral vertebræ, the first being demonstrated by part of its anterior concave articular surface (*a*) for the last lumbar vertebra. The groove for the passage of the nerve notches the back part of the parapophysis, close to the line of suture with the second sacral. In this vertebra the corresponding nerve-notch is more advanced, leaving a short sutural surface behind, indicative of a position of the neural arch crossing for a short extent the line of junction of the second with the third sacral centrum. The parapophyses of the second and third are sent off almost on a level with the lower surface of the centrum, which is flattened.

The fore part of the sacrum of a much larger Pterodactyle, from the Cambridge Green-sand, differing also in the less transverse convexity of the under part of the first centrum, measures 11 lines across the shallow anterior articular concavity, and 14 lines from the lower part of the centrum to the fore part of the base of the neural spine. The neural canal is circular and 2 lines in diameter; above it the neural arch rises like a vertical wall for 5 lines, where the spine has been broken off.

Caudal Vertebræ.

From the number of elongated caudal vertebræ in the series of fossils from the Cambridge Green-sand submitted to me—not fewer than seven—I believe the large Pterodactyle from that formation to have had a long tail, but moveable, not stiff through anchylosis of the vertebræ, as in *Pter.* (*Ramphorhynchus*) *Gemmingi, V.* Meyer.

The largest of these caudal vertebræ measures $1\frac{1}{2}$ inch in length; it is slightly contracted in the middle; the fore part of the under surface is a little produced; the back part almost flat between the rudimental parapophyses; the shallow anterior concavity has resumed its transversely elliptical shape, and the hinder convexity is defined below by a shallow groove connecting the parapophyses. There is no pneumatic foramen, unless a small hole on each side the hinder outlet of the neural canal have served as such; the neural arch is long and low, quite one piece with the centrum, which extends beyond it posteriorly. It sends off short, obtuse zygapophyses before and behind, those in front extend beyond the cup of the centrum; the surfaces on those behind look downward and backward. The base of the spine is coextensive with the summit of the arch, but is narrow. The neural canal is much contracted. There is no indication of a hæmal arch, either by articular or fractured anchylosed surfaces. The diameter of the middle of this vertebra is 6 lines.

The caudal vertebra next in size measures 1 inch 5 lines. The base of the neural spine begins 2 lines behind the fore part of the arch, but terminates nearer the hind part; the nerve-grooves notch the hinder zygapophyses.

Three more slender caudal vertebræ present each a length of 1 inch 3 lines; the diameter at the middle is 5 lines in one, 4 lines in a second, $3\frac{1}{2}$ lines in the third vertebra, showing that they become more slender without losing length. A caudal vertebra 3 lines across the middle appears to have been nearly an inch in length; but both extremities are injured.

Frontal Bone (?)

As it is probable that the median symmetrical portion of bone (Tab. IV, figs. 6, 7 and 8) may belong to the cranium of one of the large Pterodactyles from the Upper Green-sand, its description follows that of the vertebræ.

It is 2 inches 4 lines long; 10 lines across its broadest part; 1 inch 2 lines in depth, to the surface where the piece has been broken away; the sides present a smooth concave plate of bone (fig. 6), as if the piece had been nipped between a finger and thumb, but quite symmetrically; the surface, which, on the supposition that those smooth concave facets were inner walls of the orbits, would be the upper one, and due to the frontal bone, is gently convex in the direction of its length, and has a median longitudinal ridge, which expands and subsides near the end most produced beyond the lateral depressions. I have observed a similar median ridge or rising upon the single frontal bone of the *Alligator lucius*, between the orbits, and upon the double frontal, supporting the median suture, in the *Rhynchocephalus* lizard of New Zealand. There is also an indication of such a median ridge in the figure of the cranium of *Pterodactylus suevicus*, in Professor Quenstedt's Memoir on that species (4to., Tübingen, 1855).

The most perfectly preserved of the lateral impressions (fig. 6) is of an oval form, 1 inch 3 lines in long diameter; it is well defined from the narrower upper surface (fig. 7) to which it stands at nearly a right angle; the curved border defining it is not produced. The whole of the substance of the bone between the lateral plates is occupied by a moderately open and apparently pneumatic cancellous texture (fig. 8); the outer wall of bone is compact, but extremely thin; the general structure is decidedly that of a volant Vertebrate, and most resembles that of a Pterodactyle.

The parts of the skeleton of the Pterodactyle which would afford a symmetrical median piece of bone, comparable with the present fragment, are—the sternum, the fore part of the upper and lower jaw, the sphenoid at the base of the skull, and the parietal and frontal bones at the upper part of the skull. The absence of any trace of cranial cavity at the lower fractured surface, more than an inch below the outer surface, opposes the choice of the parietal with lateral impressions of temporal fossæ: there remains, therefore, the frontal with the interpretation of the lateral depressions as parts of the orbits; but the depth of the smooth impressed plates, and their divergence as they descend, oppose this interpretation. I have no evidence of sternal ends of coracoids which would require articular depressions of such size and shape as the lateral ones on the fragment in question, on the hypothesis that it may be from the fore part of the sternum. Upon the whole, therefore, I have to acknowledge a degree of uncertainty as to the exact nature of the present fragment of the skeleton, most probably, of some large Pterodactyle.

Scapular Arch.

The mechanism of the framework of the wings in the Pterodactyle is much more bird-like than bat-like. The scapular arch is remarkably similar to that of the bird of flight. It consists of a scapula and coracoid, usually anchylosed where they combine to form the shoulder-joint.

The cavity for the head of the humerus, in *Pterodactylus macronyx* * (Tab. III, fig. 6), is oval, with the great end formed by the scapula; it is concave vertically, or in the direction of its long diameter, convex transversely, but least so near the scapula. If these proportions hold good in other species, they would serve to determine the scapular or coracoid portion of a glenoid cavity, when, as in the case of the fossils here described, the rest of the scapular arch had been broken away.

The upper (scapular) border of the glenoid cavity is prominent and well defined; the bone is moderately constricted beyond it, from without inward, whence the

* Buckland, 'Geological Transactions,' 2d series, vol. iii, pl. xxvii, x, 9.

scapula extends upward and backward, as a slightly bent sabre-shaped plate, a little twisted on itself. The coracoid is thicker, straighter, and shorter than the scapula; it is rather suddenly expanded at the sternal end, where it is most compressed: the scapular end developes a protuberance below the glenoid cavity.

The scapular arch in *Pterodactylus giganteus*, Bwk., from the Chalk of Kent ('Monog. Cretaceous Reptiles,' 1851, p. 93, Tab. XXXI, fig. 7), was distinguished by a tuberous (acromial) process from the scapula, near the glenoid cavity, the corresponding anterior process from the coracoid being well marked.

The fossil fragment from the Cambridge Green-sand (Tab. III, figs. 1 and 2) consists of the coalesced extremities of the scapula (*a*) and coracoid (*b*), where they form the glenoid cavity for the humerus. The margins of the cavity are in part abraded, but its long diameter cannot have been less than 1 inch 3 lines; it is concave vertically, rather convex transversely below, but plane, or a little concave, in that direction at the upper or scapular end. The cavity is transversed obliquely by a depression pretty equally dividing it, and indicating the respective shares of the scapula and coracoid in its formation prior to the anchylosis of those two bones. The end of the scapula, near the cavity, would present an unequally three-sided figure in transverse section, the side looking inward and that looking forward being concave, the side looking outward convex. Half an inch above the border of the glenoid cavity is the fractured base of the (acromial) process answering to that in *Pterodactylus giganteus*, but which is more feebly developed in *Pterodactylus macronyx*, Bkd., and *Pterodactylus suevicus*, Qnstd. Beyond this process the bone rapidly contracts in size, and presents an oval transverse section, as at *a*, fig. 2, Tab. III.

The surface of the coalesced extremities of the bones which is applied to the thorax is concave in every direction, and an inch in breadth, with a long narrow (pneumatic) aperture near its hinder border. The anterior production of the coracoid has been broken away at *c* (figs. 1 and 2), the coracoid quickly contracts as it recedes from the humeral articulation to a size and shape shown by the section *b* (fig. 2). The size of the entire scapular arch, according to that of *Pterodactylus macronyx*, is shown by the dotted outlines in fig. 1.

Fig. 3 shows the articular surface of the scapular arch of a Pterodactyle of larger size than the preceding specimen; the oblique groove indicative of the portions contributed by the scapula and coracoid to the cavity is well marked, as it also is in the corresponding fragment of the scapular arch of the smaller Pterodactyle (fig. 4). In the still smaller but similar fragment of the scapular arch (fig. 5), the posterior concave surface shows the long (pneumatic?) foramen very distinctly, and also a trace of the primitive separation of the scapula and coracoid. If this specimen has belonged to a young individual of either of the two larger species, it shows that the union of the two bones takes place at an early age. In the bird, although the early and extensive coalescence of originally distinct bones is a characteristic of the skeleton, the scapula remains distinct from the coracoid, and the persistent suture traverses the glenoid cavity. The coracoid is shorter and straighter in birds than in Pterodactyles, but is commonly broader, and with a longer and stronger anterior process.

Humerus.

The portion of bone figured of the natural size in Tab. III, fig. 7, shows an articular surface of a reniform figure, convex in its shorter diameter, less convex upon the more prominent half, lengthwise, and slightly concave lengthwise at the side which is hollowed out. The smaller end of the surface (*a*) has been produced into a process, here broken away, and the fracture is coextensive with the length, in the direction of the shaft of the bone, of the fragment, which is nearly two inches; the larger end of the articular surface (*b*) seems not to have sent off such a process; but the back part of this end is broken away. The pterosaurian nature of the fragment is shown by the thinness of the compact wall of the shaft below the articular surface, and by the wide cancelli. The general resemblance of the articular surface, in shape, to that of the humerus of the Wealden Pterodactyle (*Pt. sylvestris*, Ow.) figured in the 'Quarterly Journal of the Geological Society,' Dec., 1845, vol. ii, p. 100, fig. 6; and to that of the more complete humerus of *Pterodactylus suevicus*, Qnstd., loc. cit., but especially to the articular surface of the portion of bone of a smaller Pterodactyle (Tab. III, figs. 14 and 15), which exhibits more distinctive characters of a humerus, have led me to refer the fragment in question (fig. 7) to the proximal end or head of that bone in one of the large species above established by maxillary characters.

The end of the articular surface (*a*) answers to the outer plate or process (*g*) in *Pterodactylus sylvestris*, and the fractured surface behind the end (*b*) might well have been the base of a shorter and thicker process, like that marked *f* in *Pter. sylvestris*. Determining, by these analogies, that *a* is the outer or radial, *b* the inner or ulnar, end of the transversely extended head of the humerus; that the convex side is the fore part, and the concave one the back part, of the same bone; it may next be remarked that the inner half of the fore part of the articular surface is extended further and more convexly upon the shaft than the outer half, which meets the vertical plane of the shaft more abruptly; but the form of this part of the head of the humerus is better shown in the next specimen.

This fragment (fig. 8) is the head of the opposite humerus of a Pterodactyle of equal size with the preceding. The boundary of the articular surface near the outer process (*a*) is very slightly raised, with a few short ridges at right angles, indicative of the firm attachment of the capsular ligament; an oblique line divides the more abruptly defined outer half of the surface from the inner anteriorly more convex half. The anterior surface of the fore part of the shaft of the humerus, here preserved, is impressed by longitudinal reticulate markings. The total length of the humerus, according to the proportions of the length of that bone to the breadth of its proximal articular surface in *Pterodactylus suevicus,** would be $10\frac{1}{2}$ inches.

Fig. 9 shows well the minutely punctate surface of the articular head of the humerus; the portion of the fore part of the shaft preserved with this shows that the fine reticulate markings are limited to a short distance below the head, and that the rest of the outer surface of the shaft here preserved is smooth. The extent of the base of the outer plate or process is 1 inch, the long diameter of the articular surface of the head being 1 inch 3 lines.

The fragment of the head of the humerus (Tab. III, fig. 10) is remarkable for the well-defined ridge bounding the anterior convex part of the articular surface.

The proximal end of the smaller humerus (fig. 11) includes nearly two inches of the shaft, of which a front view is given in fig. 12, and a back view in fig. 13. The base of the outer process (*g*) shows the same proportion to the long diameter of the head, as in fig. 9. The fractured surface along the opposite side of the shaft (*f*) seems to show that this border had been produced into a ridge or plate, as in *Pterodactylus sylvestris.* The back part of the shaft between these plates is concave transversely, but rather convex lengthwise; the opposite conditions prevail on the fore part of the bone. Here, towards the base of the outer process, is a small, apparently pneumatic, oblong foramen.

The smaller proximal end of humerus (figs. 14 and 15), shows a larger proportion of the process (*f*) which extends the bone in that direction beyond the articular head.

All these specimens show that, in the Pterodactyles from the Green-sand, there is a plate or process with a shorter base, extending close to the articular surface of the head of the bone, and that there is a plate, with a larger base, extending farther from the articular head at the opposite side of the bone.

The fragment (figs. 1, 2, and 3, Tab. IV) shows part of the articular extremity of one of the long bones of the wing. The articular surface has been partially divided into what might be called, were they entire, two condyles (*a* and *b*). The most perfect of these divisions shows a slightly convex surface (figs. 1, and 2, *a*, *a*,) occupying its major part, and a small well-defined flat surface (figs. 1, and 3, *c*,), placed obliquely. So much of the other division as is preserved likewise shows two facts

* See the plate in Quenstedt's 'Memoir,' above cited.

one, which we may call the anterior (*d*), is convex and of small extent, and behind it is a well-defined part of a concave surface (*b*). At the fore (?) part of the bone (fig. 2) the two convex surfaces extend a little upon the shaft (*a*), and are divided from each other by a moderate median depression; where the thin smooth outer crust of bone has been worn away, the small superficial cancelli are exposed. At the back (?) part (fig. 3), where the major part of the bone is broken away, the larger cancelli are exposed.

Guided by considerations of size, the fragment (Tab. IV, figs. 1—3) might form the opposite end of the bone indicated by the articular ends (Tab. III, figs. 7, and 8). I am not acquainted with the precise configuration of the distal end of the humerus, in any Pterodactyle; indeed, the articular surfaces of very few of the bones of this remarkable reptile have been perfectly preserved, so as to be recognisably delineated and described. From general analogy, however, one should scarcely be prepared to find so feeble an indication of divisions into condyles, an absence of general convexity, and a presence of a well-defined concavity in one condyle, and as well-defined a flattened or feebly concave facet in the other condyle, of the distal end of a humerus. The form of articulation above described would seem rather to be that of the end of an antibrachial bone adapted to join the bones of a carpus. But, on the hypothesis of the fragment in question being either proximal or distal, and of a radius or ulna, it expands our ideas of the bulk of the Green-sand Pterodactyle even beyond those suggested by the manifestly head of the humerus (Tab. III, fig. 7). The present description and figures will at least help, it is hoped, to forward a precise knowledge of the osteological characters of the *Pterosaurians*.

Assuming that we have in figs. 1—3, Tab. IV, the articular end of an antibrachial bone, then, according to the proportion which the broadest end of one of these bones bears to its total length in the *Pterodactylus suevicus*, the length of such antibrachial bone in the great Pterodactyle of the Green-sand here indicated would be 16 inches. The total length of wing will be calculated on this basis at the conclusion of the present Monograph.

The fifth or wing-metacarpal.

The trochlear joint of the bone (Tab. IV, figs. 9—11) belongs to the distal end of the metacarpal of the fifth or wing-finger. The pulley is more complex, in the large Pterodactyles here described, than it is in similar trochlear joints of other animals; there are three convex ridges, *a*, *b*, *c*, which traverse the articular surface from behind forward, describing rather more than half a circle; the middle ridge, *c*, is less prominent, and of less extent than the lateral ones which form the sides of the pulley. The direction of the ridges is rather oblique, and one which, to help the description, may be called the outer ridge, is rather more produced and of a less regular curve than the inner ridge. The outer ridge, *a*, begins by a rising at the middle of the fore part of the distal end of the shaft, which bends obliquely outward and meets the outer angle of that part of the shaft where the outer trochlear ridge begins to be prominent; this ridge then extends with a feeble convex curve to the back part of the trochlea, where the convexity of the curve increases, and it terminates by projecting a little beyond the level of the outer almost flattened side of the trochlea (fig. 10). The articular surface, as it extends from the margin of this element of the trochlea inward, is first gently convex, then sinks to a concave channel by the side of the low median convexity. The inner ridge *b*, begins from the inner side of the fore part of the bone, and describes a pretty regular semicircular curve as it extends backward and a little outward, to terminate near the middle of the back part of the distal end of the shaft; thus owing to the termination of the inner ridge near the middle of the back part, and to the beginning of the outer ridge near the middle of the fore part, of the metacarpal bone, these principal ridges of the trochlear joint recede from each other at the middle of the joint, and approximate at the fore and back ends of the joint. As the back ends of the two lateral ridges are on the same transverse line, and the front end of the inner ridge rises higher upon the shaft than that of the outer ridge, this is by so much the shorter of the two. The low middle ridge *c*, is much shorter than either of the lateral ones, being confined to the lower and middle part of the trochlea, to which it gives an undulating transverse outline (fig. 11).

The figure of the metarcarpal bone of the wing-finger, in *Pterodactylus suevicus*, Qnstd., does not show any trace of the mid-rising of the distal trochlear joint. The back surface of that of the left wing shows a wide and moderately deep excavation along the upper three fourths of the shaft. A portion of a similarly shaped shaft of a long bone, in size matching that of the trochlear extremity (fig. 10), is represented in Tab. IV, figs. 4 and 5. Although both ends are broken away, yet the degree of expansion toward the upper end shows that this was not very far from the proximal articulation. The shaft is three-sided; two of the sides are nearly flat or very feebly convex; they meet anteriorly at an acute angle, but this is rounded off as shown in the transverse sections of figs. 4 and 5; the third and shorter side is concave in the degree shown in the same sections. The lower of these (fig. 5), indicates the extreme thinness of the compact wall of the bone, and the size of the cancelli occupying that part of the shaft.

The portions of the wing-bones of the Pterodactyles of the Cambridge Greensand, here described and figured, show the same superior proportions over those of the great Pterodactyles from the Kentish Chalk, described and figured in a former Monograph, 4to., 1851, as do the portions of jaw bones and teeth.

The long diameter of the largest of the wing-bones, figured in Tab. XXX, fig. 1, 4to, 1851, *e.g.*, is 2 inches 2 lines; that of the wing-bone, figured in Tab. IV, figs. 1—3 of the present Monograph, is 3 inches. The transverse diameter of the distal end of the humerus of *Pterodactylus grandis*, Cuv., the largest species hitherto obtained from the Lithographic Slates of Germany, is 1 inch 3 lines; neither the radius, ulna, or metacarpal of the wing-bone of the same species presents a diameter of its largest end equalling 1 inch.*

The articular end of the long wing-bone, (Tab. IV, figs. 1—3), being most probably that of an antibrachial bone, and the total length of the bone, whether radius of ulna, being, according to proportions of either of these bones in *Pterodactylus suevicus*, 16 inches, the following would be the length of the other long bones of the wing in the large Pterodactyle to which the above-cited specimen belonged, according to the proportions which those bones bear to the radius or ulna in *Pterodactylus suevicus*.—

	Ft.	In.	Lines.
Humerus	1	0	0
Radius	1	4	0
Metacarpus of wing-finger	1	8	0
First phalanx of do.	2	3	0
Second do. do.	1	9	0
Third do. do.	1	5	0
Fourth do. do.	1	1	0
Total length of long-bones of one wing	10	6	0

Supposing the breadth of the Pterodactyle between the two shoulder-joints to be 8 inches, and allowing 2 inches for the carpus and the cartilages of the joints of the different bones, in each wing, we may then calculate that a large *Pterodactylus Sedgwickii* would be upborne on an expanse of wings of not less than 22 feet from tip to tip.

I look forward with confidence to future acquisitions of remains of the truly gigantic Pterodactyles of the cretaceous periods, more especially from the Greensand locality near Cambridge, as a means of throwing more light on the peculiar osteology of the extinct flying reptiles.

For the opportunities at present afforded me, I have to express most grateful acknowledgments to my old and much esteemed friend the Rev. Professor Sedgwick, F.R.S.; to the acute and active curator of the Woodwardian Museum, Mr. Lucas Barrett, F.G.S.; to James Carter, Esq., M.R.C.S., Cambridge; to T. W. Beddome, Esq., of Trinity College, Cambridge; and to the Rev. G. D. Liveing, M.A., of St. John's College, Cambridge; to whom I am indebted for the lower jaw of *Pterodactylus Sedgwickii* (Tab. I, figs. 2, *a*, *b*, *c*, *d*).

* These admeasurements are derived from the excellent figures of a recently acquired specimen, well described by Professor Andreas Wagner of Munich, in the "Abhandlungen der Kais. Bayer. Akademie der Wissenschaft," Band. iii, p. 663, taf. xix.

SUPPLEMENT (No. II)

TO THE

MONOGRAPH

ON

THE FOSSIL REPTILIA

OF

THE WEALDEN FORMATIONS.

Order—*CROCODILIA.*

Genus—Streptospondylus, *Von Meyer.*

This name, from the Greek *στρέφω*, I turn, *σπονδύλος*, vertebra, was applied by M. Hermann v. Meyer to the Crocodilian reptile distinguished by Cuvier as the "seconde espèce de Crocodile de Honfleur,"* and characterised by the same great anatomist as "having the cervical and anterior dorsal vertebræ, with the articular ends of the centrum, convex in front and concave behind."† By this character was distinguished the "second Gavial of Honfleur" from a "first Gavial of Honfleur," in which the articular ends of the centrum were both slightly concave.

With regard to these kinds of fossil vertebræ Cuvier writes: "je nommerai l'un *système convexe* en avant, et l'autre *système concave.*"‡ To the former he referred a gavial-like skull, with a shorter and more obtuse upper jaw, and a less depressed symphysis of the lower jaw;§ to the latter a more gavial-like skull, with longer and more slender jaws.‖

* 'Ossemens Fossiles,' ed. 8vo, 1836. Explication des Planches, p. 78, pl. ccxxxviii, figs. 5, 6 et 7.

† Ib., t. ix, p. 309.

‡ Ib., p. 308.

§ Subsequently named *Steneosaurus rostro-minor*, by Geoffroy St. Hilaire.

‖ *Steneosaurus rostro-major*, ib.

Certain vertebræ of the "anteriorly convex" system were further distinguished by the origin of the transverse process from salient ridges converging so as to form a pyramidal base of such process, and by a deep depression behind the costal facet. These characters are peculiar to the anterior dorsal vertebræ. In the posterior dorsal and lumbar vertebræ, recognised by Cuvier as belonging to the same "seconde Gavial de Honfleur" by the character of the pyramidal base of the transverse process, the anterior convexity had subsided: even in a dorsal vertebra, in which the articular surface for the head of the rib is still distinct, only a little higher placed, the terminal articular surfaces of the centrum are nearly equal and flat, "a peu près égales et planes."*

Upon the discovery of "opisthocœlian" vertebræ, or those of the "système convexe en avant" in the Wealden formations,† I threw out the suggestion ‡ that, as in the second Honfleur Gavial, they might be the anterior vertebræ of a large Wealden Saurian, having vertebræ with flattened terminal surfaces in a more posterior part of the spine. Observing, also, that such vertebræ, in the *Cetiosaurus brevis*, were slightly concave behind, though flat in front, it seemed to me that this genus might have the best claim to them. But, after pointing out the difference in the antero-posterior diameter of the large convexo-concave and plano-concave vertebræ, I remarked that "additional evidence of a very decisive character must be obtained before the great Cetiosaur can be admitted to have resembled the Pterodactyle in such disproportionate length of the cervical vertebræ."§

No discovery of the long convexo-concave or opisthocœlian vertebræ, so associated with short plano-concave or bi-concave vertebræ, as to have belonged to the same animal, has yet been made, though nearly twenty years of quest and collection of Wealden fossils have passed since the importance of that additional evidence was pointed out. I, therefore, still feel myself without the requisite grounds for a decisive settlement of the question of the genus of the long and large opisthocœlian vertebræ of the Wealden, and continue to refer them, provisionally, as in my 'Report,' to a species of *Streptospondylus*.‖

* 'Ossemens Fossiles,' tom. cit., p. 311.

† Previous to my Report on British Fossil Reptiles, 'Trans. British Association,' 1841, these vertebræ had been deemed "procœlian;" and, in the question of which of the various-shaped Wealden vertebræ might belong to the *Iguanodon*, Dr. Mantell thought that "the concavo-convex vertebræ which correspond so entirely to those of the *Iguana* and *Monitor*, would seem to offer a more probable approximation" ('Geology of the South-east of England'); only their extreme rarity opposed the hypothesis.

‡ 'Report on Brit. Fossil Reptilia,' ib., p. 96.

§ Ib.

‖ Report on British Fossil Reptiles, 'Trans. Brit. Association,' 1841, p. 91. The futility of subsequent speculations on this subject, in the 'Philosophical Transactions' of 1849, p. 286, has been shown by the discovery of the true cervical vertebræ of the *Iguanodon*, described in my 'Monograph' of 1855.

STREPTOSPONDYLUS MAJOR, *Owen.* Tab. V, VI.

The vertebræ so named, in the British Museum, and in that of the late Mr. Saull, F.G.S., now transferred to the Literary Institution, Aldersgate Street, London, have belonged to the region of the neck, or fore-part of the back, and were obtained from the Wealden formation of three localities, viz., Tilgate Forest, in Sussex; Culver Cliff, Isle of Wight; and Brook Point, Isle of Wight. They differ from the convexo-concave vertebræ of *Streptospondylus Cuvieri*, from the Lower Oolite and Lias, in their much larger size, and in the absence of the deep pit behind the costal facet. The converging, buttress-like ridges on the sides of the neural arch appear to be developed only in the anteriorly convex vertebræ of the dorsal region (Tab. VI, fig. 5, *a*, *b*).

Cervical vertebræ. Tab. V, figs. 1 and 2. Tab. VI, figs. 1, 2, and 3.

The cervical vertebra (Tab. V, figs. 1 and 2) measures six inches in length. The anterior end of this vertebra is determined by the aspect and position of the zygapophysis (ib. *z*), which, as its articular surface looks obliquely upward and inward, and is on a lower level than the oppositely turned process (*z′*), must be the anterior one. The corresponding extremity of the centrum (ib. *b*) is convex; the opposite extremity, which is somewhat overhung by the higher placed posterior zygapophyses (*z′*), is concave, as shown in fig. 2, *c*. The whole vertebra is a little crushed obliquely. The fore part of the centrum is further indicated by the position of the parapophysis (ib. figs. 1 and 2, *p*) or transverse process for the articulation of the head of the rib; at least, according to the analogy of the *Crocodilia*, in which it comes off nearer the anterior than the posterior end of the centrum.* Beneath the parapophysis (*p*) the sides of the centrum are concave, and converge downward to a broad ridge (Tab. VI, fig. 2, *h*), which terminates (at *h*) the anterior part of the lower surface of the vertebra, and corresponds with the hypapophysis given off from that part in the cervical vertebræ of the Crocodile.† A second concavity, at the upper part of the side of the body, separates the parapophysis from the base of the neural arch; from which a diapophysis (upper transverse process) is developed for the attachment of the tubercle of the rib. The diapophysis (Tab. V, fig. 1, *d*) comes off from the under and outer side of the anterior zygapophysis (ib. *z*). The articular facet of the latter process presents a full, oval figure; it is slightly raised at its outer part from the horizontal position. There

* See 'Monograph on the Reptilia of the London Clay,' 1850, t. ix, fig. 3, *p*: (*Crocodilus Hastingsiæ*).

† Ib., figs. 2 and 1.

is but little trace of spinous process from the somewhat fractured summit of the neural arch; this appears to be truncate in front, but has suffered some injury there, permitting the fore part of the neural canal and the whole anterior articular ball to be seen in a direct vertical view (as in figs. 1 and 3, Tab. VI). The back part of the neural arch appears to be deeply cleft through the backward production and divergence of the posterior zygapophyses.

In the collection of fossils of the late Mr. Saull, F.G.S., now in the Museum of the Literary Institution, Aldersgate Street, London, there is a cervical vertebra of *Streptospondylus major*, associated, as in the Mantellian Collection, with vertebræ of the *Iguanodon* and *Cetiosaurus*, all of which have been washed out of the submarine Wealden beds at the south side of the Isle of Wight, and thrown on shore near Culver Cliffs and Brook Point.

The lower half of the sides of the centrum of this vertebra of the *Streptospondylus* are, like the preceding vertebra from Tilgate, concave and obliquely compressed, so as to converge to the anterior part of the under surface (Tab. VI, fig. 2), which thus presents a triangular form, with the apex forming the obtuse anterior ridge (*h*), and the base turned backward and becoming somewhat flattened. Each lateral concavity is bounded above by a short but broad parapophysis (ib. *p*), developed from the anterior half of that part of the centrum, and terminated by an oblong flattened surface for the articulation of the head of the cervical rib; which surface is about twice as long in the antero-posterior as the vertical direction. Above this process the centrum is again concave, but there is no pit or defined cavity behind its process. The base of the neurapophysis is anchylosed to nearly the whole antero-posterior extent of the centrum, the course of the original straight suture being, however, discernible. A diapophysis is developed from the side of the base of the neurapophysis, affording a broader surface for the tubercle of the cervical rib than does the parapophysis for the head. Above the diapophysis the neurapophyses converge obliquely to the base of the spinous process. The line of the base of the spine inclines forward, and the thickness of the spine diminishes in the same direction. The posterior zygapophyses in the cervical vertebra from Culver Cliff, are similar in all respects to those in the Tilgate specimen, and equally determine the fore and hind extremities of the vertebra.

The difference in the height of the neural arch, and in the configuration of its external surface, which both the cervical vertebræ of the great Wealden *Streptospondylus* present, when compared with the dorsal vertebræ of the smaller species from the older oolitic formations,* is very great; and the more remarkable, as in the existing Crocodiles the height of the neurapophyses is greater in the cervical than in the dorsal region. Since, however, the diapophyses in the Crocodiles come off from a higher part of the neural arch in the dorsal than in the cervical vertebræ, the spine of the great Wealden *Streptospondylus* may possibly present modifications in the dorsal

* *Streptospondylus Cuvieri*, 'Ossemens Fossiles,' tom. cit., p. 308, pl. ccxxxvi.

region corresponding with those remarkable ones which Cuvier has described in the vertebræ from Honfleur.

A more posterior cervical vertebra of *Streptospondylus major* (No. 28,508, British Museum), from the submerged Wealden beds at Brook Point, Isle of Wight, shows that these vertebræ increase in height as they recede from the head.

In the present specimen the parapophysis is still developed from the side of the centrum and from its anterior half; but it expands more rapidly as it approaches the terminal ball, with which its own articular surface seems to be continuous. The side of the centrum behind the parapophysis is convex vertically at its upper half, slightly concave vertically as it descends to the thick inferior convex ridge, which is broadest behind, as in the more advanced and longer vertebræ.

The diapophysis is now supported by a thick, rounded prominence, beginning near the lower and hinder part of the neural arch, and, expanding as it rises, it advances to the base of the diapophysis; this is the beginning or rudiment of the hinder converging ridge in the type vertebra of *Streptospondylus*, as described and figured by Cuvier.*

The neural canal has the same shape and relative size as in the more advanced vertebra (Tab. V, figs. 1, 2, and 3). The pedicles or bases of the neural arch present the same superior thickness, as compared with the *Iguanodon*, showing a convex, rounded border behind as well as in front. There is a median depression at the back part of the base of the neural spine.

The following are admeasurements of the bodies of the above-described three cervical and anterior dorsal vertebræ of the Wealden *Streptospondylus*:

	Tilgate.		*Culver Cliff.*		*Brook Point.*		*Dorsal.*	
	Inch.	Lines.	Inch.	Lines.	Inch.	Lines.	Inch.	Lines.
Transverse diameter of posterior concave articular surface	5	0	6	0	6	0	5	6
Vertical diameter of posterior concave articular surface	3	6	4	6	5	0	6	0
Antero-posterior diameter of entire vertebra	6	0	5†	0	6	0	5	9
Transverse diameter of the body across the parapophyses	6	0	6	6	6	6	....	
Height from lower surface of centrum to the hind part of base of spine	....		7	9	10	0	10	6
Antero-posterior extent of parapophysis	2	2	2	4	2	9	....	
Interspace between upper and lower transverse processes	....		2	0	2	9	....	

In the museum of the Geological Society of London there is a collection of rolled

* Loc. cit.

† It is evident that an inch at least, perhaps more, has been chiselled away from the ball which terminated the anterior end of the body of this specimen in Mr. Saull's collection.

vertebræ from the coast at Brook Point, Isle of Wight, which, among the bones of *Iguanodon* and other gigantic Wealden genera, contains the centrum or body of a dorsal vertebra of the great *Streptospondylus.* This specimen, though much rolled and worn, is interesting, inasmuch as it exhibits the characteristic contraction of the middle and expansion of the ends of the centrum, together with unequivocal evidences of the marked depression on each side, near the upper part of the anterior or convex end of the centrum. What remains of the depression is about the size of the end of a man's thumb. The convexity of the anterior extremity resembles in degree, and likewise in irregularity, that in the fractured vertebra of the *Streptospondylus* from the lower Oolite, in Mr. Kingdon's collection.

The present centrum is less depressed than those of the cervical region, but agrees with them in length, as the following dimensions show:

	Inch.	Lines.
Antero-posterior diameter	5*	0
Vertical diameter of concave end	5	6
Transverse diameter of concave end	5	3
Transverse diameter of middle of centrum	3	0

In Tab. V, fig. 4, a reduced figure of two of the anterior (cervical?) vertebræ of the young *Iguanodon* from Cowleaze Chine, is reproduced to show the difference in the form of the angle between the ridges diverging from the neural spine to the posterior zygapophyses, and in the form of the ridges themselves, which are much sharper in *Iguanodon* than in *Streptospondylus major;* the degree of the terminal convexity and concavity of the centrum are both less marked in the *Iguanodon.*

Dorsal vertebra of Streptospondylus major. Tab. VII.

I am now able to carry out the comparison of the Iguanodont and large Wealden Streptospondylian vertebræ at the part of the dorsal region where the parapophysis has passed from the centrum to the neural arch, and this is decisive against the ascription of the latter vertebræ to the *Iguanodon.*

That the dorsal vertebra, with a convexo-concave centrum, belongs to the same species as the cervical vertebræ here described and referred to *Streptospondylus major*, is shown by the same vertical contour of the sides of the centrum, convex at the upper and concave at the lower half, and by the shape of the thick, obtusely rounded, inferior median ridge, which still shows the triangular form with the posterior base, and is slightly convex lengthwise (Tab. VII, fig. 3). In the corresponding vertebra of the *Iguanodon* the upper half of the side of the centrum is slightly concave vertically, and

* The margins of the extremities being worn and rounded prevent the actual length being given

the lower half convex, the converging sides here terminating in a sharp ridge, which is concave lengthwise (ib., fig. 6).

In *Streptospondylus major* the centrum loses in length and gains in height; the neural arch at the same time augmenting in height as the vertebræ recede from the neck. In the dorsal vertebra here described, there appears another Streptospondylian character, pointed out by Cuvier in the Harfleur gavial-like species, the support, viz., of the transverse process by ridges, converging to its base. The anterior ridge (ib., fig. 2, *a*) ascends almost vertically in front of the surface (*p*, fig. 2) for the head of the rib, the posterior ridge (*e*), forming the outer and back part of the neural arch, ascends obliquely forward to meet the first ridge beneath the diapophysis (*d*).

In the *Iguanodon* the first ridge (*a*, fig. 4) is hardly represented; the second (*e*) is well developed, but is nearly vertical. The chief difference, however, which the vertebræ here compared of *Iguanodon* and *Streptospondylus* present, is seen in the structure of the neural arch behind the posterior ridge.

In *Streptospondylus major* the surface of the neural arch is continued from the posterior ridge inwards and a little backwards, almost flat, to the thick, rounded border of the posterior aperture of the neural canal, expanding with a slight concavity to the base of the posterior zygapophysis. In *Iguanodon* the corresponding part of the neural arch, viz., behind the posterior ridge (fig. 5, *e*), is excavated by a large and deep cavity.

The neural canal in *Iguanodon* (fig. 5, *n*) is relatively smaller than in *Streptospondylus*, especially narrower, its area presenting the form of a vertical ellipse, whilst in *Streptospondylus* it is a wide transverse ellipse (fig. 1, *n*). In *Iguanodon* a ridge formed, as it were, by the lateral compression of the back part of the neural arch between the two large hollows behind the buttresses of the diapophyses, rises vertically to the median approximate extremities of the posterior zygapophyses (fig. 5, *z'*). A broad, vertically convex surface, holds the place of the above ridge in *Streptospondylus*. The forepart of the neural spine is thicker in *Streptospondylus* than in *Iguanodon*, and there is a deeper and more circumscribed cavity on each side of that part of the spine on the roof of the neural arch. The side walls of that arch are much thicker in *Streptospondylus*, especially anteriorly, and the arch is shorter in proportion to the centrum than in *Iguanodon*. With all these differences between answerable dorsal vertebræ of *Iguanodon* and *Streptospondylus*, there remains the capital one of the front ball and hind cup in the latter, where the corresponding surfaces are flat or very slightly depressed in the *Iguanodon*.

The determination of the true nature of the convexo-concave vertebræ of the Wealden, and of the affinities of the reptile to which they belonged, besides extending our knowledge of the gigantic oviparous animals of that epoch, removes one of the chief difficulties attending the determination of the true vertebral characters of the *Iguanodon*. For, if gigantic vertebræ, agreeing in the important character of their articular surfaces with the existing *Iguanæ*, had actually been discovered, though of rare occurrence, associated with teeth of corresponding dimensions, but similar in form to those of the Iguana, there would have been strong ground for suspicion that such vertebræ and teeth might have been parts of the same species.

We now know, however, that certain of the cup-and-ball vertebræ are of a kind more nearly resembling those of an extinct Crocodilian, with teeth very different from either those of *Iguanodon* or of the modern diminutive *Iguanæ*. The elimination of these, otherwise perplexing ball and socket-jointed vertebræ, forms, therefore, an essential step in the appropriation to the *Iguanodon* of its proper vertebral type.

Genus—Cetiosaurus, *Owen.* Tabs. VIII, IX, and X.

In the notices of the various forms or types of vertebræ from the Wealden strata, published by their persevering investigator, Dr. Mantell, prior to 1841, he states* that "his first step was, with the able assistance of the Rev. W. D. Conybeare, to separate those that belonged to the Crocodile, Plesiosaur and Megalosaur, or at least the vertebræ which most resembled those from Stonesfield."

Many enormous vertebræ remained, which are referred, in the Mantellian Catalogue of the collection subsequently purchased for the British Museum, to the *Iguanodon*. From these residuary specimens I separated, in my 'Report on British Fossil Reptiles,' of 1841, the vertebræ characteristic of the genera *Poikilopleuron*, Deslong., *Streptospondylus*, v. Meyer, and *Cetiosaurus*, which latter genus had previously been characterised by vertebral peculiarities observed in specimens obtained from older Oolitic strata.

Of the existence of vertebræ of this genus in the Wealden strata, I first became acquainted by the examination of the late Mr. Saull's collection of sea-rolled fossils washed out of the submerged Wealden beds, and deposited on the shores of the Isle of Wight, at Sandover Bay.

The vertebræ in question presented the well-marked generic characters of those of the dorsal region in the *Cetiosaurus longus* of the middle Oolite, as, *e. g.*, the breadth of the centrum, its subcircular contour, its median contraction and unequal concavity of the articular extremities; as, also, the short antero-posterior extent of the neurapophyses and their anchylosis to the anterior part of the upper surface of the centrum: but they differed from the vertebræ on which the characters of the present genus were first founded† by the shortness of their antero-posterior diameter as

* 'Illustrations of the Geology of Sussex,' 4to, 1827, p. 76; 'Geology of the South-east of England,' 8vo, 1833, p. 278.

† See 'Proceedings of the Geological Society' for June, 1841.

compared with their breadth and depth, whence I proposed to designate the species by the name of *Cetiosaurus brevis*.*

The centrum of a dorsal vertebra of this species from Culver Cliff measures,

	Inch.	Lines.
in antero-posterior diameter	3	6
transverse diameter	6	4
vertical diameter	6	0

The hind articular end (Tab. IX, fig. 2, *b*) is moderately concave: the front end (ib., *a*) from the wearing away of the margins, appears slightly and unevenly convex. The contracted middle part of the vertebra is concave lengthwise, and pretty regularly convex in the direction transverse to the axis of the vertebra: the free surface is finely striated, and perforated here and there by vascular foramina: there is no lateral depression. The bases of the neurapophyses, instead of having their long diameter corresponding with the axis of the vertebra, as in *Iguanodon*, present it in the direction transverse to that axis, as in *Plesiosaurus:* they do not quite meet at the middle of the upper or neural surface of the centrum, but are there divided by a narrow longitudinal tract forming the lower part of the spinal canal.

The antero-posterior extent of the anchylosed base of the neural arch (ib., *n*) is 2 inches 6 lines: the transverse diameter of the arch is 5 inches.

The caudal vertebræ of the same species, also from Culver Cliff, present the same length and unequal concavity of the articular extremities; the anterior one, here determinable by the anterior position of the narrower hæmapophyses, being the deepest: the sides of the body are more compressed, and more convergent towards the under surface; so that, as the expanded margins of the articular ends are worn away, the centrum presents rather a triangular than a subcircular contour. The disproportion of its antero-posterior with its transverse and vertical diameters, distinguishes it from the caudal vertebræ of the *Iguanodon*. The neurapophysis rises from the anterior three fourths of the centrum, and sends forward a subprismatic anterior oblique process, but does not develope a posterior one: it then contracts, and inclines to the base of the spine, which is much shorter than in the *Iguanodon*. The spinous process inclines backward from the vertical axis of the centrum at an angle of 45°. A short transverse process is developed from the junction of the neurapophysis with the centrum. The hæmapophysial surfaces appear single on both the anterior and posterior parts of the lower surface; they are nearly flat, and slope towards each other.

* 'Report of British Fossil Reptilia,' 1841, 'Trans. Brit. Association,' p. 94.

The following are the dimensions of the best preserved of these vertebræ :

	Inch.	Lines.
Antero-posterior diameter of centrum	3	0
Transverse diameter	5	0
Vertical diameter	5	0
Height of vertebra to summit of spine*	12	9
Antero-posterior diameter of spine	2	10
Thickness at posterior part of base	1	0
Height of spine, 1st caudal	5	0
Height of spine, 2d caudal†	4	0

The characters and dimensions of these rolled vertebræ of *Cetiosaurus* from the submarine beds of the Wealden formation, although somewhat obscured by the circumstances under which they are brought to light, are sufficiently satisfactory to establish their generic character, and to give an useful approximative idea of their size and proportions. The corresponding bones from the Wealden of Tilgate Forest supply, by their more perfect state of preservation, the deficiencies of the Isle of Wight specimens, and further establish the co-existence of the *Cetiosaurus* with the *Iguanodon*, *Hylæosaurus*, *Streptospondylus*, *Megalosaurus*, and other extraordinary reptiles of that period. The vertebræ of the *Cetiosaurus brevis* in the Mantellian Collection are amongst the most gigantic specimens of Saurian remains that enrich it. They include almost entire specimens and bodies of two dorsal vertebræ (Tabs. VIII and IX) and four entire caudal vertebræ, which, if not consecutive, seem to have come not from distant parts of the basal portions of the tail of the same individual.

No. $\frac{1333}{2133}$ "Gigantic vertebra of *Iguanodon*," MS. Catalogue of Mantellian Collection (Brit. Mus.), is a posterior dorsal vertebra of the *Cetiosaurus brevis*, and exhibits in a striking manner the peculiar characters of this species, viz., the great depth and breadth, especially the latter dimension (Tab. VIII), as compared with the length or antero-posterior diameter (Tab. IX) of the centrum or body of the vertebra.

The posterior articular surface (Tab. IX, fig. 2, *b*) is, in this region of the spine, more concave than the anterior surface, a structure which approximates to that peculiar one which characterises the *Streptospondylus*. The contour of the articular ends is subcircular, the transverse diameter being somewhat in excess. The centrum is contracted between the two articular ends, is slightly concave in the longitudinal direction at the upper part of the side of the centrum, but deeply concave below, and with a slight indication of a broad, obtuse, longitudinal ridge (Tab. IX, fig. 1, *r*), along the middle of the concave under surface. In the *Iguanodon* the sides of the vertebral body are nearly flat in the vertical direction ; in the *Cetiosaurus* they are strongly convex. The surface at the middle of the vertebra is longitudinally striated

* This is rounded off, but seems not to have been broken.

† The 1st and 2d do not here refer to the place of these vertebræ in the tail ; but if the vertebræ were contiguous in the entire animal, the tail must be much shorter than in the *Iguanodon*.

with very fine, subparallel, short impressions; these grow deeper and more irregular at the thick, rugged, and everted margins of the articular ends.

The neurapophyses are firmly anchylosed here, as in the caudal region, and the line of the primitive suture is hardly discernible: their base is shorter than the short centrum, and is attached nearer its anterior part; in the *Iguanodon* the neural arch is very nearly coextensive in antero-posterior diameter with the centrum supporting it; in a dorsal vertebra of an *Iguanodon* $4\frac{1}{2}$ inches in breadth, the antero-posterior extent of the base of the neural arch is 4 inches; in the present vertebra, which exceeds 7 inches in breadth, the antero-posterior extent of the neural arch is $2\frac{1}{2}$ inches, and only 2 inches a little above the base. The outer side of the neurapophysis is convex in the axis of the vertebra, and concave in the opposite direction as it ascends to the base of the diapophysis, showing only the posterior of those ridges and hollows that so singularly characterise the same part in the dorsal vertebræ of *Streptospondylus Cuvieri*. The antero-posterior diameter of the base of the diapophysis is 2 inches, its vertical diameter 1 inch. The diameter of the neural canal (*n*) is 1 inch 9 lines. The articular surfaces of the anterior zygapophyses (Tab. IX, fig. 1, *z*) are flat, and look upward and slightly inward and forward. In the *Iguanodon*, their under margins, in the dorsal vertebræ, converge at nearly a right angle; in the present vertebra they incline to each other at an angle of 40°. The spinous process begins to rise immediately behind the anterior zygapophyses by a narrow vertical plate, which seems as if it were nipped in between two shallow depressions; its base ascends obliquely, and grows thicker to the posterior part of the neural arch. The summit was not entire in any of these vertebræ.

The height of this dorsal vertebra to the posterior origin of the spinous process is $9\frac{1}{2}$ inches; from the base of the neurapophysis to the upper part of the transverse process, measures 3 inches.

No. $\frac{115}{2115}$ in the Mantellian Collection, British Museum ("Vertebra of *Iguanodon*, 8 inches in diameter," MS. Catalogue), may have actually presented that dimension when entire, for even now, not allowing for the margin of the posterior articular surface which has been broken away, it measures 7 inches across the surface. This remarkable specimen, which may probably have afforded the type of the "third or plano-concave" vertebral system, in the summary of the vertebral characters of the Wealden reptiles given by Dr. Mantell in his 'Geology of the South-east of England,'* and which accords best with the characters assigned by M. H. von Meyer to the vertebræ of the *Iguanodon*,† presents, in fact, in a striking degree, those of the vertebræ of the *Cetiosaurus*, and belongs to a more posterior part of the dorsal region, perhaps to the loins, of the same individual, certainly to one of the same species, as the vertebra (No. 2133) last described. A figure of a corresponding vertebra bisected vertically is given in Tab. IX, fig. 2.

* 8vo, 1833, p. 292, fig. 3.

† 'Palæologica,' p. 212.

The anterior articular extremity in one of these vertebræ makes an approach to a plane surface, being slightly concave transversely below, and very slightly convex above; vertically it is very slightly convex; the depth of the posterior concave surface at the centre is 9 lines. The general contour of the centrum has begun to change from the circular to the subquadrate, which latter figure is more decidedly expressed in the anterior caudal vertebræ of *Cetiosaurus brevis* (Tab. X).

The upper half of the sides of the centrum are more concave in the axis of the vertebra than in No. 2133. The free surface presents the same degree of smoothness, and is pierced here and there by moderate-sized vascular foramina. The neural canal makes a slight depression in the upper part of the centrum; in the *Iguanodon* it is encompassed by the bases of the neurapophyses. The transverse diameter of the neural canal is 1 inch, which small dimension satisfactorily distinguishes the present enormous vertebra from those of the mammiferous class, viz., the Cetacea, to which in other respects it has the greatest similitude. The antero-posterior diameter of the base of the neurapophysis is 2 inches.

The four anterior caudal vertebræ in the Mantellian Collection, which are here assigned to *Cetiosaurus brevis*, slightly increase in antero-posterior diameter, as is the case with *Cetiosaurus medius*, as they recede from the trunk, which seems to indicate that the present gigantic marine Saurian must have had a capacious and bulky trunk, but propelled by a longer and more crocodilian tail, than in the modern whales. It is sufficiently evident, however, that, even in the present short segment of the tail, with the slight increase of length, there is a diminution of height and breadth of the centrum, and a still more obvious subsidence of the neural arch, as the vertebræ recede from the trunk. The third of these vertebræ is figured of the natural size in Tab. X. As compared with the dorsal vertebræ, the chief change of form is the subquadrate contour produced by a lateral extension and flattening of the lower surface of the centrum, which is more essentially distinguished by four hæmapophysial articular surfaces, two at the anterior and two at the posterior margins (Tab. X, *h*, *h*) of this inferior surface. The articular surfaces at both ends of the centrum are now slightly concave; and the anterior one, which was nearly flat in the dorsals, is here the deepest; it is one inch deep at the upper third of the surface.* The sides of the centrum at the upper half are concave both lengthwise and vertically, forming a wide depression below the transverse process; the middle part of the side begins to stand out and divide the upper from the lower lateral concavity, which character, being more strongly developed in the hinder caudal vertebræ, gives the rhomboidal or hexagonal form.† The lower half of the side of

* The same modification of the articular extremities occurs in the caudal region of the vertebral column of the *Plesiosaurus*. See 'Report,' part i, 'Trans. Brit. Assoc.' 1839, p. 58.

† It is one of these posterior caudals of the *Cetiosaurus* which is figured as the type of the "second vertebral system" in the 'Geology of the South-east of England,' p. 296, fig. 2.

the centrum is less concave than in the dorsal vertebræ. The broad inferior surface is also less concave antero-posteriorly than in the dorsal vertebræ, and is nearly flat transversely; it gradually contracts, in the transverse direction, in the posterior caudals, so as to take on the form of a longitudinal sulcus. The two anterior hæmapophysial surfaces are separated from each other by an interval of two inches; the two posterior surfaces, which are larger than the anterior ones, are similarly distinct.

In the anterior as well as posterior caudal vertebræ of the *Iguanodon* the hæmapophysial surfaces are confluent on both the anterior and posterior parts of the under surface of the centrum, and the chevron bones accordingly present modifications by which they may, when detached, be distinguished from those of the *Cetiosaurus*. There was, however, as will be presently shown, another gigantic Saurian of the Wealden period, distinct from the *Cetiosaurus* and *Iguanodon*, but resembling the latter in the single hæmapophysial facet (Tab. XI).

The diapophyses, in the caudal vertebræ of *Cetiosaurus* (Tab. X, *d*), have descended, as usual, from the summit to the base of the neural arch in the anterior caudal vertebræ. They are short, compressed vertically, diminishing, and as if slightly twisted, so that the upper margin is turned forward, at their extremity. The vertical diameter of the base of the transverse process in the largest of the present caudal vertebræ is 3 inches; its antero-posterior diameter is 1 inch 6 lines; its length is 2 inches 7 lines: the extremity terminates obtusely. The upper ridge-like termination of the transverse process is continued to the base of the anterior zygapophysis. These processes (ib., *z*) are alone developed, as such, in the present vertebræ; the posterior articular surfaces (ib., *z'*) being impressed upon the sides of the posterior part of the base of the neural spine. The anterior zygapophyses project almost horizontally forward, diminishing, chiefly in vertical diameter, to an obtuse apex; convex externally, flattened internally by the oblong articular surface, and separated by a fissure nearly 1 inch wide: the length of these processes, from the bottom of the intervening fissure in the second of the four caudals, where they are most entire, is 2 inches. When the vertebræ are placed in juxtaposition, these processes reach beyond the middle of the vertebræ next in front, and pinch, as it were, the back part of the base of the spine so as to impress upon it the surfaces representing the posterior zygapophyses. These processes are well developed, on the contrary, in the corresponding vertebræ of the *Iguanodon*, and overhang the posterior surface of the body of the vertebra to which they belong. The spinous process, which appears to be nearly perfect in the second caudal, is short, strong, and truncated at the summit. Its height from the anterior oblique processes is 4 inches: the total height of the vertebra is 13 inches. The antero-posterior diameter of the side of the neural arch is 2 inches. The spinal canal is wider in these caudal than in the dorsal vertebræ, indicating the greater muscularity of the part deriving its nervous power from the corresponding part of the spinal cord: its transverse diameter is 1 inch

10 lines; its vertical diameter is 2 inches. The neural arch is, as usual in the present genus, anchylosed to the anterior part of the upper surface of the centrum: one inch and a half of this surface is left free behind the attachment of the arch. The finely wrinkled or fibrous character of the free surface is more strongly marked in these caudal than in the dorsal vertebræ.

In the three succeeding vertebræ the neural arch diminishes in height, the anterior articular processes diminish in length, and the posterior articular impressions in depth. The upper and lower parts of the sides of the body become somewhat more concave; the posterior articular surface grows flatter.

A detached chevron bone, 8 inches in length, consisting of two hæmapophyses, anchylosed only at their distal or inferior extremities, and with their distinct proximal ends more divaricated than are the confluent ones in the *Iguanodon*, corresponds with the caudal vertebræ here described, and doubtless belongs to the *Cetiosaurus brevis.*

The following are dimensions taken from the four caudal vertebræ above described:

	1st.		2d.		3d.		4th.	
	Inches.	Lines.	Inches.	Lines.	Inches.	Lines.	Inches.	Lines.
Antero-posterior diameter of centrum .	3	9	4	2	4	3	4	3
Transverse diameter of centrum . .	7	2	7	1	6	9	6	4
Vertical diameter of centrum . .	6	10	6	8	6	0	6	0

Of the present species of *Cetiosaurus*, I have examined specimens of the bodies of one dorsal and three posterior caudal vertebræ in the collection of Gilpin Gorst, Esq., which were obtained from the central strata of the Wealden, near Battle Abbey, commonly called the "Hastings beds."

The dorsal centrum closely agrees with those in the Mantellian Collection: its anterior surface is, as in them, nearly flat, or slightly convex; the posterior surface is concave.

	Inches.	Lines.
The antero-posterior diameter	3	2
The transverse diameter of the anterior surface	5	3
The vertical diameter of the anterior surface	5	2

The neurapophyses, with an antero-posterior extent of base of 2 inches 3 lines, are continuously anchylosed with the centrum, and leave about three quarters of an inch of the posterior part of the centrum free. The floor of the spinal canal is horizontal lengthwise; its transverse diameter 1 inch 3 lines.

The posterior caudal vertebræ present an antero-posterior diameter of nearly 4 inches, with a breadth of $3\frac{1}{2}$ inches, and a depth of 4 inches, measuring to the lower part of the posterior hæmapophysial surface. The antero-posterior length of the base of the neurapophysis is 2 inches 2 lines; and it does not begin so close to the anterior part of the centrum as in the dorsal vertebra. There are no posterior zygapophyses. The upper and lower portions of the side of the centrum are more distinctly separated by the comparative projection of the middle part, which gives the obscurely hexagonal form to these vertebræ. The inferior parts are most concave, and converge to form the sides of the longitudinal sulcus, to which the inferior surface of the centrum is reduced at this part of the tail. It is plain, from these modifications of the vertebræ, that the tail must here have presented the compressed Crocodilian type; and it is satisfactory to have these indications of the Saurian affinities of the present gigantic fossil, in consequence of the very close approximation of the larger vertebræ to the Cetaceous type. The vertical extent of the osseous basis of the tail was here augmented by strong hæmapophyses, which have left more prominent articular facets on the under part of the centrum than in the larger anterior caudal vertebræ: these facets, instead of being in pairs, as in the anterior caudals, approximate, and become confluent in the vertebræ of between 3 and 4 inches in breadth.

Occasionally the hæmal arch is found anchylosed to the posterior of these so confluent hæmapophysial surfaces, as in the posterior caudal vertebra figured in Tab. V, figs. 3 and 4.

A vertical section, through the middle of a dorsal vertebra, from that part of the back where the rib has ascended to articulate wholly with the diapophysis, well displays this characteristic modification of the articular parts of the centrum, in *Cetiosaurus* (Tab. IX, fig. 2). The same section shows the closer cancellous texture of the centrum near those articular ends; the more open texture, with a general tendency to a longitudinal course of the cancelli, in the middle; and the still more open and irregularly disposed cancellous structure at the base and back part of the neural spine.

From the foregoing data it may be inferred that there existed, at the period of the deposition of the Wealden, a Saurian reptile of dimensions at least equalling those of the *Iguanodon*, but with modifications of the vertebral column, from the middle of the back to the tail, departing from the Dinosaurian and approaching to the Crocodilian type. If, as is very probable, the cervical and anterior dorsal vertebræ above described (pp. 22—26, and provisionally referred to *Streptospondylus*), belong to the same reptile as the succeeding vertebræ, here referred to *Cetiosaurus*, we should then have a gigantic Crocodilian of the peculiar transitional type, as between that order and the Dinosaurian, which is manifested by the second "Honfleur Gavial" of Cuvier; *i. e.*, with convexo-concave vertebræ at the fore part of the trunk, graduating into plano-subconcave vertebræ, with elevated and somewhat complex neural arches, at the middle and back part of the trunk, and with vertebræ sub-concave at both ends, in the tail.

Of the nature of the sacrum and pelvis in the present genus nothing definite and assured is at present known. Such proportions of the entire skeleton of one and the same individual as have imparted our present knowledge of the *Iguanodon* and *Megalosaur*, have not yet been discovered of the *Cetiosaurus*. Certain co-existences in relation to strata and localities, but hardly amounting to juxtaposition, indicated that the tibia and some other limb-bones of the Reptile with Cetiosaurian vertebræ were without a medullary cavity, and with the centre occupied by a coarse cancellous tissue.*

At the period when the vertebræ of this type were first discriminated from the veritable ones of the *Iguanodon*, I had not met with this characteristic structure of Cetiosaurian limb-bones in strata above the Portland Stone (Middle Oolite). They have since been found in the Wealden strata.

The late Dr. Mantell, in his Memoir on the *Pelorosaurus*, states: "I have a series of bones from Brook, in the Isle of Wight, through the kindness of my distinguished friend, Sir R. I. Murchison, proving the existence of *Cetiosauri* in the Wealden; all the long bones are destitute of a medullary cavity."†

A somewhat crushed femur of *Cetiosaurus longus*, measuring 4 feet 3 inches in length, from the Middle Oolite at Enslow Bridge, Oxfordshire, is preserved in the Geological Museum at Oxford: it does not show any medullary cavity. The specimens of Cetiosaurian long bones, from Wealden strata, which have hitherto come under my observation, are fragmentary. It is probable that parts of the coracoid and pubic bones, also from the Wealden, indicating a greater relative breadth of those elements of scapular and pelvic arches, than in true *Crocodilia*, but differing in form from the answerable bones in known *Dinosauria*, may have belonged to *Cetiosaurus brevis*, Ow.

The suppression of the species so named by me has been proposed, and its appropriation by another has been attempted,‡ under the name of *Cetiosaurus Conybeari*, Melville, "in order to prevent confusion and to remove the objection that may well be raised against the *nomen triviale* '*brevis*;'" "for who will venture," asks the appropriator, "to indicate the relative length of an animal with no known affine, from four of its anterior caudal vertebræ?"

Believing that the generic affinity of the *Cetiosaurus brevis* with *Cetiosaurus longus* and *Cetiosaurus medius* to have been demonstrated, I ventured to suggest, in 1841, that the *nomen triviale* might be found appropriate in reference to the relative length of the entire body, from what was then known "of the constancy and regularity of this dimension" (viz., length of vertebral centrum) "in the back bone of

* 'Report on British Fossil Reptiles,' 1841, p. 102.

† 'Philosophical Transactions,' 1850, p. 381.

‡ Ibid., 1849, p. 297.

individuals of the same species of Saurian." Subsequent experience of this constancy in the dorso-lumbar and caudal regions of the spine in *Crocodilia* and *Dinosauria* has confirmed me in that opinion. But I expressly stated, when proposing the specific names of the different species of *Cetiosaurus*, that those names referred "to the relative length of their vertebræ."* The highest authorities in palæontology had sanctioned this system of naming species from characters of instructive parts. And no naturalist appears to have supposed that the *Palæotherium latum* of Cuvier had necessarily a trunk as broad in proportion as the foot, or that the whole frame of *Anoplotherium obliquum* was askew. The *Raia spiralis* of Münster was not a twisted Skate, any more than the *Otodus ramosus* of Agassiz was a branched Shark. As to the plea of preventing confusion by changing the published name of an adequately defined species, competent naturalists concur in denouncing the practice, as being the chief cause of the present grievous confusion in zoological synonymy.

The objections to the species *Cetiosaurus brevis*, and a subsequent attempt to suppress the genus, call for notice here on account of their admission into volumes of so high a scientific repute as the 'Transactions of the Royal Society.' The reporters on the papers by Drs. Melville and Mantell must have assigned some value to the remarks which here receive the explanation from the author against whom they were directed.

Genus—Pelorosaurus, *Mantell.* Tab. XI, XII.

When publishing condensed descriptions of the previously undescribed, and for the most part undetermined, fossil remains of *Reptilia*, in my 'Reports' on that class submitted to the British Association in 1840 and 1841, it was known that the drawings made by aid of the grant voted for that purpose by the Association would subsequently be published in the work or monographs containing the more complete history of those British Fossil Reptiles. Reduced figures of the vertebræ, ascribed to *Cetiosaurus brevis*, and described in pp. 95—100 of the 'Report' of 1841, were, however, published, by anticipation, in the 'Philosophical Transactions' for 1850; the author quoting a remark by Sir J. G. Dalyell, that "delineation should be the inseparable accompaniment of description in natural history" (tom. cit., p. 382), and citing the descriptions in detail of these vertebræ, given "by Dr. Melville, in the 'Philosophical Transactions,' 1849, p. 296."

* Report, 'Trans. Brit. Assoc.,' 1841, p. 102.

On referring to that volume and page, however, I find the description limited to a partial quotation from my 'Report,' with the acknowledgment that "the four huge caudal vertebræ already mentioned as assigned to the *Cetiosaurus brevis*, exhibit very peculiar characters, fully detailed by Professor Owen."

The only objection offered by Dr. Melville is to the "nomen triviale" of the species to which they were assigned, and to which objection the reply has been given above. The subsequent proposal to suppress the "nomen genericum" was made under the following circumstances. In 1847 there was discovered, in the Wealden of Tilgate Forest, Sussex, the limb-bone, measuring 4 feet 6 inches in length, regarded as a "humerus" by Dr. Mantell, and, on account of its difference of form from that bone in the *Crocodiles*, *Iguanodon*, and *Hylæosaurus*, and its large medullary cavity, referred to a genus distinct from all then known Wealden Saurians under the name of *Pelorosaurus*.*

This unique fossil bone, of truly extraordinary size viewed as a humerus, was obtained by purchase, for the British Museum, after the demise of Dr. Mantell; and with it a number of large vertebræ, most of them from the caudal region, marked *Pelorosaurus*, were purchased at the same sale.

These vertebræ, now bearing the Museum numbers 28.627, 28.633, 28.634, 28.635, 28.653, 28.654, 28.655, 28.656, 28.657, correspond in colour and mineralized condition with the large, hollow long-bone. The original Mantellian labels, in the same handwriting, ascribing them to *Pelorosaurus*, have been scrupulously preserved, as they were attached to the specimens. It may, therefore, be inferred that they belonged, in the opinion of Dr. Mantell, to the genus and species which he established in the 'Philosophical Transactions' for 1850. Accordingly, the best preserved of these vertebræ is here figured, of the natural size, in Tab. XI, as the type of the anterior caudal vertebræ of *Pelorosaurus*, and the foregoing details are given in support of this ascription; because, singular as it may appear, not any of the vertebræ, marked *Pelorosaurus*, and preserved by Mantell, with the enormous limb-bone, in his private museum, as long as he lived, are figured, described, or even alluded to in his memoir on that genus; whilst he assigns to the base of the tail of his *Pelorosaurus*, the four vertebræ which were obtained by the British Museum, in the purchase of the first Mantellian Collection, in 1839, which were entered as vertebræ of the *Iguanodon* in the catalogue then prepared by the vendor, and on which I founded, in 1841, the species of *Cetiosaurus*, distinguished as *brevis*, from the longer Cetiosaurian vertebræ of older Oolitic strata.

A glance at the vertebræ figured of the natural size, and from the same

* Πέλωρ, monster, σαυρος, lizard.

aspect, in Tab. X and XI of the present Monograph, will suffice to satisfy even a superficial comparative osteologist that they must belong to different species, if not genera, of Saurians. They are both from that anterior part of the tail where the vertebræ still retain the zygapophyses and send off the transverse processes (dia-pleur-apophyses, *d-pl*) from the base of the neural arch at its junction with the centrum: they are nearly, if not quite, homologous vertebræ. If No. 28.633 (Tab. XI) belonged, as its original possessor had marked it, to his genus *Pelorosaurus*,—No. 10.390 (Tab. X) of the earlier collection of fossils, originally marked *Iguanodon*, could not belong to the same genus.

It will be presently shown that the caudal vertebra (Tab. XI) marked *Pelorosaurus* by Mantell in his latest collection of fossils, although much more like the corresponding vertebra of *Iguanodon* than is the vertebra (Tab. X) so called in the first Mantellian collection, yet presents such differences as might have justified a generic separation from *Iguanodon*, if even the indication of the distinct genus of huge Wealden Saurian had not been afforded by the hollow limb-bone of 4½ feet in length.

The generic distinction of the above-cited vertebra from the first collection (Tab. X), selected by Mantell, in his memoir of 1850, to illustrate the vertebral characters of the new genus *Pelorosaurus*, founded on the later acquired fossil limb-bone, is much more strongly marked as compared with *Iguanodon*, or with the anterior caudals marked *Pelorosaurus* in the last collection.

In 1850, therefore, the persevering investigator of the geology of the South-East of England had evidence of two gigantic genera of Wealden *Reptilia* distinct from his *Iguanodon*, afforded by vertebræ, and he possessed also similar evidence afforded by bones of the limbs.

Those of the latter which were destitute of a medullary cavity he unhesitatingly referred to my genus *Cetiosaurus*, and he founded upon the long-bone with the medullary cavity the genus *Pelorosaurus;* but, with respect to the vertebræ, he chose to select for the *Pelorosaurus* those that had been previously demonstrated by me to present the Cetiosaurian character.

Pelorosaurus Conybearii.

The anterior caudal vertebra (Tab. XI) differs from the corresponding vertebræ of *Iguanodon*, and is here referred to *Pelorosaurus*, on the authority of the Mantellian label, according to which it was purchased as belonging to that genus, and is so entered in the Register of the British Museum, under the number 28.633.

It presents the following dimensions:

	Inches.	Lines.
Antero-posterior diameter of centrum	4	0
Transverse diameter of centrum	7	9
Vertical diameter of centrum	8	9
Height of vertebra to summit of neural spine*	24	0
Antero-posterior diameter of spine	4	3
Thickness at posterior part of base	1	9
Height of neural spine	13	6

From these dimensions it will be seen that the vertebra of *Pelorosaurus* is shorter in proportion to its breadth than in the *Iguanodon;* in that respect resembling *Cetiosaurus:* the sides of the centrum are more concave lengthwise and less flattened vertically than in the basal tail-vertebræ of *Iguanodon.* Both the articular ends of the centrum are more deeply cupped. The neural spine is thicker and relatively shorter than in *Iguanodon*, but much longer than in *Cetiosaurus;* whilst the neural canal is more contracted than in either of those genera.

The anterior caudal vertebræ of *Pelorosaurus* differ from those of *Cetiosaurus* in the readily recognisable character of the singleness of the hæmapophysial surface (Tab. XI, *h*), and in this particular they resemble those of *Iguanodon.* As in the anterior caudals of that genus, also, the surface is much less marked at the fore than at the back part of the centrum. There is no longitudinal fossa connecting them (as in Tab. IX, fig. 5, 'Monograph,' 1855): but this character is not common to all the caudal vertebræ in *Iguanodon.*

Humerus. Tab. XII.

The limb-bone, four feet and a half in length, discovered in 1847 by Mr. Peter Fuller, in the Wealden sandstone of Tilgate Forest, Sussex, so far as its extremities can be judged of in their present mutilated state, bears a closer resemblance to the right humerus of the Crocodiles and Alligators than to any other long-bone of known *Reptilia.* But were the wanting parts, of the proximal end more especially, to be such as to cause a closer resemblance to that end of the femur in *Iguanodon* or *Megalosaurus* than at present appears, the process *d* (Tab. XII, fig. 2), which, on the humeral determination, is the deltoid ridge, would answer to the inner trochanter (*d*), in the femur of the above-named *Dinosaurs* (see Tab. VII, 'Monograph,' 1856), a process which is wanting in the Crocodilian femur. I incline, however, to believe in the determination of this bone, adopted by the authors of the Memoir on

* From a contiguous vertebra of similar size, from the same collection and series, equally marked *Pelorosaurus,* and with the neural spine entire.

the *Pelorosaurus*, in the 'Transactions of the Royal Society' for 1850; but, unfortunately, the mistake of the anterior for the posterior surface of the bone—viewed as a humerus—in that memoir, vitiates the description, and must have added to the difficulty of comprehending, and to the doubts respecting, the nature of the bone, felt by the anatomists acquainted with it only by the figures and text in the 'Philosophical Transactions.' It may be that some transposition and misarticulation of the skeleton of the Gavial, in the museum of the eminent physiologist, whose aid Dr. Mantell acknowledges, occasioned the mistake. According to the analogy of the humerus of the Crocodile, the posterior contour of the shaft of the bone is concave above, convex below; but in a less degree in the *Pelorosaurus*. This longitudinal concavity would, however, be more marked in the specimen had the posterior part of the head (wanting at *a*, figs. 1 and 3) been preserved, and had the three pieces in which this half of the shaft was extracted from the matrix been a little more naturally joined together. The proximal end of the bone is transversely oblong, moderately convex, with both anterior and posterior borders broken away, but leaving the latter more prominent and convex. The internal angle or tuberosity (*i*), which, if entire, would have confirmed so satisfactorily the determination adopted, is also broken away. A still larger proportion of the external side of the proximal end is wanting, leaving only the lower end of the deltoidal ridge (fig. 2, *d*). This, however, reaches three sevenths of the way down the bone, but subsides, and probably begins, nearer the proximal end of the humerus than in the Crocodiles. It projects forward, and bears the same relative position to the fore and outer parts of the bone in *Pelorosaurus* as in *Crocodilia*. The transverse concavity on the inner side of the deltoidal process is continued lower down upon the shaft of the bone of the *Pelorosaurus*, which shaft is more compressed from before backward, giving a longer and narrower sub-elliptical section (Tab. XII, fig. 4) than in the *Crocodilia*. Below the middle the shaft gradually expands to the distal end, the condyles of which project chiefly from the fore part of the bone, as in the Crocodile: they are, however, more unequally developed, the outer one (figs. 2 and 5, *c*) being much the largest.* There is an indication of a low ridge diverging to the outer and fore part of the outer condyle, as in the Crocodile.

At the back part of the humerus of the *Pelorosaurus*, the upper half shows a minor degree of longitudinal concavity, and a lower and more regular transverse convexity, than in the Crocodiles. There is a foramen for the medullary artery at the middle of the back of the shaft, where I have observed it in some *Crocodilia* (e. g. *Croc. Hastingsiæ*). At the lower half the surface, instead of being flat, is transversely concave at the middle, or more concave and with such channel more longitudinally extended, than in *Crocodilia*. The depth has been increased

* This character is rather exaggerated in fig. 2.

at one part by pressure. The medullary cavity of the bone is well marked, and bears to the compact wall the proportion shown in fig. 4, Tab. XII.

From the foregoing scanty data relative to the *Pelorosaurus*, and on the supposition of the long-bone being, as I believe it to be, a humerus, it may be inferred that there coexisted at the Wealden period, with the *Iguanodon*, *Megalosaurus*, and *Hylæosaurus*, a reptile of more Crocodilian affinities, and of a bulk at least equalling that of the largest of these *Dinosauria*.

In the characters of the best-preserved vertebræ—those, viz., from the base of the tail,—the *Pelorosaurus* most resembles the *Iguanodon;* and the differences here observable may not be of more than specific importance: the Crocodilian character of the humerus points, however, to a generic distinction.

From the *Cetiosaurus* the *Pelorosaurus* is more obviously and decidedly distinct, by vertebral characters, which, in regard to the latter genus, have now been, for the first time, pointed out.

The genera of Saurian reptiles, hitherto determined, from the Wealden strata, have been founded on vertebral characters. With these, in regard to two of the genera, viz., *Iguanodon* and *Megalosaurus*, corresponding generic distinctions have been yielded by the teeth. The same may be affirmed, with a high degree of probability, but not as yet with certainty, in respect of the *Hylæosaurus*. There is a fourth form of tooth, generically distinct from the foregoing, applicable in respect of size to either *Cetiosaurus* or *Pelorosaurus*.

Not any of the foregoing genera have been founded on the structure of the limb-bones; for, indeed, such structure is not generic. Some of these bones, for example, may be hollow, and others solid in the same limb of the same reptile. The femur of the *Cetiosaurus* might have a small medullary cavity, whilst the tibia, the fibula, and the metatarsal were cancellous in the centre. The generic distinction of this huge reptile was originally, and in every subsequent descriptions of its specifically differing remains, founded upon vertebral characters. The names of the species bear reference to the proportions and minor modifications of essentially Cetiosaurian vertebræ. If, therefore, the long-bone—most probably humerus—above described, should belong to the same species as the *Cetiosaurus brevis*, and not to the very distinct species established in the vertebræ marked *Pelorosaurus* by Dr. Mantell in his last collection, the medullary cavity of the Crocodilian bone would be no sufficient ground for suppressing the genus.

Neither, supposing the appearance of the cancellous centre of the equally long limb-bone of the great Saurian from the Bradford Clay at Enslow Bridge, Oxfordshire, to be due to compression, obliterating the medullary cavity, would that afford just and satisfactory ground for determining the genus of reptile to which the crushed bone belonged. The tibia of the correspondingly large reptile from the same formation and locality, originally deemed to be Cetacean, is, indeed, solid; but it might have coexisted with a femur in which a small medullary cavity had been established. Compression proves nothing, however, as against the cancellous tissue of the centre of a bone: the force that would squeeze the medullary shaft of a Crocodilian femur 4 feet long, to a thickness of 3 or 4 inches, would overcome any resistance that the loose spongy texture of a Cetiosaurian bone would offer. Moreover, the shorter diameter of the humerus, referred by Dr. Mantell to *Pelorosaurus*, is but $4\frac{1}{2}$ inches; and the medullary cavity there, is most patent and perfect: such a cavity could scarcely have escaped the notice of so close an observer as the late Mr. Hugh Strickland, if it had really existed in the long-bone from Enslow Bridge, now in the Geological Museum at Oxford, and referred to the genus *Cetiosaurus*.

The satisfactory proof of the existence of remains of a huge species of Wealden Saurian distinct from *Iguanodon*, *Hylæosaurus*, *Megalosaurus*, and *Cetiosaurus*, is afforded by the vertebræ, one of which is figured, of the natural size, in Tab. XI. For this genus and species the name of *Pelorosaurus Conybearii*, may be most conveniently retained: most properly so, indeed, if ulterior discoveries should prove the hollow humerus to belong to a reptile with the Pelorosaurian type of vertebra.

In the descriptions of the vertebræ from the Wealden given in my 'Report' of 1841, and in the figures of them now published, the foundations, at least, may be laid for rightly reconstructing the huge and strange Reptilia to which they severally belonged.

Tooth of a large carnivorous Wealden Reptile.

A fossil tooth of a large reptile was discovered, some years ago, in the Wealden Clay of Brixton Bay, Isle of Wight, which differs from the similarly sized teeth of *Iguanodon* and *Megalosaurus*, and, therefore, most probably belongs to either the *Cetio-* or *Peloro-saurus*.

The crown of this tooth, measured along the greatest extent of enamel, is 2 inches: about 1 inch and 5 lines of the fang is continued beyond the crown. The fang is subcylindrical at its broken base, becomes compressed as it approaches the crown, and this expands, with a diminution of thickness, as it extends from the fang, for about one third of the length, where two opposite trenchant margins begin; after which it gradually contracts to a point.

The extreme breadth of the crown measures 1 inch; the thickness is 8 lines. On one side the crown is unequally convex; on the opposite side, at the apical two thirds, it becomes a little concave: one margin is gently convex, the other is very slightly concave. The convex side of the crown is covered by smooth enamel, which forms four low ridges on its most prominent part, and terminates inferiorly, by a delicate rugous structure, in a well-defined border, concave toward the root. The opposite side of the crown, flattened below and concave above, has the enamel smooth, except at the base, where it is rugous, and is extended nearly half an inch lower down the crown, where it terminates by a border convex toward the root.

The margins of the crown are obliquely abraded toward the concave side of the crown, and, near the base of the straighter border, there is an oblique depression.

The root is subcylindrical, and shows the remains of a pulp-cavity: it appears as if it had been implanted in a complete alveolar cavity; but the unequal extent of the enamel on the two sides of the crown indicates a corresponding inequality in the outer and inner alveolar walls of the jaw which supported this tooth. Assuming the thecodont mode of its implantation, it would in this respect resemble the teeth of the Crocodiles, and of certain Enaliosaurs and Dinosaurs.

The shape of the crown of this tooth, especially the degree of compression of the crown and its expansion above the root into opposite borders, which become trenchant, accords best with the characters of the teeth in the carnivorous Sauria. Of such teeth as have hitherto been discovered in the Wealden strata, those that have been referred to the *Hylæosaurus** make the nearest approach to the form of the tooth in question; but, besides the difference of size, the crown has a more symmetrical shape in *Hylæosaurus*, and its broadest part is nearer the apex: the opposite worn margins which converge to the tip are both relatively shorter and thicker, and are not obliquely abraded so as to be trenchant, as they are in the larger Wealden tooth here described. It is a tooth of allied form to that of the *Hylæosaurus*, and, like it, was implanted by a cylindrical fang, apparently in a distinct socket: the few specimens that have been discovered of the teeth ascribed to *Hylæosaurus* appear to have been broken from the socket, not to have been naturally shed so as to show the traces of absorption; and the same is the case with the larger tooth in question.

The difference of form between the tooth of the *Megalosaurus* † and the present large piercing and cutting tooth is too obvious and strongly marked to need particularising; and it departs still further, both in shape and mode of implantation, from the tooth of the Iguanodon.‡

The present tooth, therefore, indicates a reptile equal in size to any of those above cited from the Wealden strata, but of a distinct genus: and vertebral evidence has been adduced, in the present 'Monograph,' of at least two genera—independently of *Streptospondylus*—of large Wealden reptiles equally distinct from those originally made known by Buckland and Mantell.

The tooth in question may, very probably, belong to either *Cetiosaurus* or *Pelorosaurus*. Future discoveries of teeth or of jaws with teeth, associated with the

* 'Monograph on Wealden Reptiles,' part iv, 1856, p. 21, Tab. VIII, figs. 6—9.

† Ibid., part iii, 1856, p. 21, Tab. XI and XII.

‡ Ibid., part i.

characteristic vertebræ of one or other of these large reptiles, will determine this question.

The tooth here described was first made known to geologists, and figured by Dr. Thomas Wright, F.G.S., an indefatigable explorer of the geology and fossils of the Isle of Wight, in a paper on the Palæontology of the Island, in the 'Annals and Magazine of Natural History' for August, 1852.

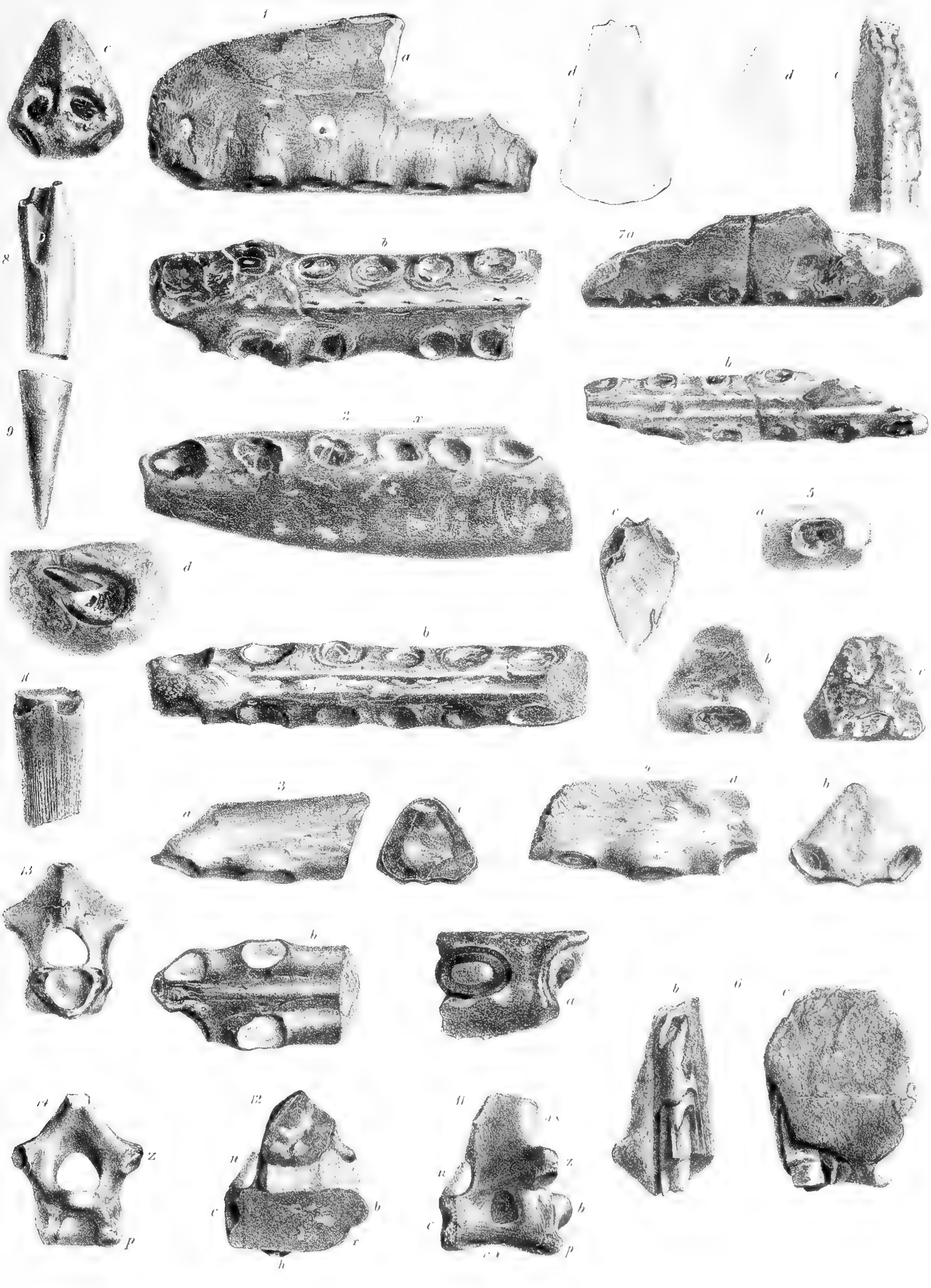
TAB. I.

Genus *Pterodactylus.*

Fig.

1. Fore part of the upper jaw of *Pterodactylus Sedgwickii: a*, side view; *b*, under view, or palatal surface; *c*, front view or end; *d*, section of fractured opposite end.
2. Fore part of the lower jaw of *Pterodactylus Sedgwickii: x*, side view; *b*, upper view; *c*, section of fractured end; *d*, one of the sockets, magnified, showing the protruding apex of a young successional tooth.
3. Fore part of the upper jaw of *Pterodactylus Fittoni: a*, side view; *b*, under view; *c*, section of fractured end.
4. Another portion of the upper jaw of *Pterodactylus Fittoni: a*, side view; *b*, section.
5. A fragment of the upper jaw with one socket of *Pterodactylus Fittoni: a*, under view; *b*, outside view; *c*, inside view, showing the large cancelli.
6. A fragment of the upper jaw of a large *Pterodactylus Sedgwickii: a*, under view; *b*, end view, showing the deep implantation of the tooth; *c*, outside view.
7. Part of the under jaw of *Pterodactylus Sedgwickii: a*, side view; *b*, upper view, or that next the mouth; *c*, under view; *d*, section.
8. Base of a tooth, impressed by the apex of a successional tooth, at *o*.
9. Crown of a tooth.
10. Base of a large tooth, showing the longitudinally wrinkled cement.
11. Anchylosed atlas and axis: *c*, centrum of atlas; *cx*, centrum of axis; *b*, articular ball of axis; *p*, inferior process; *o*, pneumatic foramen; *n*, neurapophysis of atlas; *nx*, neural arch of axis; *z*, posterior zygapophysis and tubercle of axis.
12. Section of anchylosed atlas and axis: *h*, median hypapophysis.
13. Front view of the axis vertebra from which the atlas has been detached.
14. Back view of the same vertebra.

All the foregoing figures are of the natural size, and from specimens in the Woodwardian Museum of the University of Cambridge (with the exception of fig. 7 in the Private Collection of the Rev. G. D. Liveing, M.A., of St. John's College, Cambridge); they were obtained from the Upper Geen-sand (Neocomian), near that town.



Jos. Dinkel lith

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TAB. II.

Vertebræ of *Pterodactylus Sedgwickii* and *Pter. Fittoni.*

Fig.

1. Front view of anchylosed atlas and axis.
2. Back view of the same.
3. Side view of the same.
4. Under view of the same: *a*, anterior tubercle, or rudiment of zygapophysis, of axis; *z*, posterior zygapophysis, of axis; *c*, centrum of atlas; *p*, infero-posterior processes of axis; *b*, articular ball of axis.
5. Front view of a larger specimen of atlas and axis.
6. Under view of the same, indicative of a species distinct from fig. 4.

7. Side view, 8. Back view, 9. Upper view, 10. Front view, 11. Under view } of a middle cervical vertebra.

12. Under view, 13. Side view } of a cervical vertebra.

14. Upper view, 15. Side view, 16. Under view } of a cervical vertebra.

17. Upper view, 18. Under view } of a more complete cervical vertebra.

19. Section of a large cervical vertebra.

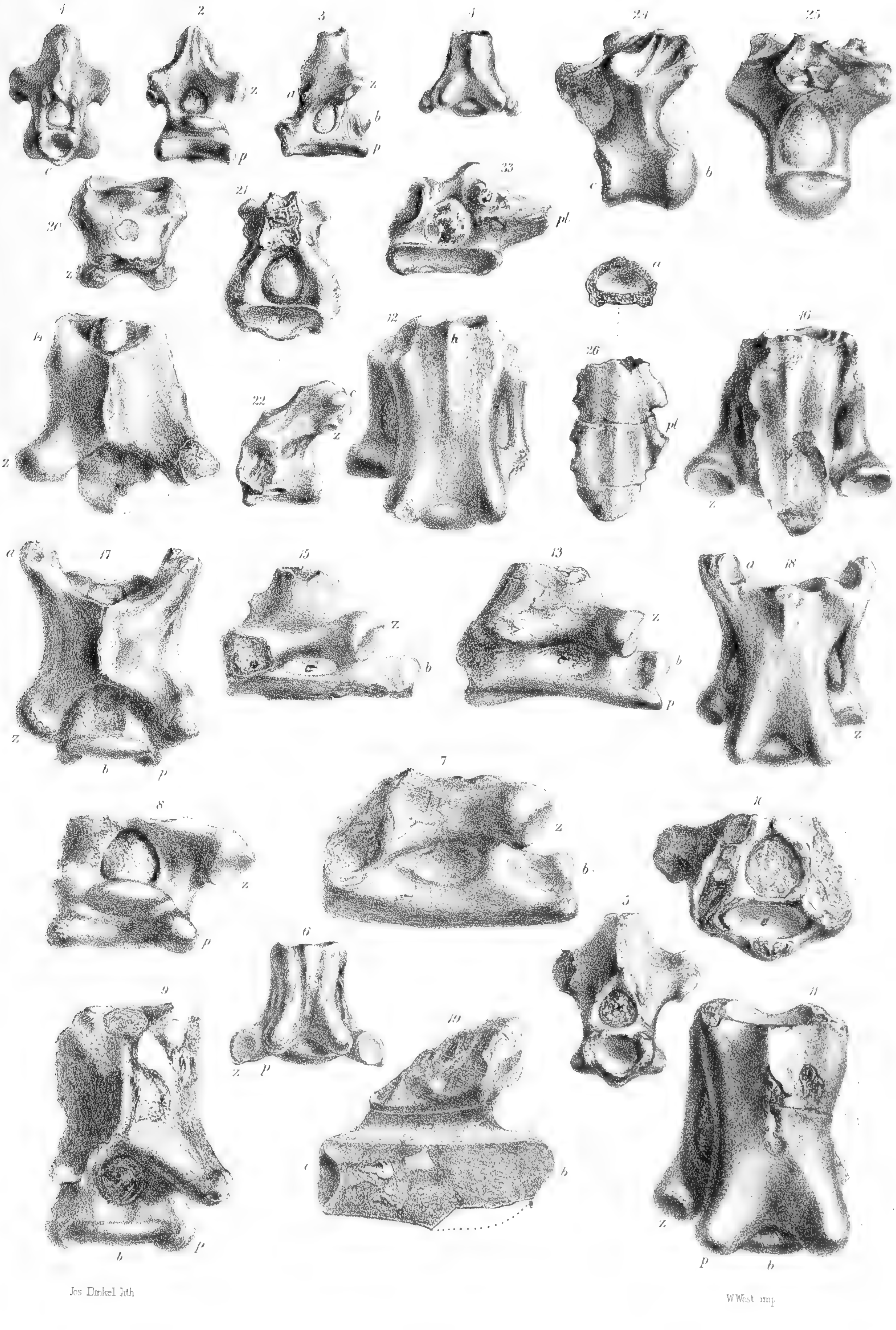
20. Under view, 21. Front view, 22. Side view } of an anterior dorsal vertebra.

23. Front view of a lumbar vertebra.

24. Side view, 25. Back view } of a dorsal vertebra.

26. Under view of three anchylosed sacral vertebræ.

All the figures are of the natural size, and from specimens in the Woodwardian Museum of the University of Cambridge, which were found in the Upper Green-sand (Neocomian) near that town.



Jos. Dinkel lith

W. West imp.

TAB. III.

Pterodactylus Sedgwickii and *Pterodactylus Fittoni.*

Fig.

1. Humeral end of anchylosed scapula *a*, and coracoid *b*, with the glenoid articular cavity. The letter *c* indicates the base of the broken-off anterior or angular production of the coracoid.
2. Front view of the same specimen.
3. Similar view of the glenoid articular cavity of a similar sized Pterodactyle.
4. Glenoid articular cavity of a smaller specimen, and probably different species.
5. Inner surface of the anchylosed humeral end of the scapula and coracoid of a still smaller Pterodactyle.
6. The scapulo-coracoid arch of *Pterodactylus* (*Dimorphodon*) *macronyx*, Bkd.
7. The articular head of the right humerus of a large Pterodactyle.
8. The articular head of the left humerus of a large Pterodactyle.
9. The articular head of the left humerus of a smaller Pterodactyle.
10. The articular head of the right humerus of a similar sized Pterodactyle.
11. The articular head }
12. (The convex side) } of the proximal end of the humerus of a Pterodactyle.
13. (The concave side) }
14. (The convex side) } of the proximal end of the humerus of a smaller Ptero-
15. (The concave side) } dactyle.

16—20. Different teeth of Pterodactyles.

All the figures are of the natural size, and from specimens in the Woodwardian Museum of the University of Cambridge, which were found in the Upper Green-sand (Neocomian) near that town.

Jos Dinkel lith

TAB. IV.

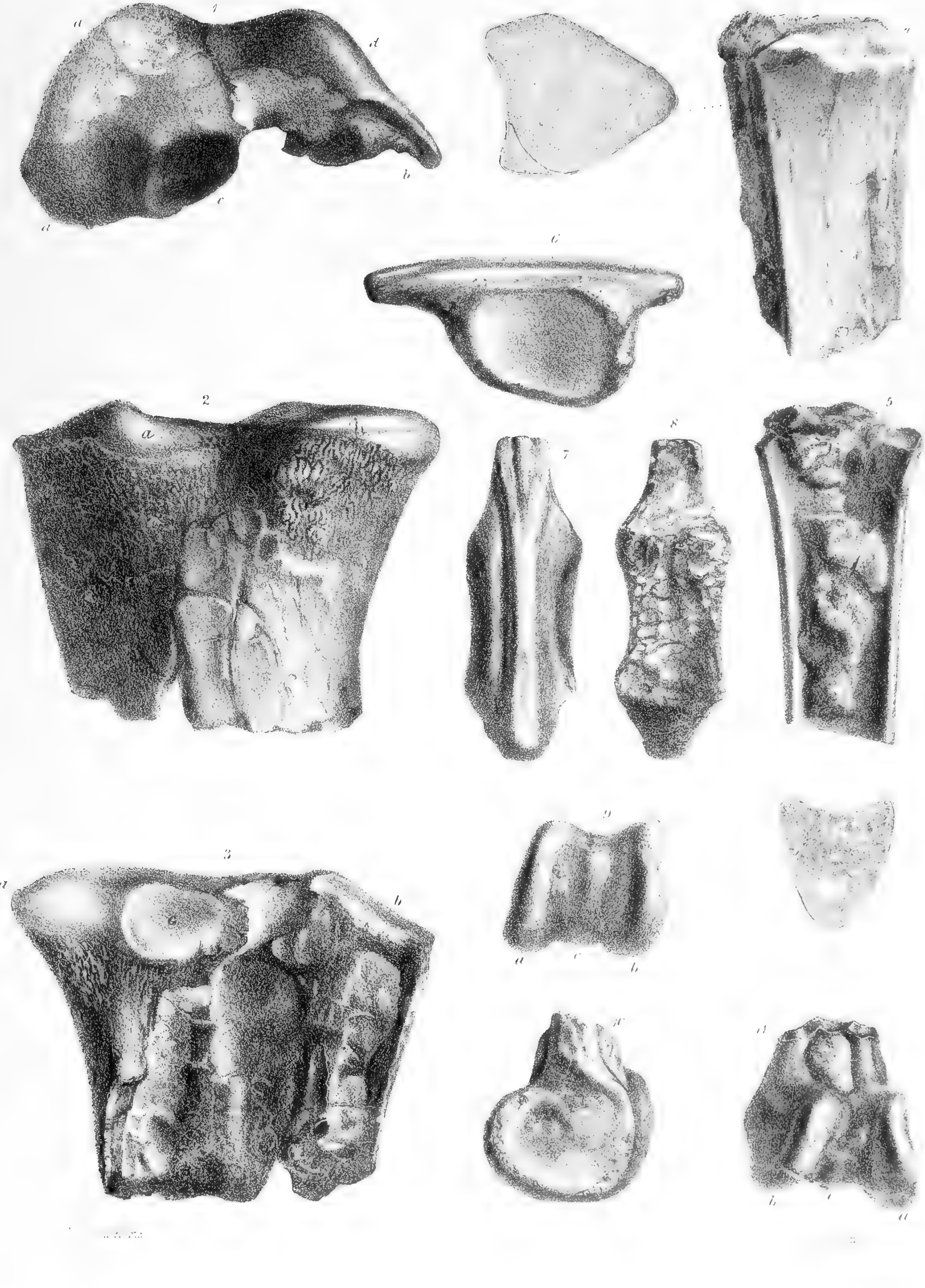
Pterodactylus Sedgwickii and *Pter. Fittoni.*

Fig.

1. Articular end,
2 Front (?) surface ⎫ of a long bone of the wing.
3. Back (?) fractured) surface ⎭
4. Side view ⎫ of part of the proximal end of the metacarpal of the 5th or wing-
5. Back (?) view ⎭ finger.
6. Side view ⎫
7. Upper (?) view ⎬ of a symmetrical (probably frontal) bone.
8. Opposite fractured surface ⎭
9. Articular end ⎫ of the trochlear distal extremity of the metacarpal of the 5th or
10. Side view ⎬ wing-finger.
11. Back view ⎭

All the figures are of the natural size, and from specimens in the Woodwardian Museum of the University of Cambridge, which were found in the Upper Green-sand (Neocomian) near that town.

T. IV



TAB. V.

Streptospondylus major.

Fig.

1.
2. } Cervical vertebra, half natural size.

3.
4. } Posterior caudal vertebra (*Pelorosaurus* ?), one fourth natural size.

From the Wealden of the Isle of Wight. British Museum.

Jos Dinkel lith

W West imp

Streptospondylus

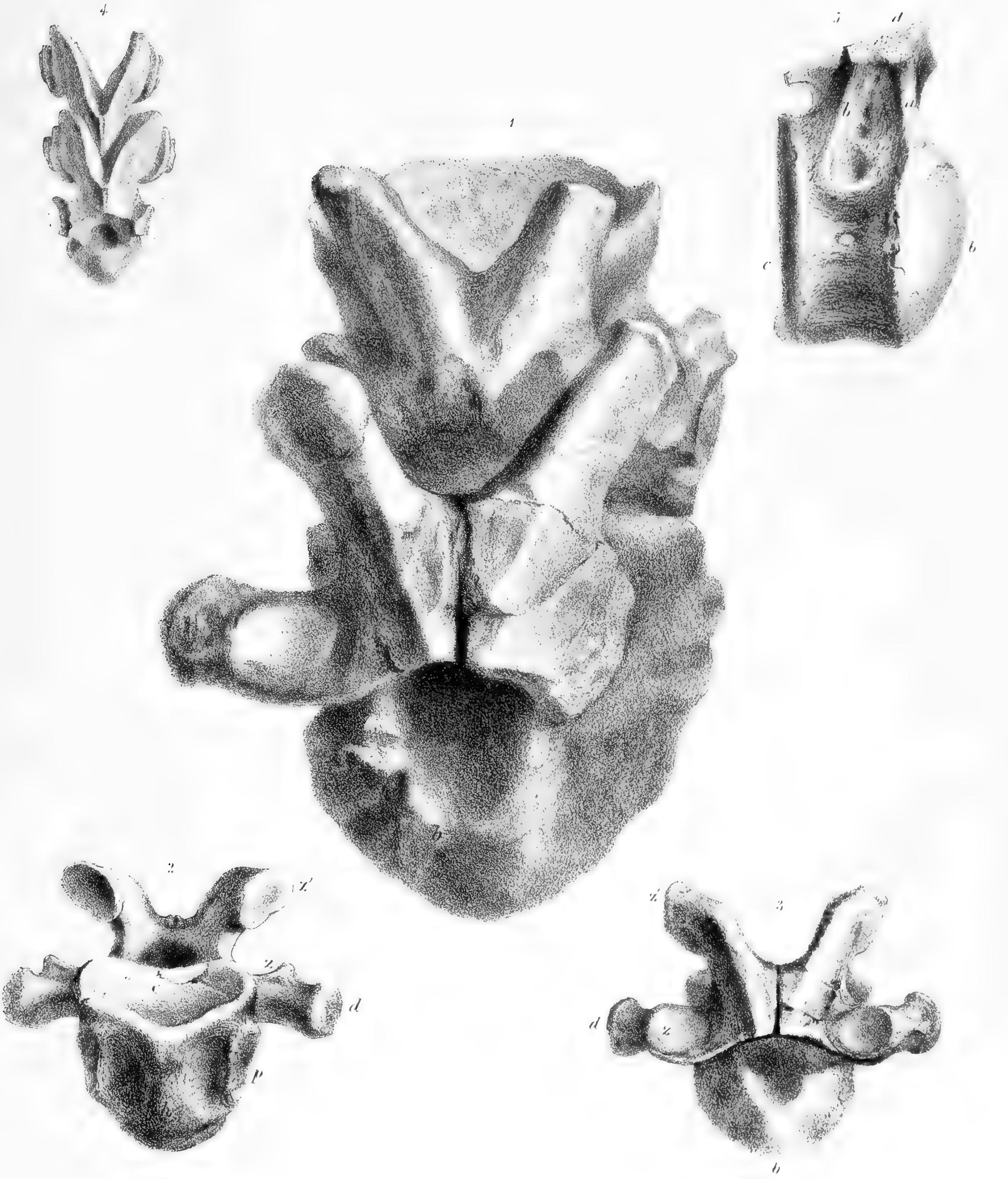
TAB. VI.

Streptospondylus major.

Fig.

1. Upper view of cervical vertebra, half natural size.
2. Under view } of cervical vertebra, one sixth natural size.
3. Front view }
4. Two anterior cervical vertebræ of a young Iguanodon, half natural size.
5. Side view of dorsal vertebra of *Streptospondylus major*, one sixth natural size.

From the Wealden of the Isle of Wight. British Museum.



Jos. Dinkel lith.

W. West imp.

Streptospondylus.

TAB. VII.

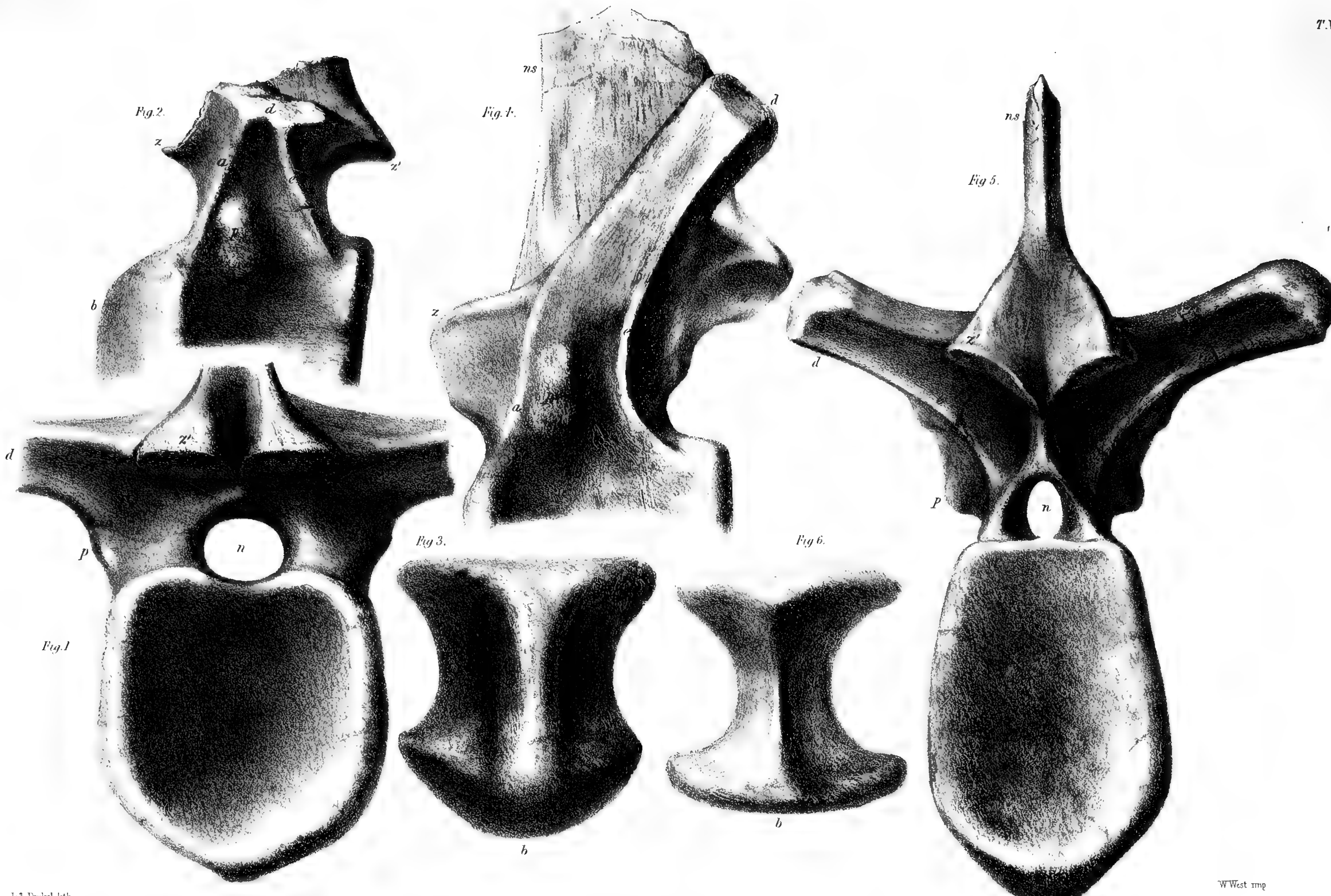
Dorsal Vertebræ of *Streptospondylus*, figs. 1, 2, 3; and *Iguanodon*, figs. 3, 4, 5; half natural size.

Fig.

1. Back view of centrum and base of neural arch.
2. Side view of base of neural arch.
3. Under view of centrum.
4. Back view of corresponding vertebra of Iguanodon.
5. Side view of base of neural arch.
6. Under view of centrum.

From the Wealden of the Isle of Wight. British Museum.

T. VII.



Joh? Dinkel lith.

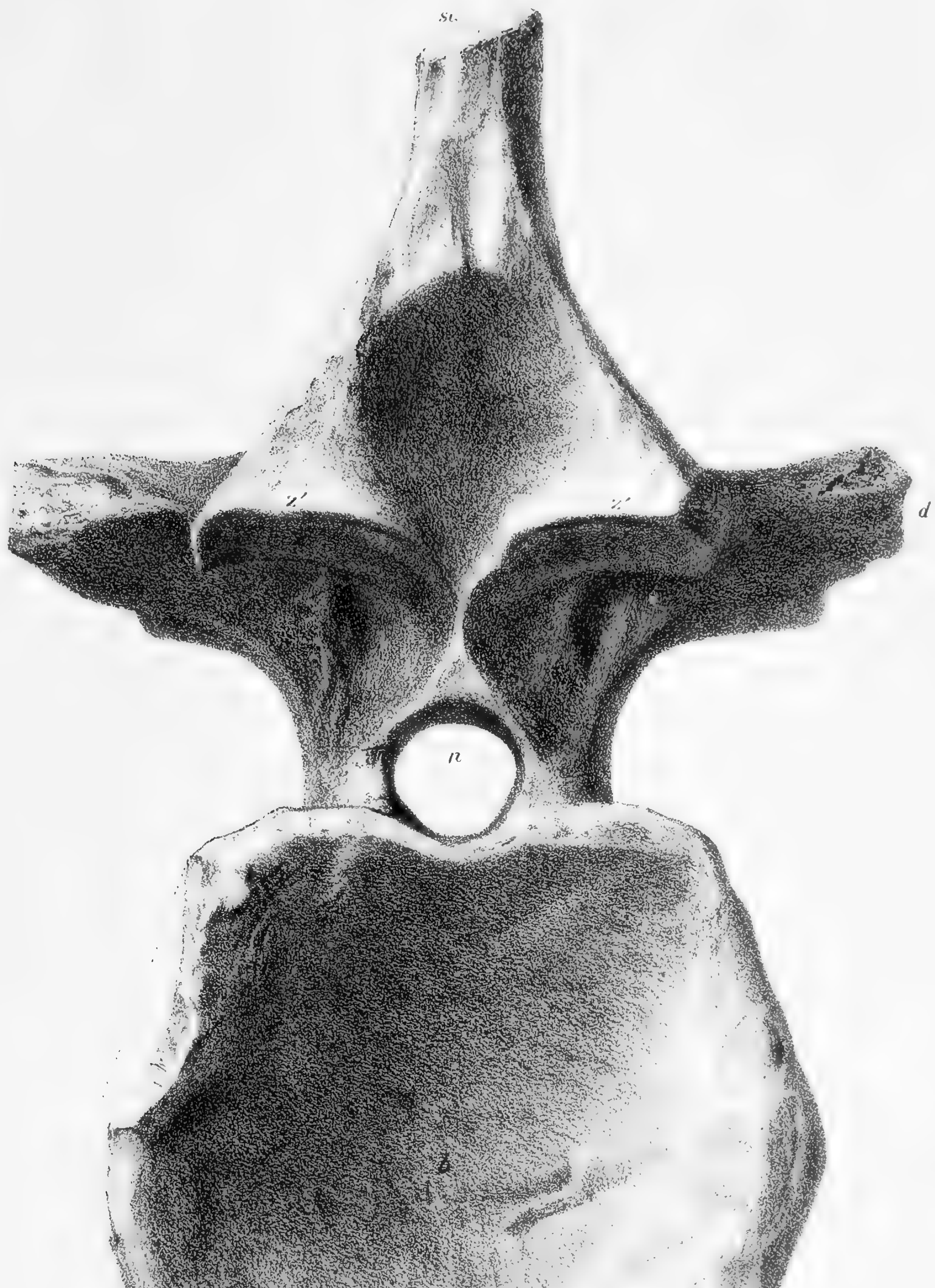
W West imp.

TAB. VIII.

Cetiosaurus brevis.

Posterior view of a dorsal vertebra, half natural size.

From the Wealden of the Isle of Wight. British Museum.



Jos. Dinkel lith.

TAB. IX.

Cetiosaurus brevis.

Fig.

1. Side view of a dorsal vertebra, half natural size.
2. Vertical longitudinal section of a dorsal vertebra, half natural size.

From the Wealden of the Isle of Wight. British Museum.

Fig. 1.

Fig. 2.

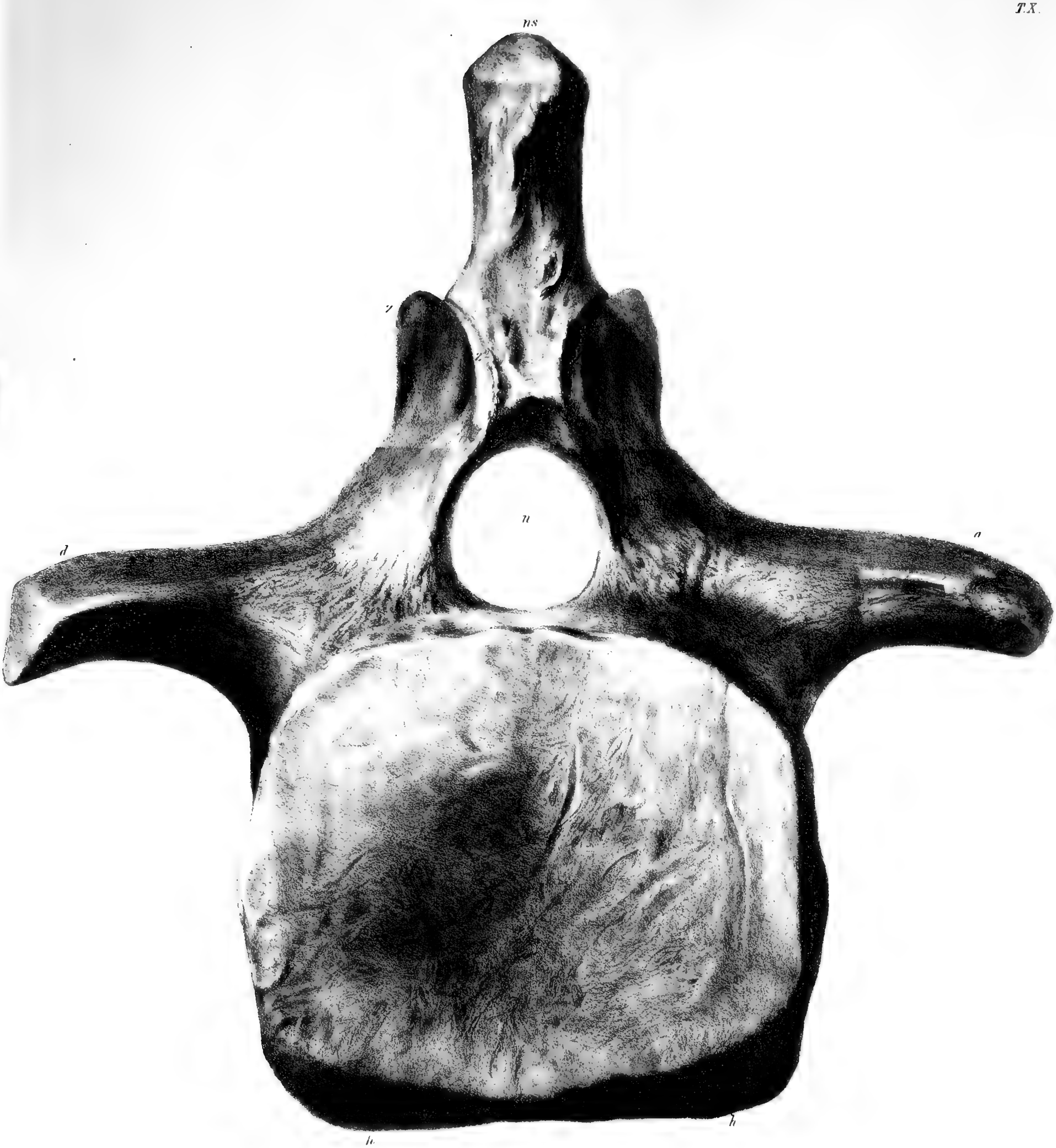
Jos Dinkel lith

TAB. X.

CETIOSAURUS BREVIS.

Posterior view of a caudal vertebra, natural size.

From the Wealden of Sussex. British Museum.



Nat size

Cetiosaurus

TAB. XI.

Pelorosaurus Conybearii.

Posterior view of a caudal vertebra, natural size. The line below gives the antero-posterior dimension.

From the Wealden of Tilgate Forest. British Museum.

Jos Dinkel lith.

Pelorosaurus.

W West Imp

TAB. XII.

Right Humerus of *Pelorosaurus Conybearii*, one sixth natural size.

Fig.

1. Back view.
2. Front view.
3. Proximal end.
4. Section of middle of shaft, showing the medullary cavity.
5. Distal end.

From the Wealden of Tilgate Forest. British Museum.

T. XII

Jos Dinkel lith.

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

ISSUED FOR 1857.

LONDON:

MDCCCLIX.

A MONOGRAPH

OF

THE FOSSIL POLYZOA

OF THE

CRAG.

BY

GEORGE BUSK, F.R.S., F.L.S., F.G.S., &c.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1859.

J. E. ADLARD, PRINTER, BARTHOLOMEW CLOSE.

CONTENTS.

ADVERTISEMENT.

The materials from which the following Monograph has been drawn up have been afforded by the copious and valuable collections of Crag Polyzoa placed, with their wonted liberality, at my disposal by Mr. Searles Wood and Dr. Bowerbank.

The work was originally undertaken by the late much-lamented M. Jules Haimes, but he was unable even to commence it before death put an end to the labours of one whose accurate knowledge and practised observation of similar fossil remains would have enabled him to treat the present subject far more satisfactorily than it has been in my power to do.

Though long accustomed to the study of recent Polyzoa, until the present undertaking was commenced I had formed but an imperfect idea of the difficulties attending the investigation and accurate discrimination of fossil forms.

With respect to the synonymy of species, so little assistance, with regard to the more minute though essential characters, can in most cases be derived from published descriptions and figures, with the sole exception almost of the admirable works of Hagenow and of Reuss, that it is almost impossible to arrive at any certainty without the direct comparison of specimens. And though no endeavours or time have been spared in the elucidation of this part of the subject, I am fully conscious that it still remains in an unsatisfactory state. In order to obviate some of the difficulties above referred to, the utmost care has been taken in the drawing of the figures to render the characters as clear and distinct as the condition of the specimens would allow. This could only be done by the adoption of a scale somewhat larger than that usually employed. It is consequently to be hoped that future inquirers will at any rate have little difficulty in recognising the species here intended.

I cannot conclude this reference to the figures without expressing my warm acknowledgments to Mr. George West, for the unwearied pains and great skill with which he has executed them from the actual specimens, as well as for the important aid which, in many cases, I have derived from his intelligent observations on points of structure to which his attention was drawn in the execution of his work, and which would otherwise probably have escaped my notice.

The following are the principal Works or Papers to which reference has been made:

ALDER, JOSHUA. 'A Catalogue of the Zoophytes of Northumberland and Durham;' 8vo, Newcastle, 1857.

BLAINVILLE, H. M. D. DE. 'Manuel d'Actinologie ou de Zoophytologie;' 8vo, Paris, 1834.

BUSK, G. 'Catalogue of Marine Polyzoa in the Collection of the British Museum;' 12mo, London, 1852.

BRONN, H. G. 'Lethæa geognostica oder Beschreibung und Abbildungen der für die Gebirgs-Formationen bezeichnendsten Versteinerungen;' 8vo, Stuttgard, 2de Aufl. 1838.

,, 'System der urweltlichen Pflanzenthiere, durch Diagnose, Analyse, und Abbildung der Geschlechter erläutert;' fol. Heidelb., 1825.

BOSÇ, L. A. G. 'Histoire naturelle des Vers;' 18mo, Paris, 2de Ed. 1830.

COUCH, R. Q. 'A Cornish Fauna,' &c.; 8vo, Truro, 1844.

DAWSON, J. W. 'Additional Notes on the Post-Pliocene deposits of the St. Lawrence Valley;' 8vo, Montreal, 1859.

D'ORBIGNY, ALCIDE. 'Paleontologie Française.—Description zoologique et geologique de tous les animaux mollusques, et rayonnés fossiles de France. (Terrains Crétacés et Jurassiques; Planches);' 8vo, Paris, 1840–53.

,, 'Recherches zoologiques sur la classe des Mollusques Bryozoaires,' "Ann. d. Sc. Nat.," 3 ser., t. xvi and xvii, 1851.

DUNKER u. KOCH. 'Beiträge zur Kentniss des norddeutschen Oolithgebildes und dessen Versteinerungen,' 4to, Brunswick, 1837.

ELLIS J. 'An Essay towards a Natural History of the Corallines,' &c.; 4to, London, 1755.

ESPER, E. J. C. 'Die Pflanzenthiere in Abbildungen nach der Natur, nebst deutlicher Beschreibungen;' 4to, Nuremberg, 1791–98.

GOLDFUSS, G. A. 'Petrefacta Germaniæ,' &c.; fol. Dusseldorf, 1826–33.

GRAY, J. E. 'Spicilegia Zoologica;' pt. 1, 1828.

HAGENOW, F. v. 'Die Bryozoen der Maastrichter Kreidebildung.'

,, '"Bryozoen," in Geinitz, Grundriss der Versteinerungs-Kunde;' 8vo, Dresden, 1846.

JOHNSTON, GEO. 'History of British Zoophytes;' 2d edition, 8vo, London, 1847.

LAMARCK, J. B. P. A. DE. 'Histoire naturelle des Animaux sans Vertèbres;' 2d edition, 8vo, Paris, 1836.

LAMOUROUX, J. 'Exposition méthodique des Genres de l'ordre des Polypiers,' &c.; 4to, Paris, 1821.

LONSDALE, W. 'Account of six species of *Polyparia* obtained from Timber Creek, New Jersey,' "Journ. Geol. Soc.," vol. i, p. 65, 1845.

,, 'Report on the Corals from the Tertiary formations of North America,' *ibid.*, p. 495.

LONSDALE, W. 'Notes on Fossil Zoophytes found in the Deposits described by Dr. Fitton in the section from *Atherfield* to *Rocken End*,' *ibid.*, vol. v, p. 55.

,, In Dixon's 'Fossils of Sussex;' 4to, London.

,, In Sir R. I. Murchison's 'Siluria;' 8vo, London, 1854.

LYELL, SIR CHARLES. 'Manual of Elementary Geology;' 5th ed., 8vo, London, 1855.

M'COY, PROFESSOR. 'Carboniferous Fossils of Ireland;' 4to, Dublin, 1844.

MANTELL, G. 'The Medals of Creation;' 12mo, London, 1844.

MICHELIN, H. 'Iconographie Zoophytologique; Description par localités et terrains des Polypiers fossiles de France,' &c.; 4to, Paris, 1841–44.

MILNE-EDWARDS, H. 'Recherches Anatomiques, Physiologiques et Zoologiques sur les Polypiers;' 8vo, Paris, 1838.

MOLL, J. P. C. '*Eschara*, Zoophytozoorum seu Phytozoorum ordine pulcherrima ac notatu dignissimâ,' &c.; 4to., Vind. 1803.

MORRIS, JOHN. 'A Catalogue of British Fossils, comprising the Genera and Species hitherto described,' &c.; London, 1854.

PALLAS, P. S. 'Elenchus Zoophytorum;' 8vo, Hagæ Comitum, 1766.

,, 'Charakteristik der Thierpflanzen;' 4to, Nürnberg, 1787.

REUSS, A. E. 'Die Versteinerungen der Böhmische Kreide-formation.'

,, 'Fossilen Polyparien der Wiener Tertiärbeckens;' 4to, Wien, 1847.

ROËMER, F. 'Die Versteinerungen des norddeutschen Oolithen-Gebirges;' 4to, Hannover, 1836.

,, 'Die Versteinerungen des norddeutschen Kreidegebirges;' 4to, Hannover, 1841.

WOOD, SEARLES. 'Descriptive Catalogue of the Zoophytes from the Crag,' "Ann. Nat. Hist.," xiii, p. 10.

,, 'Monograph of the Crag Mollusca;' 4to., London, 1850.

WOODWARD, S. 'Outline of the Geology of Norfolk;' 8vo, Norwich, 1833.

ERRATA.

In page 123, line 14 from bottom, *omit* " not."

In page 182, after "*Cheilostomata*," pp. 8, 9, *add* p. 10.

After "Synoptical Classification of," *for* p. 12, *read* p. 13.

The initials *S. W.* indicate Mr. Searles *Wood*,

and *J. S. B.*, Dr. J. S. Bowerbank.

A

MONOGRAPH

OF

THE CRAG POLYZOA.

INTRODUCTORY OBSERVATIONS.

Before proceeding to give an account of the fossil remains of a class of animals of which so little is generally known as of the Polyzoa, it will be necessary, if only for the due understanding of the descriptive terms employed, by those who may be wholly unacquainted with the subject, to say a few words respecting their structure and affinities. No very detailed remarks, however, are required for that purpose, and it is the less necessary, perhaps, to enter fully into the subject, seeing that it has been almost exhausted in the admirable Monograph of Professor Allman, on the "Fresh Water Polyzoa," to which the reader, who is desirous of further information, cannot do better than refer. But as that author's observations, after he has explained the structure and relations of the Polyzoa as a class, are confined more especially to that division of them which forms the subject of his own memoir, and which differs in several important particulars from those divisions to which the subjects of the present work belong, some additional details referring more directly to the latter, seem to be called for.

Thirty-one years ago, Dr. Grant, in some "Observations on the Structure and Nature of Flustræ," drew, for the first time, a distinction between the animals inhabiting those growths, and the Sertularian, or Hydroid Polypes, with which they had previously been associated. Shortly afterwards, the observations of M. Milne Edwards not only showed the propriety of this distinction, but indicated also the still more important fact of the close relationship, in many respects, between the structure of the Ascidian Molluscs and that of the animals in question, which he thence proposed to distinguish by the name of "*Polypes tuniciers.*"

Another independent observer, however, Dr. John V. Thompson, of Cork, was also at work on the same subject, the results of whose researches, apparently commenced in 1820, were not published till December, 1830, in the first part of his "Zoological Researches and Illustrations." He, like M. Milne Edwards, recognising the close affinities presented in the structure of the animals to that of the compound Ascidians, was the first to propose for them an appellation wholly independent of their former incongruous allies, the hydroid "Polypes." The term he employed was "*Polyzoa,*" it "being applied" as he says, "to a distinct class of Polypes hitherto in great measure confounded with the Hydroida." But it is to be remarked that he used the word in the singular number, so that the plural term, "Polyzoa," as now employed, though etymologically more correct, is not in reality synonymous with that of Dr. J. V. Thompson. This fact, which appears to have been strangely overlooked till 1852, may fairly enough be used as an argument in their favour, by those who are inclined to prefer the Ehrenbergian term "Bryozoa." But as this preference, which is still extensively prevalent, more especially on the Continent, is based simply upon the supposed priority of Professor Ehrenberg's appellation, a claim which has been shown[1] to be wholly untenable, it is scarcely likely that British naturalists will refuse the honour justly due to Dr. J. V. Thompson, for what can scarcely perhaps be regarded as a sufficient reason.

With respect to the general affinities of the Polyzoa as a class, it may be stated that the Molluscan Sub-kingdom admits of subdivision into three great primary groups or provinces, separated by well-marked characters. These are—1. The Cephalophora, including the *Cephalopoda*, *Gasteropoda* and *Pulmonata.* 2. The Acephala, embracing the *Lamellibranchiata*, and, according to many, the *Brachiopoda.* And 3. The Molluscoida, to which belong, according to some, the *Brachiopoda*, the *Tunicata* or *Ascidioida*, and the *Polyzoa*, whose affinity to the latter, at any rate, is generally admitted; whilst their relationship to the former is in many respects also unmistakeable.

Like many of the lower members, more especially of the Tunicate class, the Polyzoa all live in an associated form; the compound growth or "polyzoarium" (*cœnœcium*, Allm.) being composed of a congeries of distinct individuals, arising by a process of continuous gemmation, from a single primary parent. The colonies thus formed vary infinitely in form, appearance, and consistence. Some are phytoid and erect, whilst others are massive, creeping, or crustaceous. Some, soft and flexible, composed wholly or in part of a horny substance, form delicate growths which yield gracefully to every motion of the waves; whilst others, firm, rigid, and unyielding as the rocks they live upon, bid defiance to the ravages of time or tempest.

The class, or rather one order of it, is cosmopolite, its members being found from the

[1] On the Priority of the term "Polyzoa" for the Ascidian Polypes. ('Ann. Nat. Hist.,' 2d ser., vol. x, p. 352, 1852.)

extreme limits of the Arctic to those of the Antarctic Ocean. They are found also at all depths from above low-water mark to more than 100 fathoms deep. As regards geographical distribution, it may be remarked that, whilst many species appear to be universally distributed over the surface of the globe, many marine genera are confined to either the austral or the boreal hemisphere; and that one entire order, including the Fresh-water Polyzoa, is, so far as we know, limited to a portion of the North Temperate Zone.

With this wide though unequal geographical range and great apparent adaptability to external conditions, we may expect to find that the Polyzoa are of considerable importance in a geological point of view. Their remains are found accordingly in rocks of nearly every epoch, from the Paleozoic to the most recent. Though not numerous in species, they are plentiful in the Upper Silurian and Carboniferous Limestones; very abundant in the Jurassic and Cretaceous rocks, in some of which, as in Le Cotentin, the Departments of La Sarthe, Charente, &c., at Maastricht and Fauquemont, they appear even to constitute the principal bulk of the deposit. In fact, speaking geologically, the Cretaceous period seems to have formed the culminating point of the calcareous Polyzoa. But in the tertiary rocks, also, of different periods, their remains are nearly equally abundant, and more especially is this the case in the Miocene deposits of Brittany and Touraine; in Hesse Cassel; in the tertiary basin of Vienna; and also in North America, in New Jersey and Virginia; whilst their abundance in the older Pliocene deposits of Suffolk and Norfolk is evidenced in the present monograph.

As regards the general conditions under which the Polyzoa which occur in a fossil state have lived, M. D'Orbigny attempts to show, with every probability, that those most conducive to their multiplication, are :—1, a considerable depth of water, as is proved by their occurring in association with the remains of *Pentacrinus* and of *Brachiopoda;* 2, clearness or limpidity of the water; and 3, the existence of strong currents. But it should be remarked that these observations are true only of certain forms of Polyzoa, and of those chiefly which belong to the families or genera whose representatives or extinct allies are found in the fossil state. For it is well known that many species of a more fragile nature occur, as before said, even above low-water mark, and that some especially delight in shallow, muddy water. And this serves partly to explain a circumstance at first sight calculated to excite some surprise; namely, that whilst many recent genera, and even some recent species, belonging to certain divisions of the class, or to certain families, frequently occur in the fossil state, others which are known to exist under similar conditions at the present time, and are far more numerous, are wholly wanting. But very little consideration will show that the apparent deficiency at former periods does not necessarily prove the non-existence then of similar or of representative forms. It is obviously due to the circumstance that several entire orders, and many genera, have been unable to resist the attacks of external agencies; the inability arising either from the individual elements, though themselves sufficiently calcareous, being so joined together by perishable connexions as to have fallen entirely asunder, or to the whole growth being composed of a similar decomposable organic material. In the former case the minuteness of the separate particles would render them wholly inappreciable; and as regards the latter it is clear that we can expect to find in the fossil state only those forms of Polyzoa the walls of whose cells contain such an amount of earthy matter as will enable them to maintain their figure when the organic material is removed. And since one or other of the above conditions obtains in a large proportion of the class, it is only of a limited number of families that we can expect to discover the fossil remains in the older sedimentary deposits.

The general structure and physiological relations of the animals composing this class, notwithstanding the diversified forms exhibited in their skeleton-remains, are extremely simple, and conformable to a very uniform type throughout.

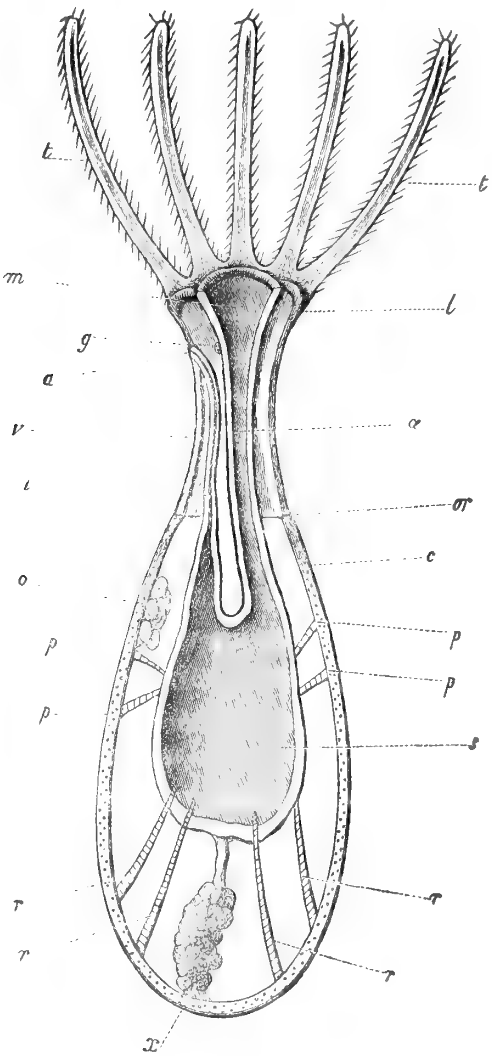
It has been before said that the Polyzoa are always associated into compound growths, made up of a congeries of individuals, which though distinct yet retain some degree of inter-communication, comparable in kind perhaps, though not in degree, to what obtains in many of the compound Ascidians. That this community exists is proved by the otherwise inexplicable circumstance that the polyzoaria in many instances present elements common to the whole growth, and not belonging specially to any individual. The chief bond of connexion would appear to reside partly in the continuity of the external integument, and partly also, in all probability, in a slow interchange of the vital fluid with which the cavities of the cells are charged.

Each individual Polyzoon may be briefly described as possessing a saccular body and as having two orifices, an oral and an anal, which, however, are not at opposite ends of the body, but in close approximation. The oral orifice or mouth is surrounded with a single row of non-contractile tentacles, which are hollow, seated upon a thickened band or ring —the lophophore,—and furnished on the exterior with vibratile cilia, by whose action the nutriment is conveyed to the mouth, and a current kept up on the surface of the tentacles for the purpose of respiration.

The walls of the saccular integument, which may be wholly membranous, or, as is more usual, partly soft and membranous, and partly calcareous and rigid, or fleshy, is attached round the neck, as it may be termed, immediately behind the lophophore, so as to form a completely shut sac, except where it is perforated for the passage of the fæces, but as the walls are there also continuous with those of the intestine, it results that a closed cavity is formed by them, in which are contained the alimentary and reproductive organs, together with the rudimentary nervous system. The upper part of this sac, or that immediately succeeding its attachment, invariably remains flexible and membranous, whilst the remaining portion is usually solidified by the deposition in its tissue of carbonate of lime, or of a horny substance resembling chitine or perhaps conchiolin, in chemical and physical properties.

The walls of the sac are constituted of two membranes, an internal and an external— the *endoderm* and *ectoderm*, or as they have been termed by Professor Allman, the *ectocyst* and *endocyst;* but, inasmuch as their constitution is in all probability fundamentally the same throughout, that is to say, in the permanently membranous portion, as in the rigid part or true cell, the former terms would seem to be rather more appropriate. Be

Fig. 1.



t.t. Tentacles.
l. Lophophore.
m. Mouth.
g. Nervous ganglion.
a. Anus.
œ. Œsophagus.
v. Tentacular sheath, or vaginal portion of integument.
i. Intestine.
or. Orifice of calcareous cell.
c. Calcareous or rigid portion of integument.
o. Ovary.
x. Testis.
s. Stomach.
p.p. Protrusor muscles.
r.r. Retractor muscles.

this as it may, the solidifying material, whatever its nature, belongs to the external tunic, which is in all respects comparable to the external coat or test of an Ascidian, whilst the internal tunic is soft, transparent, and contractile. In consequence of the marked difference just indicated between the upper and lower portions of the integument, the latter in most cases forms a sort of cup or receptacle into which the upper or flexible portion, together with the parts attached to it, can be drawn by appropriate muscles. Now the parts attached, or in immediate connexion with this flexible portion, are—1, the tentacles, which project externally; and 2, the alimentary canal with its immediate appendages, which is lodged in the cavity of the receptacle or "cell" as it is termed. As the tentacles are not contractile, and as, when the body is retracted, they are received completely within the "cell," it follows that the flexible part of the sac which admits of invagination must be at least equal in length to those organs. It is also evident that when retracted the tentacles will be lodged in a tubular sheath formed by the membrane in question, which has thence received the name of "tentacular sheath." The invagination and evagination of this sheath are effected by the action of special muscles, of which a full account will be found in Professor Allman's work above cited; and the evagination may be *perfect* as in most of the marine and some few of the fresh-water Polyzoa, or *imperfect* as in the greater number of the latter class. In which case may be perceived an approach to the formation of an atrium, or common cloacal cavity, such as exists in the Ascidians. The border line between the rigid and flexible portions of the tunic circumscribes an opening, as it were, through which the extrusion and protrusion of the soft parts of the animal take place. This opening, therefore, is termed the "orifice" or "mouth of the cell." In those instances where the cell is of a tubular form the orifice is usually of the same diameter as the tube, but where the cell is of an urceolate or other shape the orifice is usually of less diameter. In a systematic point of view this part of the cell, when the soft parts are removed, affords characters of great importance, as will be afterwards perceived. Other points of importance, presented on the exterior of the "cell" are—1, the condition of the surface, whether it be smooth, punctured, dotted, reticulated, &c.; and 2, the existence of certain external organs which will be afterwards more particularly referred to when we come to speak of the Cheilostomatous Sub-order. But one circumstance should be here mentioned. The surface of the cell is in almost all cases in recent Polyzoa covered with a horny cuticle or epidermis, apparently analogous to that on the outer surface of many shells. This epidermis is often so thick as materially to affect the aspect of the surface, by filling up perforations and smoothing asperities which would otherwise be evident. It is, of course, invariably absent in fossil specimens, and it is therefore in most cases necessary, and in all advisable, when a comparison is instituted between recent and fossil species, to remove the organic matter from the former. Owing to the intractable nature of the covering in question, the only or the most effectual way of doing this is by incineration in the flame of a spirit-lamp, sometimes aided by the blow-pipe.

Within the "cell" thus formed are contained all the soft parts of the animal. These, however, do not occupy the whole of the space, the remainder being occupied by a "clear fluid, in which float numerous particles of very irregular form and size; and in this fluid may be observed a constant rotatory motion, rendered apparent by the floating corpuscles as they are whirled away under the influence of the currents." The space within the "cell," thus filled with fluid, is termed the "perigastric" or "perivisceral space," and obviously corresponds with the space occupied by fluid which intervenes between the viscera and the walls of the body in most of the lower animals, whilst the fluid in question, as in numerous other cases, performs the common functions of nutrition and respiration. The rotatory movement observed in it appears to be due, as remarked by Professor Allman, in part to the action of cilia with which the surface of the endoderm, more especially of that lining the tentacular sheath, is furnished, and in part to the varying contractions of the walls in the different and continual movements of the animal.

The chief bulk of the solid contents of the "cell" is formed by the alimentary canal and its appendages. Commencing at the base of the lophophore, this canal descends towards the lower part of the perivisceral space, and then turning abruptly upwards, ascends to reach the upper part of the tentacular sheath, which it perforates nearly on a level with the mouth. The alimentary tract admits of division in the usual way into an œsophagus, stomach, and intestine; to which, in some cases, may be superadded, a dilatable pharynx and a proventriculus or gizzard, furnished with a masticatory apparatus. The œsophagus is contracted and muscular; the stomach, which principally forms the lower part of the loop, is much dilated, and in many cases partially divided into cardiac and pyloric portions; the intestine, which proceeds directly from the stomach to the anus, is at first wide, but ultimately becomes much contracted. The whole tract appears to be lined with vibratile cilia, and on the external surface of the stomach are placed numerous brown hepatic granules. The mouth, at which the aliment enters, is placed, as already observed, within a circle of tentacles, and it may be either a simple orbicular contractile opening, or furnished with a peculiar, apparently protective organ, not unlike the epiglottis in form, and termed by Professor Allman, the epistome.

The nervous system of the Polyzoa is in a very rudimentary condition, being represented only by a small ganglion, usually of a yellowish colour, and placed as in the Ascidians, on the dorsal or rectal aspect of the œsophagus, and thus between the mouth and the anus. From it, in some few cases, fine nervous filaments have been seen to proceed.

The Polyzoa, so far as is known, are all hermaphrodite,[1] each individual being capable of furnishing both the elements required for sexual reproduction. The organs destined for this purpose are of the simplest kind, consisting of an *ovary* and *testis*. The ovary is a rounded, sessile, or shortly pedunculate, granular mass attached to the parietes of the cell, near its summit, in which the ova are developed by a gradual differentiation, and from which, when mature, they escape by dehiscence into the perivisceral chamber. The *testis* is situated at the bottom or lower part of the cell, usually in connexion with a long, cylindrical, granular appendage, passing from the fundus of the stomach to the bottom of the cell, and which has been termed by Professor Huxley, the "funiculus." From this testis the spermatozoa, like the ova, escape into the perivisceral space in vast numbers, and there perform their

[1] With the exception, as it would seem, according to Professor Kölliker, of *Alcyonidium gelatinosum*, Johnst. (*Halodactylus diaphanus*, Farre).

fertilizing function. No special exit appears in most cases to be provided for the escape of the impregnated ova, or of the embryos, which it may be presumed are liberated only after the decease or disruption of the parent.

The above brief exposition will perhaps serve to convey a sufficient general idea of the structure and affinities of the Polyzoa, but as several important modifications of the typical conformation are found in the various sections of this class, it will be necessary, before going farther, to explain the mode in which the primary divisions are formed. In doing this, I shall follow the arrangement proposed by Professor Allman,[1] merely making a few changes in the characters of some of the subdivisions.

Most of the terms employed for the purpose of this classification have already been explained; all that is necessary to add is, that by "front" of the cell is meant that aspect upon which the orifice is situated, whilst the "upper or superior" end is that nearest which it is placed.

[1] Op. cit., p. 10.

SYNOPSIS OF PRIMARY DIVISIONS OF THE POLYZOA.

I. Lophophore bilateral, mouth with an epistome.

Order I. PHYLACTOLÆMATA, *Allm.*

(*a*) Arms of lophophore, free or obsolete. Consistence horny, subcalcareous.

Sub-Order I. LOPHOPEA (freshwater).

(*b*) Arms of lophophore united at the extremities. Consistence soft, fleshy.

Sub-Order II. PEDICELLINEA (marine).

II. Lophophore orbicular, or nearly so; no epistome.

Order II. GYMNOLÆMATA, *Allm.*

(*a*) Polypide completely retractile; evagination of tentacular sheath imperfect. Consistence horny or subcalcareous.

Sub-Order III. PALUDICELLEA (fresh-water).

(*b*) Polypide completely retractile; evagination perfect; orifice of cell sub-terminal, of less diameter than the cell, and usually closed with a moveable lip or shutter; sometimes by a contractile sphincter; cells not tubular. Consistence calcareous, corneous, or fleshy.

Sub-Order IV. CHEILOSTOMATA, *Busk* (marine).

(*b*) Cell tubular; orifice terminal, of same diameter as the cell, without any moveable apparatus for its closure. Consistence calcareous.

Sub-Order V. CYCLOSTOMATA, *Busk* (marine).

(*c*) Orifice of cell terminal, furnished with a usually setose fringe for its closure; cells distinct, arising from a common tube. Consistence horny or carnose.

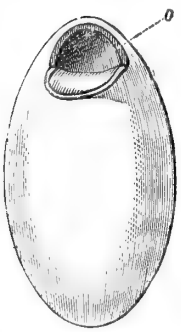
Sub-Order VI. CTENOSTOMATA, *Busk* (marine).

Of these Orders and Sub-orders, we may at once, in a palæontological point of view, dismiss from consideration all but the *Cheilostomata* and *Cyclostomata,* to which alone, so far as is at present certainly known, do any fossil remains belong. The reason of this has already been explained, or will be obvious upon a glance at the characters of the orders in the foregoing synopsis.

OF THE CHEILOSTOMATA.

The members of this sub-order may perhaps be regarded as the most highly organized of the Polyzoa, inasmuch as in addition to the common attributes of the class, they are provided with certain organs not found in their allies. The points in which they differ from the Cyclostomata are—1, in the form of the cell, which is never a simple, open, cylindrical tube of pretty nearly uniform diameter throughout, but is either urceolate, turbinate, or of an elliptical or oblong figure, or, as in *Ætea,* tubular, expanded, and closed at the extremity; 2, in the position of the orifice, which is never strictly terminal, but always either parallel or oblique to the axis of the cell, and sometimes placed near the centre of the front; 3, by the circumstance that the orifice is fitted with a special apparatus for its closure when the animal is retracted. In the greater number of cases this purpose is effected by means of a membranous or horny, semicircular lip or shutter, the two angles of which are articulated to the sides of the orifice, and which is moved by special muscles (fig. 2). Although from its extensive prevalence the sub-order has derived its name from the presence of this organ, it does not exist universally, the closure of the orifice in some cases, as in *Bugula,* being effected, as it would seem, by a sort of muscular sphincter instead.

Fig. 2.



o. Orifice.

The consistence of the cell-walls in the Cheilostomata varies from a soft fleshy, or a horny texture, to one either wholly or partially calcareous. But in many of the instances in which it is usually regarded as altogether corneous, or in which, at any rate, a considerable degree of flexibility is retained, incineration will show that a sufficient amount of calcareous matter is present to maintain the form of the cell, though of course in a most fragile condition, as is the case, for instance, in many *Flustræ,* &c.

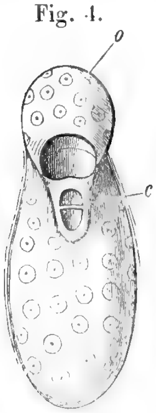
In a great many, moreover, of the more highly calcified Cheilostomata, the walls of the cell remain to some extent membranous. In these cases, when the animal matter is removed, a greater or less space in or the whole of the anterior surface will appear open. This space (fig. 3 *b*) in the recent condition is filled up by a thin membrane, in which, in some instances, the orifice with its moveable lid, or surrounded with its sphincter, is placed. In many species also, belonging to the encrusting forms the posterior wall of the cell is apparently altogether deficient, the cavity being bounded behind by the surface of the shell, &c., upon which the cell is affixed; although it cannot be doubted that a membranous pellicle must intervene between this surface and the perivisceral space of the Polyzoon.

Fig. 3.

a. Margin.
b. Aperture.
c. Lamina.
d. Orifice.

The surface of the cell varies infinitely in appearance; it may be either smooth and entire, spinous or granulous; perforated with minute pores, or cribriform with larger openings; reticulate or ribbed, &c., all of which conditions, with certain precautions, afford excellent diagnostic characters. The margin of the orifice, sometimes termed the "*peristome*," may be simple or thickened, unarmed or beset with erect "marginal spines," which again may be either rigid or articulated at the base, simple or branched.

Fig. 4.



o. Ovicell.
c. Avicularium.

The Cheilostomata, moreover, as a class are especially distinguished by the position and form of an organ termed the "ovicell," and by the possession of certain external agents of offence and defence, termed "avicularia" and "vibracula."

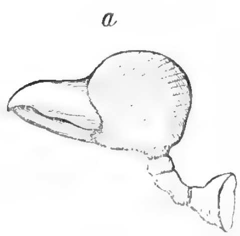
The ovicell is not found in every species, and when present is in some cases so deeply immersed as to be inconspicuous. In a great many species, however, it is apparent in the form of a more or less rounded eminence situated above or behind the cell, as shown in fig. 4. The cavity of the organ is continuous with the perivisceral space, through a passage situated at the upper and back part of the cell, and through which it would appear the ova are conveyed as into a sort of marsupial pouch. This organ is wanting in the Cyclostomata, in which its functions are apparently supplied by a dilatation of the body of the cell itself.

Fig. 5.

Sessile avicularium.

The other class of organs above referred to is also peculiar to the Cheilostomata, though wanting in many of them. For a detailed account of these interesting appendages the reader may refer to some "Observations" respecting them contained in the British Museum Catalogue of Marine Polyzoa, or to a paper on the subject in the 'Transactions of the Microscopical Society.'[1] It will be sufficient here to remark that the avicularia are so termed from the strong resemblance the earliest and best known form of them presents to a bird's head (fig. 6). They may be subdivided, for the purpose of systematic description, into three sorts—the sessile (fig. 5), the immersed (fig. 4 *c*), and the pedunculate (fig. 6). But whatever its diversity of form, an avicularium always consists of two parts, viz., a moveable mandible, and a cup furnished with a horny beak, with which the point of the mandible is capable of being brought into opposition. The cup contains muscles properly arranged for the elevation and depression of the mandible, and other parts which need not here be particularised.

Fig. 6.



Pedunculate avicularium.

The vibracula are organs very similarly constructed, but having, instead of a mandible, an elongated seta, capable of extensive movement principally in one plane.

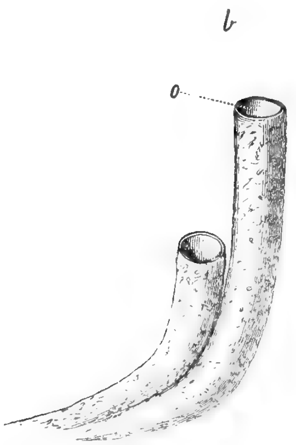
[1] 'Quart. Journ. Microscopical Science,' vol. ii ('Transactions,' p. 26), 1854.

Both these organs, where they exist, are of very great use in the distinction of genera and species; the distinctions being drawn from the differences in position, form, and size, &c., of the organs in question. They are as useful, or nearly so, in this respect in the case of fossil remains as they are in that of recent species, for, although the moveable parts are of course deficient in the former, the remains of the cup are always perceptible in the form of openings and processes of various kinds and in various positions.

The true nature of these openings, &c., not having been understood, they have hitherto been erroneously interpreted or left wholly unnoticed, but in the following pages will be found to have been copiously employed.

In the Cyclostomata the conformation of the cell is simpler. It consists, as above remarked, of a rigid, cylindrical, calcareous tube, whose orifice is terminal and in most cases of about the same diameter as the tube. The *peristome* is usually simple; sometimes, however, slightly expanded, thickened, emarginate, or even denticulate. The orifice is never furnished with any special apparatus for its closure. The surface of the cells is either smooth and entire, or finely dotted and porous (fig. 7).

Fig. 7.



In both these sub-orders, as, in fact, in all the rest except the Ctenostomata, the cells arise immediately from one another, either in close contiguity or with the intervention of tubular processes; and the infinite diversity of form exhibited in the polyzoaries is mainly due to the direction in which the gemmation takes place, and which differs in almost every species. For instance, if each cell pullulate at a single point at the upper and back part, a polyzoary consisting of a linear series of cells, such as that of *Ætea*, or of *Hippothoa*, or *Crisidia* will be presented; whilst if from each cell two are given off and remain in close apposition, a circularly expanded disc of greater or less regularity will be produced, as in *Lepralia*, *Patinella*, &c., and so on,[1] as was long ago pointed out by M. M. Edwards.

Having thus endeavoured to indicate the general relations, and so much of the nature of the Polyzoa as a class, and more particularly of the Cheilostomatous and Cyclostomatous Sub-Orders, as will render the descriptive terms employed intelligible, I will proceed to the proper subject of the memoir, viz., an account of the fossil species found in the Crag, commencing with the Cheilostomata, of which the families or genera may be conveniently arranged as in the following synopsis:

[1] 'Eng. Cyclop.,' art. Polyzoa, p. 5.

SYNOPTICAL CLASSIFICATION of the CHEILOSTOMATA.

Class **POLYZOA.**

Order II. GYMNOLÆMATA.

Sub-Order I. CHEILOSTOMATA.

§ I. ARTICULATA. Polyzoarium divided into distinct internodes by flexible joints.

§§ 1. Unicellulares. Internodes formed of a single cell.

Fam. 1. *CATENICELLIDÆ,* Busk, Brit. M. Cat., part i, p. 3.

* Cell at each division of the branches geminate.

1. Catenicella.

** Cell at each division single.

2. Alysidium.
3. Chlidonia.

*** Cells bi-trilocular.

4. Calpidium.

**** Cells forming the stem and primary branches slender and tubular, without a mouth.

5. Eucratea.

§§ 2. Multicellulares. Internodes multicellular.

A. Cells disposed in the same plane.

Fam. 2. *CELLULARIIDÆ.*

(*a*) *Inarmatæ.* Neither avicularia nor vibracula.

6. Cellularia.

(*b*) *Armatæ.* With avicularia or vibracula, or with both.

α. With avicularia and vibracula.

7. Scrupocellaria.

β. With avicularia only.

8. Menipea.
9. Emma.

γ. With vibracula only.

10. Canda.

B. Cells disposed round an imaginary axis.

Fam. 3. *SALICORNARIIDÆ.*

* Surface areolated; front of cell depressed, closed.

11. Salicornaria.

** Cells with a raised border; front of cell partially open.

12. Nellia.

*** Cells ventricose; peristome not produced.

13. Onchopora.

**** Cells ventricose; peristome produced into a tube.

14. Tubucellaria.

§ II. INARTICULATÆ. Polyzoarium continuous throughout.

§§ 1. Flexiles. Texture more or less flexible. Polyzoarium erect, sub-erect, or decumbent and repent, never adnate.

A. Uniseriales. Cells disposed singly in linear series.

Fam. 4. *SCRUPARIIDÆ.*

* Cell closed.

15. Scruparia.

** Cell open in front.

α. Repent.

16. Beania, Johnst.

β. Erect.

17. Brettia, Dyster.

B. Multiseriales. Cells disposed quincuncially in contiguous series.

1. *Planæ.* Cells disposed in the same plane.

(*a*) *Ligulatæ.* Branches or divisions narrow, ligulate.

α. With dorsal vibracula or sessile avicularia.

Fam. 5. *CABEREIDÆ.*

* With dorsal vibracula.

18. Caberea.

** With dorsal avicularia.

19. AMASTIGIA.

β. Avicularia, when present pedunculate; no vibracula.

Fam. 6. *BICELLARIIDÆ.*

* Cells turbinate, distant; oral and other spines.

20. BICELLARIA.

** Cells contiguous; unarmed.

21. HALOPHILA.

*** Cells elliptical, contiguous; with pedunculate avicularia.

22. BUGULA.

(b) *Foliaceæ.* Polyzoarium foliaceous, expanded, entire or lobed.

Fam. 7. *FLUSTRIDÆ.*

a. Cells contiguous.

* In two layers.

23. FLUSTRA.

** Cells in a single layer.

24. CARBASEA.

β. Cells discrete.

25. DIACHORIS.

2. *Cylindricæ.* Cells disposed around an imaginary axis.

Fam. 8. *FARCIMINARIIDÆ.* Corneous; a large aperture.

26. FARCIMINARIA.

3. *Geminatæ.* Cells in pairs.

Fam. 9. *GEMELLARIIDÆ.*

(a) *Armatæ.* Furnished with avicularia.

27. NOTAMIA.

(b) *Inarmatæ.*

* Cells back to back in the same plane.

28. GEMELLARIA.

** Cells back to back, the alternate pairs at right angles.

† Each pair arising from that immediately below.

29. DIMETOPIA.

†† Each pair arising from the next but one below.

30. CALWELLIA.

*** Cells side by side.

31. DIDYMIA.

§§ 2. RIGIDÆ. Texture calcareous, rigid. Polyzoa immoveably fixed or wholly unattached; adnate and crustaceous, erect or massive.

A. ADNATÆ. Polyzoarium wholly adnate. Cells serial, series contiguous or distant

(*a*) Series distant, repent.

Fam. 11. *HIPPOTHOIDÆ.*

* Cells urceolate, decumbent.

† Branches given off from the sides of a cell.

32. HIPPOTHOA.

†† Branches springing from the summit of a cell.

33. ALYSIDOTA.

** Cells tubular, erect.

34. ÆTEA.

(*b*) Series contiguous; polyzoarium crustaceous, spreading.

Fam. 12. *MEMBRANIPORIDÆ.*

† Cells depressed, or open in front, with a raised margin.

35. MEMBRANIPORA.

** Cells urceolate, closed in front.

36. LEPRALIA.

B. ERECTÆ. Polyzoarium erect, or massive; cells decumbent and serial; or sub-erect and confused.

(*a*) Cells sub-erect and confusedly heaped.

Fam. 13. *CELLEPORIDÆ.*

37. CELLEPORA.

(*b*) Cells decumbent serial, in one plane.

a. *Affixæ*. Immoveably fixed by a calcareous base.

Fam. 14. *ESCHARIDÆ.*

(*a*) Cells in a single plane.

* Two layers of cells.

† Series longitudinal.

38. ESCHARA.

†† Series transverse.

39. MELICERITA.

** A single layer of cells.

† Polyzoarium reticulate.

40. RETEPORA.

†† Polyzoarium entire.

41. HEMESCHARA.

β. *Liberæ*. Polyzoarium unattached, usually discoid, conical or irregular.

Fam. 15. *SELENARIIDÆ*.

* Vibracula inter-serial.

42. LUNULITES.

** Vibracula intra-serial.

43. CUPULARIA.

*** Vibracula scattered.

44. SELENARIA.

(*c*) Cells disposed around an imaginary axis.

Fam. 16. *VINCULARIIDÆ*.

45. VINCULARIA.

Or in a tabular form, as follows, in which those families, genera, &c., in which fossil species occur, are printed in italics :—

TABULAR VIEW of CHEILOSTOMATA.

CHEILOSTOMATA

Articulata		Unicellulares		Catenicellidæ	Catenicella Alysidium Chlidonia Calpidium Eucratea
		Multicellulares		*Cellulariidæ*	Cellularia *Scrupocellaria* Emma Canda
				Salicornariidæ	*Salicornaria* Nellia Onchopora Tubucellaria
Inarticulata	Flexiles	Uniseriales		Scrupariidæ	Scruparia Beania Brettia
		Multiseriales?	Ligulatæ	Cabereidæ	Caberea Amastigia
				Bicellariidæ	Bicellaria Halophila Bugula
			Foliaceæ	*Flustridæ*	*Flustra ?* Carbasea Diachoris
			Cylindricæ	Farciminariidæ	Farciminaria
			Geminatæ	Gemellariidæ	Notamia Didymia Dimetopia Calwellia Gemellaria
	Rigidæ	*Adnatæ*	*Repentes*	*Hippothoidæ*	*Hippothoa* *Alysidota* Ætea
			Crustaceæ	*Membraniporidæ*	*Membranipora* *Lepralia* Flustrellaria
		Affixæ	*Massivæ*	*Celleporidæ*	*Cellepora*
			Planæ	*Escharidæ*	*Eschara* *Melicerita* *Hemeschara* *Retepora* *Lanceopora*
			Cylindricæ	*Vinculariidæ*	*Vincularia* *Millepora*
		Liberæ	. . . . .	*Selenariidæ*	*Lunulites* *Cupularia* Selenaria *Flabellopora ?*

§ I. ARTICULATA.

§§ 2. MULTICELLULARES.

Fam. I. *CELLULARIIDÆ, Busk.*

Genus 1. SCRUPOCELLARIA, *Van Beneden.*

Cellulis rhomboidalibus, posticè sinuatis; angulo cellulæ superiore aviculario sessili, armato; vibraculo in sinu dorsali posito; aperturâ spinis marginalibus supra armatâ, operculo pedunculato subinde tectâ. Cellulis biserialibus, in singulo internodio numerosis.

Cells rhomboidal, with a sinus behind; a sessile avicularium on the upper and outer angle; a vibraculum seated in the dorsal sinus; aperture, with marginal spines above; sometimes protected by a pedunculate operculum. Cells biserial, numerous in each internode.

SCRUPOCELLARIA, *Van Beneden*, Recherches, &c., p. 42; *Busk.*
BICELLARIA (sp.), *Blainville.*
CELLULARIA (sp.), *Pallas; Fleming; Johnst.*
CELLARIA (pars), *Solander* and *Ellis.*
SCRUPARIA (sp.), *Oken.*
BACTRIDIUM, *Reuss.*, Foss. Polyp., d. Wien. Tertiärbeck, p. 55.

1. S. SCRUPOSA (?) *Lin.* Pl. I, fig. 6.

Cellulis subelongatis, angustis; aperturâ ellipticâ, 3—4 spinis marginalibus supra armatâ; ovicellulâ glabrâ.

Cells subelongate, narrow; aperture elliptical, with three or four marginal spines above; ovicell smooth.

SERT. SCRUPOSA, *Linn.*
CELLULARIA SCRUPOSA, *Pallas, Johnston.*
SCRUPOCELLARIA SCRUPOSA, *V. Beneden*, l. c., pp. 43 and 50, pl. v, figs. 8—16. *Busk*, Ann. Nat. Hist., 2 ser., vii, p. 85, pl. ix, figs. 8, 10. Brit. M. Cat., part i, p. 25, pl. xxii, figs. 3, 4.

Habitat.—C. Crag, *S. W.* (*Recent*); Britain, ubique.

A single, small, and very imperfect fragment of a Scrupocellaria occurs in Mr. S. Wood's collection, whose condition renders it almost impossible to be certain of more than the generic character. The aspect of the specimen, however, when compared with that of broken fragments of *S. scruposa,* is sufficient to justify its provisional reference to that species, which it resembles perhaps more closely than it does either of the four species of *Bactridium,* noticed by Reuss, in the Vienna Tertiary Basin.

Fam. II. *SALICORNARIIDÆ, Busk.*

Cells disposed quincuncially around an imaginary axis; forming the cylindrical internodes of a dichotomously divided, erect, phytoid polyzoarium.

Genus 1. Salicornaria, *Cuvier.*

Polyzoarii superficie in areis angulatis divisâ; avicularii immersis, irregulariter inter cellulas sparsis. Ovicellulis occultis, poro areæ summitate posito.

Surface of polyzoarium subdivided by ridges into more or less uniform, angular *areæ;* immersed avicularia dispersed irregularly among the cells. Ovicells concealed, opening at the summit of the area.

Salicornaria, *Cuvier,* R. An., 1817; *Johnston; Busk;* Auct.
Salicornia, *Schweigger.*
Cellularia (pars), *Pallas; Bruguière; Ellis* and *Solander.*
Cellaria (pars), *Lamouroux; Lamarck; Blainville; Bosc; Reuss.*
— *Hagenow; D'Orbigny* (including *Cellarina*); *S. Wood; J. Morris.*
Vincularia, *Bronn.*
— (pars), *Defrance* et Auct.
Glauconoma (pars), *Goldfuss.*
Eschara (sp.), *Linn.; D'Orbigny.*
Escharinella (sp.), *D'Orbigny.*
Farcimia, *Fleming; Couch.*
Tubularia (sp.), *Linn.; Olivi.*
Isis (sp.), *Fabricius.*
Flustra (sp.), *Linn.*

The distinction between *Vincularia,* Defrance, and *Salicornaria,* is sufficiently marked by the character that in the latter genus the polyzoarium is subdivided into distinct internodes, whilst in the former the branches are continuous, as in a branching *Eschara* or *Cellepore*. The junction between the separate joints or internodes in all recent Salicornariidæ is effected by means of flexible, chitinous tubes, and it is extremely rare to meet with an instance of rigid anchylosis between them. In one recent species, however, (*Sal. malvinensis*, nob.), the two internodes may occasionally be seen thus united, whilst the rest of the growth retains the flexible condition. This observation is of particular interest with regard to the fossil Salicornariæ of the Crag, in which a rigid connexion appears to be far more frequent, although, notwithstanding this frequency, little doubt can be entertained that it is what may be termed accidental or exceptional, as in *Sal. malvinensis*. It will be observed that even where anchylosis has taken place, the apparent branch is contracted at the point of junction, which is not the case in the true *Vinculariæ*, of which one well-marked recent species at any rate exists. It follows from this, therefore, that fragments of a fossil *Salicornaria* may, in most cases, be distinguished, among other characters, by their tapering towards the ends. The peculiar angular areolation of the surface, and the presence of scattered immersed avicularia, are other characters also sufficiently diagnostic of the genus, which we consequently fully agree with Dr. Hagenow in regarding as altogether distinct from *Vincularia*, Defrance, a term which should be restricted to the continuous, cylindrical polyzoaria which seem to have predominated in past periods, whilst the true *Salicornariæ* appear to have been gradually increasing in number of species up to the recent epoch.

With respect to the appropriate appellation of the *genus*, the synonymy above given will show that great confusion has existed.

The *Salicornariidæ*, or species having articulated polyzoaries composed of cylindrical internodes, in which the cells are disposed around an imaginary axis, were originally confounded by Pallas under his genus *Cellularia*, and by Solander under that of *Cellaria*, with many others not possessing that peculiar characteristic. The term *Cellaria*, it is true, was afterwards restricted by Lamouroux to those species which had cylindrical branches, or rather in which the cells were disposed around a central axis; but as this definition would also include *Vincularia* and our genus *Onchopora* ('Quart. Journ. Mic. Soc.,' iii, p. 320, 1855), it would not be equivalent to *Salicornaria*, as here understood. And as it might also be readily confounded with the more extensive *Cellaria* of Dr. Solander and most authors except Blainville, it seems hardly advisable that it should be readopted in again an altered sense. Among the other appellations already in use, none appears more suitable or less liable to be misunderstood than that of *Salicornaria* Cuv., which has moreover the advantage of having already been very generally adopted.

It is necessary to explain a few of the terms employed in the description of the *Salicornariidæ*, which appear to be demanded by some peculiarities belonging to them.

1. The angular spaces into which the surface of the internodes is divided, and each of which corresponds to the outline of a cell, are termed the *areæ*.

2. The orifice perceptible in many of the cells at the summit of the "area," and

which represents the opening of a concealed ovicell, is termed the *ovarian orifice* or *pore.*

3. The secondary openings, often of considerable size, observable at the apex of many of the cells, having been shown by observation of recent forms to belong to avicularia, are termed accordingly *avicularian openings.*

1. Salicornaria crassa, *S. Wood* (sp.) Pl. XXI, figs. 4, 6.

Internodiis crassis, clavatis, subcompressis; cellulæ orificio infrâ denticulo valido acuto, interno utrinque munito. Ovicellulæ orificio dente conico unico infra armato; cellulæ facie anteriori lineâ elevatâ utrinque signatâ.

Internodes thick, clavate, sometimes compressed; a large tooth on each side of the orifice within the lower border; a single conical tooth on the lower border of the ovarian pore; a narrow raised line on the front of the cell on either side of the mouth, meeting below.

Cellaria crassa, *S. Wood,* Ann. Nat. Hist., xiii, p. 17; Morris's Catal., p. 120.

Habitat.—Cor. Crag, *S. W.*

This species appears to exhibit a very great tendency to ossification of the junctions between the internodes; so much so, in fact, that most of the specimens present a bifurcate aspect at one end. The avicularian areæ are quadrangular, with a circular aperture, whence it is probable that the mandible was rounded or obtuse, as in *Sal. farciminoides.* The surface of the cells and of the ridges, so far as can be judged of in a fossil, are smooth or very finely granular; and the front of the cell within the area is very peculiarly marked by the presence of two slender, straight, raised lines or ridges, which, commencing at the sides of the area, about on a level with the upper border of the mouth, descend on either side and meet towards the lower part of the cell. These lines are shown, but not very distinctly, at *d,* fig. 4, and *c,* fig. 6. Rounded raised lines, much in the same situation, are occasionally to be seen in *Sal. farciminoides,* but these do not appear to meet below, and are far less constant in that species than the lines in question are in *S. crassa.* The single conical tooth in front of the ovarian opening is also characteristic of *S. crassa.* In *S. farciminoides* this opening is unarmed, and at first narrow and elongated longitudinally, whilst in *S. crassa,* at its earliest appearance, it is round and afterwards elongated transversely with the tooth in question on its lower margin. The proper form of the tooth is seen in the lowermost cell in *b,* fig. 4; in *d,* fig. 6, it is represented bifid, but this is an accidental appearance, and probably due to injury.

2. S. SINUOSA, *Hassall.* Pl. XXI, fig. 5.

Internodiis cylindricis, equalibus vel superne subinde incrassatis. . Areâ elongatâ rhomboidali, hexagonâ, vel pyriformi; superficie delicate granuloso. Orificio subquadrangulari, margine inferiori valde elevato; ovicellulæ orificio transverse elongato, dente bicuspidato lato infra armato. Avicularii mandibulo, triangulari, acuto.

Internodes cylindrical, uniform, or slightly incrassated above. Area elongated, rhomboidal, hexagonal, oblong or pyriform; surface finely granular. Orifice subquadrangular, with a much-raised lower lip; ovarian orifice elongated transversely, with a broad bicuspid tooth on the lower margin. Mandible of avicularium triangular pointed.

FARCIMIA SINUOSA, ***Hassall***, Ann. Mag. N. H., vi, p. 172, pl. vi, figs. 1, 2; *Johnston; Macgillivray.*
FARCIMIA SPATHULOSA, ***Hassall.***
SALICORNARIA FARCIMINOIDES (var.), ***Busk***, B. M. Cat., p. 16; *S. Wood; J. Morris.*

Though at one time I entertained the opinion that *Sal. farciminoides* and *Sal. sinuosa* were one and the same species, I have long been convinced that they are specifically distinct. The distinction does not, however, arise so much from the prevailing form of the areæ in either, seeing that no fixed characters could be thence derived, but chiefly from the following particulars: 1. In *S. farciminoides* the mandible of the avicularium is semicircular, small, blunt, and looks upwards, whilst in *S. sinuosa* it is triangular, acutely pointed, and directed either straight or obliquely downwards. 2. The ovarian orifice in *S. farciminoides* is simple, and either round or elongated in a longitudinal direction, and in *S. sinuosa* narrow, slit-like and transverse, the lower border being formed by a wide bicuspid tooth. 3. In *S. farciminoides* the front of the cell often presents on each side within the area an elongated elevation or ridge, which is never perceptible in *S. sinuosa.* As to the identity of the fossil and recent forms, a close comparison of numerous specimens of both leaves no doubt whatever on my mind. The only difference between the two, of the least moment, is the frequency or rather the occasional occurrence in the former of anchylosis between the internodes, which has never offered itself to my observation in the latter. Scarcely any remark is required to point out the distinction of this species from its fossil congener, whose more robust and often compressed form, shortness and venation of the areæ, simple tooth at the ovarian pore, &c., allow of no hesitation on the subject.

§ II. INARTICULATA.

§§ 2. RIGIDÆ.

§§§ 1. Adnatæ.

A. Repentes.

Fam. III. *HIPPOTHOIDÆ, Busk.*

Cellularum seriebus distantibus, repentibus.
Series of cells distant, repent.

Scrupariadæ (pars), *Gray; Busk.*
Eucratiadæ (pars), *Johnst.*

Genus 1. Hippothoa, *Lamx.*

Cellulis urceolatis seu pyriformibus, decumbentibus. Ramis a lateribus cellulæ datis.
Cells urceolate or pyriform, decumbent; branches given off from the sides of a cell.

Hippothoa, *Lamx.*, Exp. Meth., p. 82, 1821; *Johnst.; Busk.*
Catenicella (pars), *Blainville* (non *M. Edwards*).
Terebripora, *D'Orbigny.*
Alecto (sp.), criserpia (sp.), *Michelin.*
Catenaria (sp.), *S. Wood.*

1. H. patagonica, *B.* Pl. I, fig. 5.

Cellulis pyriformibus, infra attenuatis, irregulariter annulatis; orificio orbiculari, subtus inciso; ramis angulo prope recto divaricatis.

Cells pyriform, attenuated below, irregularly annulate; orifice orbicular, with a notch below; branches divaricate nearly at a right angle.

H. PATAGONICA, *Busk*, B. M. Cat., p. i, p. 30, pl. xvii, fig. 1.
ALECTO VESICULOSA (?), *Michelin*, Icon. Zooph., p. 319, pl. lxxvii, fig. 3.

Habitat.—C. Crag, on *Pecten*, *S. W.*; *Hippurite limestone*, St. Gregoire, near Rennes, *Michelin*. (*Recent*), Coast of Patagonia, Falkland Islands, on fucus, *Darwin;* Britain (?); Tasmania.

The Crag fossil corresponds in all respects with the Patagonian form. The circumstance that the latter would appear always to select a fucus for its base is probably in this genus one of little importance. A species bearing considerable resemblance to the present occurs in the Arctic sea, but is distinguishable by its mouth being larger and without the notch at the lower margin. The cells, moreover, and their tubular prolongation, are less distinctly annulated.

2. H. ABSTERSA, *S. W.* Pl. XXII, fig. 6.

Cellulis ovatis, elongatis, vel subpyriformibus, infra subattenuatis, seu potius productis; superficie glabro, compressis; orificio suborbiculari subtus inciso; ramis ascendentibus, confertis.

Cells ovate, elongate, or subpyriform, very slightly attenuated or produced below, smooth, compressed, or slightly raised in front; orifice suborbicular, with a notch below; branches ascending crowded.

L. ABSTERSA, *S. W.*, Ann. Nat. Hist., xiii, p. 19.
CRISERPIA PYRIFORMIS (?), *Mich.*, Iconog. Zooph., p. 332, pl. lxxix, fig. 6.

Habitat.—Coralline Crag, Walton, on inside of Pholas, *S. W.;* (?) Douè (Maine et Loire), *Mich.*; Red Crag, Sutton, on *Pectunculus glycimeris*.

3. H. DENTATA, *S. W.* Pl. I, fig. 7.

Cellulis angustis, ovatis, lanceolatis, seu pyriformibus; aperturâ ovali, margine spinoso; ramis angulo prope recto divergentibus.

Cells slender, ovate, lanceolate, or pyriform; aperture oval, margin spinous; branches divaricated nearly at a right angle.

CATENARIA DENTATA, *S. W.*, l. c., p. 19.

Habitat.—C. Crag, on shell, *S. W.*

The peculiar armature of the aperture in this species distinguishes it from *H. catenularia*, with which in some conditions it might otherwise readily be confounded.

Genus 2. ALYSIDOTA, *Busk.*

Cellulis urceolatis, uniserialibus; ramis cellulæ summitate surgentibus.
Cells urceolate, uniserial; branches springing from the summit of a cell.

ALYSIDOTA, *Busk*, Quart. Jour. Mic. Sc., iv, p. 311.

In the British Museum Catalogue of Marine Polyzoa, p. 82, pl. xcii, figs. 1, 2, a species of *Lepralia* is described and figured under the name of *C. labrosa,* in which the series of cells are not contiguous as in a true *Lepralia,* but divergent, branching out irregularly from a common point, around which the cells are sometimes crowded together without any definite order. Standing alone as it then appeared to do, this species was regarded as an aberrant *Lepralia,* a genus to which the present is undoubtedly very closely allied. But when a second well-marked form of the same kind was noticed by Mr. Alder, it seemed advisable that similar growths should be associated into a distinct generic group. The latter species, of which numerous specimens have since been collected by Mr. Barlee in the Orkneys, will be found described in the 'Quart. Journ. Micros. Sc.,' p. 311, and figured in pl. ix (Zoophytology), figs. 6, 7.

The genus stands between *Hippothoa* and *Lepralia,* though perhaps more closely allied to the latter than to the former, from which it is distinguished by the circumstance that the cells arise from each other by a broad base, or are, as it were, immediately contiguous without the intervention of a tubular prolongation, and that the branches divide for the most part dichotomously or irregularly, while in *Hippothoa,* owing to their always springing in opposite pairs from the sides of a cell, from which a third series is also continued in the original direction, the ramification may be termed trichotomous.

1. A. LABROSA, *B.* Pl. XXII, fig. 7.

Cellulis ovatis puncturatis; orificio orbiculari, peristomate valde elevato, incrassato, expanso, supra sæpius emarginato; ovicellulâ globosâ, glabrâ, recumbente.

Cells ovate punctured; orifice orbicular, with a much-raised, thick, expanded peristome, which is often deficient above or behind; ovicell globose, smooth, recumbent.

LEP. LABROSA, *B.*, B. M. Cat., p. ii, p. 82, pl. xcii, figs. 1, 2.

Habitat.—Red Crag, on inside of a shell, *S. W.* (*Recent*); Belfast Bay, in deep water, on the inside of a dead shell, *W. Thompson.*

2. A. CATENA, *S. W.* (sp.) Pl. VII, fig. 7.

Cellulis ovatis, quadri costatis, costâ infimâ mediâ impari; sulcis longitudinaliter striatulis seu obscurè punctatis; orificio suborbiculari; spinis tribus marginalibus.

Cells ovate, with four costæ on each side and a single median one below; sulci longitudinally striate, or obscurely punctate; orifice suborbicular; three marginal spines.

L. CATENA, *S. W.*, l. c., p.

Habitat.—Cor. Crag, Sutton, *S. W.*, on the inside of a small bivalve.

This species appears to possess, in a remarkable degree, the power of excavating or eroding the surface of the shell upon which it grows, a property common to several other *Lepraliæ*, though the means by which it is exerted is very obscure.

B. CRUSTACEÆ.

Fam. IV. *MEMBRANIPORIDÆ.*

Polyzoario membranaceo-calcareo seu calcareo, incrustante, adnato, cellulis horizontalibus, quincuncialibus seu oppositis, contiguis composito.

Character.—Polyzoarium membranaceo-calcareous or calcareous, adnate, encrusting; cells horizontal, quincuncial, or opposite, series contiguous.

FLUSTRA (pars), *Linn.*
FLUSTRADÆ (pars), *Gray*, Cat. B. M., 145.
CELLEPORIDÆ (pars), *Johnston*, Brit. Zoophyt., 2d ed., p. 263.
MEMBRANIPORIDÆ, *Busk*, B. M. Cat., p. ii, p. 56.

SYNOPSIS OF GENERA.

(*a*) Cells more or less open or membranaceous in front, with raised margins; growth indefinite.

1. MEMBRANIPORA.

(*b*) Cells closed in front; contiguous; growth usually circumscribed.

2. LEPRALIA.

Genus 1. Membranipora.

Polyzoario diffuso; cellulis anticè depressis, sæpius plus, minusve membranaceis sive apertis, margine elevato circumdatis.

Polyzoarium encrusting, spreading irregularly. Cells more or less irregularly disposed or quincuncial; margins raised; front depressed, often more or less membranaceous or open in front.

Eschara (pars), *Pallas.*
Flustra (pars), *Linn.; Muller; Esper; Lamarck; Grant; Fleming; Risso; Johnst.*, Transact. Newc. Soc.; *Lamouroux*, Hist. d. Polypes, p. 96.
Membranipora, *Blainville*, Man. d'Actinol., p. 447; *Johnston; Busk*, B. M. Cat., p. ii, p. 56; *W. Thompson; Hassall; Reuss* (1851, not 1847).
Cellepora (pars), *Hagenow; Reuss; D'Orbigny.*
Discopora (pars), *Lamarck*, An. S. V., ii, p. 248, 1836.
Annulipora (sp.), *Gray*, Append. B. M. List.
Conopeum (sp.), *Gray*, ib.
Callopora (sp.), *Gray*, ib.
Amphiblestrum (sp.), *Gray*, ib.
Micropora (sp.), *Gray*, ib.
Marginaria (pars), *Ræmer; Hagenow.*
Dermatopora (pars), *Hagenow.*

In the genus *Membranipora*, the polyzoarium is adnate, creeping in an irregular manner over the surface of rocks, shells, or fuci. The cells are contiguous, sometimes disposed in parallel lines or series, sometimes very regularly quincuncial. The peculiar characters of the cell itself consist in its being either much depressed or partially open in front, that is to say, the calcareous wall of the cell is deficient for a greater or less extent, the vacancy or "aperture" being occupied in the recent state by a thin chitinous membrane, in which is placed the true orifice, with its moveable lip. In many cases, however, in advanced age the membrane becomes more or less completely calcified, but in this case the character of the genus is still manifested in the persistent elevated border which surrounds the cell, and constitutes a sort of frame. Some of the species are variously armed with spines, tubercles, and avicularia, whence good specific characters are derivable. Some exhibit very great varieties of aspect, according to their age, the situation in which they have lived, or the greater or less degree to which they may have been exposed to various external influences; and so great is this variety that it is difficult, even in recent or living forms, always to be certain of any given specimen. Numerous species, both recent or fossil, have been described, and their appearance on the globe appears to date from the Cretacean period. But among the fossil forms, belonging more especially to the *Marginaria* of Rœmer, some may perhaps be regarded as representing the much-worn remains either of other species of *Membranipora* or of *Lepralia,* in which only the outline, as it were, of the adherent cells is left.

SYNOPSIS OF SPECIES.

(*a*) Cells more or less open in front; usually no posterior calcareous wall.

α. *Inarmatæ.*

1. M. TUBERCULATA.
2. M. MONOSTACHYS.
3. M. SAVARTII.
4. M. ELEGANS.
5. M. DUBIA.

β. *Armatæ.* (Furnished with avicularia.)

6. M. TRIFOLIUM.
7. M. POUILLETII.
8. M. RYNCHOTA.
9. M. APERTA.

(*b*) Cells closed in front by a calcareous lamina; posterior wall calcareous.

α. *Inarmatæ.*

10. M. OBLONGA.
11. M. BIDENS.
12. M. ANDEGAVENSIS.
13. M. FISSURATA.

β. *Armatæ.*

14. M. OCEANI.
15. M. HOLOSTOMA.

§ 1. Inarmatæ.

1. M. tuberculata (?) *Bosc.* Pl. II, fig. 1.

Cellulis subovalibus seu quadrangularibus; margine sulcato granuloso; aperturâ magnâ oram scabram, subinde denticulatam ostendente; supra utrinque tuberculo obtuso munitâ.

Cells suboval or quadrangular; margin sulcate, granular; aperture large with a rough, sometimes denticulate margin; a blunt tubercle on each side above the aperture.

Flustra tuberculata, *Bosc,* Vers., 2d ed., t. iii, p. 143 (ex. syn.)
Flustra membranacea, *Esper,* Flustra, pl. v.
Flustra crassidentata, *Lamarck,* H. n. d. An. s. V., 2d ed., t. ii, p. 224.
M. membranacea, *S. Wood,* Ann. N. H., xiii; (var.) *Busk,* B. M. Cat.
Mem. tuberculata, *Busk,* Q. I. Mic. Sc. (Zoophytology), vi, p. 126, pl. xviii, fig. 4.

Habitat.—C. Crag, Sutton; and Red Crag, *S. W.*, on *Mactra ovalis* (?) (*Recent*), Atlantic Ocean, Madeira, Rio de Janeiro, on *Sargassum fluitans.*

The resemblance between the present species and the *M. tuberculata,* Bosc (sp.), of which abundant examples may be found on the vesicles of Gulf-weed, is so strong as to induce me to regard them as most probably identical, though some not unimportant differences may be pointed out between them.

The most striking of these is the circumstance that the recent *M. tuberculata* is found almost exclusively upon Gulf-weed, or, at any rate, upon some species of fucus, whilst the fossil encrusts dead shells. In the form and general appearance of the cells, when the animal matter has been removed by incineration in the recent species, the resemblance between the two is very striking, allowing, of course, for the greater sharpness of the recent form; but in one particular, a distinction is apparent even in this respect. In the recent *M. tuberculata* the spines are cylindrical, ascending, and more nearly approximated than they are in the fossil; in fact, so nearly do they occasionally approach each other in the living form as sometimes to coalesce into a single bifid tubercle. In the fossil, on the contrary, the spines, or rather the remaining bases of them, present an elliptical outline, the longer axis being oblique with respect to the longitudinal axis of the cell, and they never show any inclination to a nearer approximation. In the fossil form also the spines are often wholly wanting throughout the greater part of a patch, as is shown in *c*, fig. 1—but in the recent they are invariably present. As the deficiency, however, may perhaps, in great measure be owing to attrition (though of this there is no clear evidence), it cannot be relied upon as a certain diagnostic character.

2. M. MONOSTACHYS, *Busk.* Pl. II, fig. 2.

Polyzoario primum ramoso, deinde conferto; cellulis ovatis seu pyriformibus deorsum attenuatis, in seriebus linearibus dispositis. Aperturâ ovali margine tenui, granulosâ; spinâ submarginali unicâ acuminatâ sub aperturam positâ. Aviculariis subinde inter cellulas sparsis.

Polyzoarium in the young state ramose; cells ovate or pyriform, attenuated downwards, and disposed in linear series. Aperture oval, margin thin, granular, a single acuminate submarginal spine below the aperture; avicularia sometimes scattered amongst the cells.

M. MONOSTACHYS, *Busk*, B. M. Cat., P. ii, p. 61, l. lxx.
M. NUDA, *S. Wood*, MS. label on specimen.
FLUSTRA PUSTULOSA (?), *D'Orbigny*, Terr. Cret., pl. DCCXXV, figs. 22—25.
MEMB. NOBILIS (?), *Reuss*, Fossil Polyp., W., T. Beck, p. 98, pl. xi, fig. 26.

Habitat.—Red Crag, on *Mactra ovalis, Mya arenaria* and *Purpura lapillus* (?) (*Recent*) abundant on the Suffolk coast, in the mouth of the Deben, &c., on shells.

3. M. SAVARTII, *Aud.* Pl. II, fig. 6.

Area quadrangulari oblonga; marginibus incrassatis, granulosis, sulcatis; aperturâ magnâ subellipticâ.

Area of cells quadrangular oblong; ridges thick, granular, deeply sulcate; often a triangular space at each angle of the cell. Aperture large, subelliptical.

FLUSTRA SAVARTII, *Audouin*, Expl. i, p. 240; *Savign.*, Egypt, pl. x, fig. 10.
M. LACROIXII (var), *Busk*, Brit. Mus. Cat., part ii, pl. civ, fig. 1.
FLUSTRA DISTANS ? (pars ?) *Hassall*, Ann. N. H., vii, p. 369.
M. LIGERIENSIS (?), *D'Orbigny*, l. c., pl. DCVII, figs. 5, 6.

Habitat.—Red Crag, on *Solen.*, *S. W.* (*Recent*) Britain (?); Mediterranean.

4. M. DUBIA. Pl. III, fig. 12.

Polyzoario crasso; cellulis elongatis oppositis, discretis; marginibus incrassatis, glabris, supra arcuatis.

Polyzoarium thick; cells elongate, oblong, opposite, separated by elongate spaces; margin rounded, smooth, arched above.

Habitat.—C. Crag, on shell, *S. W.*

Though placed among the *Membraniporæ,* it is extremely doubtful whether the fragment here described be a *Membranipora,* or even a Polyzoon at all. If so, it should perhaps form the type of a new genus or even family.

§ 2. Armatæ.

5. M. trifolium, *S. Wood.* Pl. III, figs. 1, 2, 3, 9.

Polyzoario discoidali, radiato, diffuso; cellulis elongatis, rhomboidalibus seu hexagonis; aviculario unico vel duobus in fronte cellulæ infrâ posito; ovicellulâ aream depressam triangularem ostendente.

Polyzoarium discoidal, radiate, indefinite, cells elongated, rhomboidal or hexagonal; one or two avicularia on the lower part of the cell in front within the area; surface smooth; ovicell with a triangular depression in front.

M. trifolium, *S. Wood,* Ann. Nat. Hist., xiii

Habitat.—C. Crag, on *Terebratula grandis,* and other shells; very abundant. Red Crag (?) *S. W.*

The peculiar trifoliate shape of the aperture at once distinguishes this species from all the other fossil *Membraniporæ* of the Crag, as well as from all living species with which I am acquainted, except, perhaps, *M. Flemingii.*

The avicularia are not always present, and instead of one in the median line on the front of the cell, there may be two, one on either side, arising apparently in the line of division between two cells. The double avicularia are usually found on those parts of the polyzoarium in which the ovicells exist; the latter consequently are commonly, if not always, seen to be crowned, as it were, with two avicularia, one on either side of the summit, as is often the case also in the recent *M. Flemingii.*

The only Red-Crag specimen which appears to belong to this species is too imperfect to allow of its identity being positively determined.

6. M. Pouilletii, *Audouin.* Pl. III, figs. 4, 5, 6.

Cellulis ovatis, deorsum latioribus; lamina 0; margine granuloso, tenui; supra, 1—6 spinis armato. Avicularius sparsis seu subinde aviculariio utroque lateri ovicellulæ posito.

Cells ovate, broader below; no lamina; margin granular, thin; from four to six oral spines above. Avicularia dispersed, sometimes one on each side of the ovicell.

FLUSTRA POUILLETII, *Audouin*, Expl., p. 240; *Savigny*, Egypt, pl. ix, fig. 12.
M. POUILLETII, *Alder*, Transact. Tyneside Nat. Field Club, p. 56, pl. viii, fig. 5.

Habitat.—C. Crag, on shell, *S. W.* (*Recent*) Britain; Mediterranean.

A very small fragment only has been observed, but with the characters so well displayed that little doubt can be entertained of its identity with the recent form.

7. M. RHYNCHOTA (*n. sp.?*) Pl. III, fig. 7.

Polyzoario radiato; superficie glabrâ; aperturâ magnâ, oblongâ, deorsum latiori; margine incrassato, spinâ (articulatâ ?) uno latere armato. Aviculario cylindrico ascendente, in fronte cellulæ posito. Ovicellulâ exiguâ, fossâ triangulari signatâ.

Polyzoarium radiate; surface smooth; aperture large, oblong, wider below, margin thickened; a small marginal spine (probably articulated) on one side, about one third of the length of the cell from above; a prominent, cylindrical, ascending avicularium on the front of the cell below. Ovicell small, with a triangular fossa in front.

M. TRIFOLIUM (? var.) *S. W.*

Habitat.—C. Crag, on shell, often overgrowing species of *Lepralia* or *Membranipora trifolium. S. W.*

The form of the aperture, and the position and presumed articulation of the marginal spine, give this form some resemblance to *M. Flemingii,* in which occasionally a single, very large, articulated spine may be observed on one side only of the aperture (*vide* 'B. M. Cat.', pl. lxxxiv, fig. 3). But in other respects, no relation whatever exists between the two. The long and strong cylindrical avicularium on the front of the cell, and which is very rarely absent, affords an easy diagnostic character to this species. When the ovicell is developed, as it appears in most cases to be, the avicularium of the cell above is elevated, as it were, by the rising ovicell of the cell below, which thus comes to be crowned, and in fact almost concealed, by the avicularium.

8. M. APERTA (*n. sp.*) Pl. III, fig. 13.

Polyzoario effuso, reticulari; cellulis apertis; margine superne elevato, glabro; avicu-lariis magnis, elongatis, lanceolatis, inter cellulas dispositis.

Polyzoarium spreading, reticular; aperture occupying the whole front of the cell; margin projecting above, smooth; large, elongated, lanceolate avicularia interspersed among the cells.

Habitat.—C. Crag, *S. W.*, on *Tereb. grandis*, spreading over *Lepralia punctata.*

9. M. OBLONGA (*n. sp.*) Pl. II, fig. 3.

Polyzoario effuso, irregulari; areis oblongis, rectangularibus; laminâ utrinque punctatâ; septis glabris, longitudinaliter sulcatis; orificio semiobiculari, labro inferiori recto; tuberculo rotundato utrinque supra aperturam. Ovicellulis immersis, inconspicuis.

Polyzoarium spreading irregularly; area of cell oblong, rectangular; lamina punctured at the sides; septa smooth, sulcate; orifice semicircular above, with a straight lower lip; slightly raised; a rounded tubercle on each upper angle; ovicells deeply immersed; inconspicuous.

Habitat.—C. Crag, on *Pecten*, and pebble, *S. Wood.*

10. M. BIDENS, *Hagenow.* Pl. II, fig. 4.

Areis ovalibus, supra arcuatis; infra truncatis; cellulis clausis; superficie anteriori convexâ, glabrâ; orificio terminali, semilunari, labro inferiori dentibus duobus làtis armato, ovicellulis immersis, inconspicuis.

Area oval, arched above, truncate below; front of cell convex, smooth; orifice quite at the summit, crescentic; lower lip with two broad teeth; septa smooth, sulcate, or simple; ovicells immersed, inconspicuous.

CELLEPORA BIDENS, *Hagenow*, Bryoz. Maäs. Kreideb. p. 9, pl. xi, fig. 16.
CELLEPORA HIPPOCREPIS (?), *Reuss*, Foss. Pol., W., T. Beck., p. 95, pl. xi, fig. 14.

Habitat.—C. Crag, on *Pecten* and other shells and pebbles, *S. W.* Chalk formation, Maastricht, *Hagenow*, *Goldfuss.*

Hagenow's figure of *M. bidens* appears to correspond in every respect with that of the Crag fossil, which is, therefore, referred to his species. The form of the cell and of the orifice in *M.* (*C.*) *hippocrepis*, Goldf., and of which a figure is also given by Hagenow (ib., fig. 17), appears to approach very nearly to that of *M. bidens*, so nearly, in fact, as almost to lead to the suspicion that the two forms are very intimately related, especially when it is remembered that they both occur in the same locality. A very considerable difference, however, in size, is apparent between the two; and although this may not perhaps be a very decisive character, one of more importance exists in the presence in *M.* (*C.*) *hippocrepis*, of large, scattered, lanceolate avicularia among the cells, none of which are visible in the figure of *M. bidens*, nor in the Crag specimens.

11. M. ANDEGAVENSIS, *Michelin*. Pl. II, fig. 5.

Areis elongatis, supra arcuatis, lateribus subparallelis; cellulis clausis, laminâ depressâ, glabrâ, poro singulari medium supra utrinque perforatâ; orificio semilunari, elevato, margine simplici; ovicellulis magnis, conspicuis.

Area elongated, sides nearly parallel, rounded above; surface of cell concave, smooth, with a single pore on each side above the middle; ridges simple, smooth; orifice sub-crescentic, raised; peristome simple; ovicell large, conspicuous.

ESCHARA ANDEGAVENSIS, *Mich.*, Icon. Zoophyt., p. 329, pl. lxxviii, fig. 11.

Habitat.—C. Crag, on shell, *S. W.* Doué, &c., *Michelin*.

12. M. FISSURATA (*n. sp.*)[1]

Areâ oblongâ supra arcuatâ, infra truncatâ; septis tenuibus, simplicibus, glabris. Orificio magno transverso, labro inferiori subrecto; laminâ utrinque fissuram longam curvatam ostendente.

Area oblong, arched above, truncate below; ridges narrow, simple, smooth; mouth large, arched above, lower lip nearly straight, or raised in the middle; a long curved fissure on each side of the front of the cell.

Habitat.—C. Crag, on *Eschara monilifera*.

A very well marked species, distinguishable at once by the elongated curved fissure on each side of the front of the cell. The septa between the cells are thin and very regularly arranged, and the calcareous lamina forming the front of the cell appears to be extremely delicate and fragile, so that the specific characters are only here and there apparent, even in a large patch. The species seems to be parasitic upon other Polyzoa, and when the front of the cells is entirely destroyed may be distinguished by the large size of the empty spaces left, the comparative thinness of their walls, and the absence of intercellular avicularia.

13. M. OCEANI, *D'Orbigny*. Pl. III, fig. 8.

Polyzoario effuso, irregulari; cellularum areis pyriformibus, superne depressis, parte depressâ lineâ elevatâ circumscriptâ, utrinque poro lunato signatâ; orificio suborbiculari,

[1] The figure of this species has been accidentally omitted.

elliptico, subinde trifoliato; peristomate plano. Cellulis pluribus, aviculario medio infra aream depressam posito, armatis. Ovicellulis parvis, prominentibus, rostro sulcato munitis.

Polyzoarium spreading irregular; cells pyriform; upper two thirds of front occupied by a broad oval space, bounded by a ridge, within which the surface is depressed; orifice suborbicular, elliptical, sometimes trifoliate; margin level; a crescentic pore on each side of the depressed area; surface smooth; an avicularium on many cells on the median line in front below the area; ovicell small, prominent, with a sulcate rostrum in front.

Escharina (Cellepora oceani), *D'Orbigny*, Pal. Franc. (Terr. Cret.), pl. dcv, fig. 14.

Habitat.—C. Crag, inside of a small *Astarte Omalii,* and of a small Pecten.

The trifoliate form of the orifice, or, more properly speaking, of the aperture occasionally noticed in this species, appears to be due to an arrest in the calcification of the lamina filling up the oval area on the front of the cell; the lateral leaflets of the opening then representing the lunate pores visible in the cells where the calcification has proceeded to its full extent. With this form of the aperture, and the presence of the median avicularium at the lower half of the cell, *M. oceani* exhibits characters in common with *M. trifolium,* but attentive consideration has satisfied me that the two are distinct.

Of the identity of *M. oceani* with M. D'Orbigny's species, little doubt can be entertained on comparison with his figure, notwithstanding the great difference which would seem to exist in the respective ages of the rocks in which they occur.

14. M. holostoma, *S. W.* Pl. III, fig. 11.

Polyzoario irregulari; areis cellularum ovalibus, pyriformibus, subhexagonis, vel supra arcuatis et latioribus, infra angustioribus, apice truncàtis; septis valde elevatis, granulosis, longitudinaliter sulcatis; laminâ superficie granulosâ utrinque medium versus perforatâ; orificio suborbiculari, peristomate elevato; aviculariis magnis, ellipticis, numerosis inter cellulas dispersis.

Polyzoarium irregular; front of cell oval, pyriform, subhexagonal, or arched and expanded above, contracted below, and truncate at bottom; margin much raised, granular; a distinct line of separation between the margins of contiguous cells; surface of lamina granular; orifice suborbicular, peristome raised; an elliptical pore on each side about the middle; numerous large elliptical avicularia between the cells.

Flustra holostoma, *S. W.*, Ann. N. H., xiii, p. 20.

Habitat.—C. Crag, *S. W.*, on inside of a small *Pectunculus glycimeris.*

Genus 2. LEPRALIA, *Johnston.*

Polyzoario adnato, incrustante, irregulariter suborbiculari e puncto centrali radiante; e cellulis urceolatis, calcareis, decumbentibus, contiguis seu conjunctis, unico in strato dispositis composito.

Polyzoarium adnate, encrusting, spreading more or less regularly from a centre in a circular form; composed of a single layer of urceolate, calcareous, decumbent, contiguous or connected cells.

ESCHARA (pars), *Pallas; Ellis* and *Solander; Moll; Linn.; Michelin.*
CELLEPORA, *Oth. Fabric.*, 1780; *Gmelin* (pars); *Esper* (pars); *Lamarck*, 1801 (pars); *Oken* (pars); *Audouin* (sp.); *Lamouroux*, 1812; *Hagenow* (pars); *Reuss; D'Orbigny*, 1852; *Goldfuss.*
FLUSTRA (pars), *Audouin; Lamouroux.*
DISCOPORA, *Lamarck; Gray* (pars); *Rœmer*, 1845; *Lamouroux* (pars), not *Fleming.*
ESCHARINA, ESCHAROIDES, and DISCOPORA, *Milne Edwards*, 1837; *Rœmer*, 1840; *D'Orbigny*, 1839–47; *Van Beneden.*
BERENICEA (sp.), *Fleming*, not *Lamouroux.*
LEPRALIA, *Johnston; Gray* (sp.); *Busk; S. Wood; J. Morris; Hassall; Landsborough*, &c.
CRIBRILLINA, HERENTIA, ESCHARELLA, PORELLA, CELLEPORELLA (all sp.), *Gray.*
MARGINARIA (pars), *Rœmer; Reuss; Hagenow.*
MOLLIA (sp.), *Lamouroux; D'Orbigny.*

The preceding synonymy, which might without difficulty be considerably increased were it worth while, will perhaps be sufficient to show the advisability of the adoption of some term, which, though of more recent date, would avoid the ambiguity unavoidable in the use of a prior term already very largely employed in various senses. There can be no doubt that the term *Cellepora* originally proposed by O. Fabricius for four or five true species of *Lepralia,* should, so far as priority is concerned, have the preference. But as this term has been employed in the original sense only by two or three writers, and not very strictly even by them, and has by many more been applied to a widely different group of species, it appears very unadvisable that it should be again used in its original signification.

The term *Escharina* proposed by M. Edwards, in 1837, and which has been extensively adopted, is liable to the objection, that like other words ending in the same way, it has been employed as expressive of a family or tribe; nor does it moreover, as used by M. Edwards, include all the forms embraced under *Lepralia* as here understood. *Discopora* has some claims to adoption, but as it has never been restricted to the Lepraliæ proper, and has been applied by Dr. Fleming to a totally distinct genus, its use would now be attended with some confusion. The remaining appellation here adopted was originally proposed by

Dr. Johnston, and although it does not appear to have been used by any Continental writer, has been so generally employed by English naturalists, and is so appropriate and free from ambiguity, as to claim general approbation.

The very large number of species, both recent and extinct, included in the Genus *Lepralia,* renders it one of the greatest importance. It appears to date from the Cretaceous period, and species belonging to it abound in the tertiary beds, as well as at the present epoch. As might be expected in a group of related forms enjoying so wide a distribution in time, they are found to enjoy an equal existence in space. Of the numerous species some are found in all parts of the globe, from the Arctic to the Antarctic regions, many being apparently cosmopolite. This capacity for general diffusion appears to be conjoined with a power of adaptation to different circumstances, perhaps greater than resides in any other genus of Polyzoa; and thus arises a disposition to variation which adds very considerably to the difficulty of discriminating species. It is not improbable, also, that owing to this peculiarity, some of the presumed extinct forms might be traced by careful research into connexion with those still living. For the same reason, also, it is highly probable that continued study may show that many species now regarded as distinct are in reality only varieties. But notwithstanding this, there can be no doubt of the existence of a vast number of truly distinct forms, whose similitude renders it indispensably requisite, for the convenient determination of any particular species, to subdivide the genus into minor groups, which, however, must be regarded simply as artificial, and contrived solely for the purpose of convenient reference.

The following synopsis is pretty nearly the same in form as that employed in the British Museum Catalogue, Part ii, p. 63.

SYNOPSIS OF SPECIES OF LEPRALIA.

§ 1. Armatæ. (Furnished with avicularia or vibracula.)

(*a*) *With oral spines.*

(*b*) *Without oral spines.*

§ 2. Inarmatæ. (No avicularia or vibracula.)

(*a*) *With oral spines.*

(*b*) *Without oral spines.*

§ 1. Armatæ.

(a) With oral spines.

1. L. punctata, *Hassall.* Pl. IV, fig. 1.

Cellulis subcylindricis, irregularibus, sæpe immersis, foraminosis; puncturis in seriebus transversis dispositis; orificio oblongo, transverso, subinde angustissimo, labio inferiori prominente, mucronato; utrinque avicularium ostendente. Supra 4—6 spinis marginalibus non raro absentibus. Ovicellulis pyramidalibus facie anteriori carinatis, subinde avicularium parvum summitate gerentibus.

Cells subcylindrical, irregular, often wholly immersed, foraminiferous; punctures in transverse rows; orifice oblong, transverse, occasionally very narrow; lower lip projecting, mucronate; 4—6 marginal spines above, often absent. Ovicell pyramidal, keeled in front, and sometimes crowned with a small avicularium at the summit; an avicularium on each side of the orifice (sometimes absent).

L. punctata, *Hassall; Johnst.; Busk*, B. M. Cat., pt. ii, p. 80, pl. xc, figs. 5, 6; pl. xcii, fig. 4; pl. xcvi, fig. 3.

Habitat.—C. Crag, on shells, *S. Wood; J. S. B.* (very common). (*Recent*) Britain.

A very protean species in the recent state, though presenting very constant characters in the fossil.

2. L. innominata, *Couch.* Pl. IV, fig. 2.

Cellulis ovatis, utrinque sulcis 6—7 e lineâ centrali divergentibus, porosis signatâ; orificio semicirculari labio inferiori recto; facie cellulæ anteriori juxta orificium medio perforatâ, tuberculo obtuso utrinque munitâ; spinis marginalibus quinque. Ovicellulâ facie anteriori carinatâ; aviculariis inter cellulas raro sparsis.

Cells ovoid, with 6—7 grooves on each side radiating from a central line; a line of minute pores along each sulcus; orifice semicircular, straight below; a perforation in the median line close below the orifice, on each side of which is a blunt tubercle; five marginal spines. Ovicell keeled in front; avicularia sparingly scattered among the cells.

L. innominata, *Couch; Johnston; Gray; Busk.*

Habitat.—C. Crag, *S. W.* (*Recent*) Britain.

3. L. PUNCTURATA, *S. Wood.* Pl. VI, fig. 2.

Cellulis ovoideis, convexis, utrinque 5—6 sulcis porosis ornatis; orificio suborbiculari, labio inferiori incrassato, elevato, supra spinâ marginali mediâ unicâ et utrinque aviculario armato; ovicellulâ depressâ rotundatâ, antice punctis 3 signatâ.

Cells ovoid, convex; 5—6 sulci on each side; punctures along the sulci; orifice suborbicular, lower margin thickened, prominent; a single median marginal spine above; an avicularium on each side of the mouth; ovicell depressed, rounded, with three punctures in front.

L. PUNCTURATA (pars), *S. W.*, Ann. Nat. Hist., xiii, p. 18.

Habitat.—Red Crag, *S. W.*, on the inside of *Cytherea rudis* and (?) *Cardium vulgare*.

The only species with which the present can be confounded is *L. punctata*, a species very abundant in the Coralline, but also occurring in the Red Crag, to which *L. puncturata* seems to be confined. Both species have the front of the cell punctured in a somewhat similar manner, and both have an avicularium on each side of the orifice; so that in general aspect, on a superficial inspection, they might be very readily confounded. The differences between them, however, seem amply sufficient to separate them.

1. The ovicell in *L. punctata* is pyramidal, carinate in front and not punctured, and often has an avicularium on the summit; whilst in *L. puncturata* the ovicell is depressed and rounded, with three distinct puncta on its anterior surface, which is either quite smooth, or raised into a short umbo.

2. The lines of punctures in *L. punctata* are, for the most part, continued across the cell uninterruptedly, showing but little disposition to radiate from the centre; whilst in *L. puncturata* the lines of punctures are, in almost every instance, placed in grooves distinctly radiating from a central line, across which the punctures are not continued, as in *L. annulata*.

3. The cells in *L. punctata* are always deeply immersed, and usually disposed in linear series, whilst in *L. puncturata* they are very convex in front, distinct from their neighbours, and disposed quincunically.

4. The single median spine on the upper margin of the mouth is a further distinguishing characteristic of *L. puncturata*.

Finding several specimens marked *L. puncturata* in Mr. S. Wood's collection, I have retained his appellation for this form, although it would seem he did not himself distinguish it from *L. punctata*.

4. L. Woodiana (*n. sp.*) Pl. VII, figs. 1 and 3.

Cellulis ovatis marginem circa serie unicâ punctorum ornatis, basim versus immersis, supra liberis, suberectis; facie anticâ granulosâ umbone elevato supra excavato munitâ. Orificio semicirculari, labio inferiori recto, medio inciso, 4—6 spinis marginalibus supra armato. Aviculario minimo in partem cellulæ supremam utrinque posito.

Cells ovate, immersed below; upper half free, raised; surface granular; a single row of punctures round the margin; orifice semicircular above, lower border straight, with a narrow fissure in the middle; 4—6 marginal spines above; a broad prominent umbo below the orifice, with a cup-like cavity above it; a very minute avicularium on each side of the orifice on the highest part the cell; ovicell depressed.

Habitat.—Cor. Crag, on *Tellina, S. W.;* (*Recent*) Belfast Bay, on *Venus rugosa,* Rev. T. Hincks.

This peculiarly formed species is characterised by the orifice, which has a straight lower border, having a narrow slit or fissure in the middle; and by the circumstance that below the orifice the surface is smooth and hollowed into a sort of cup, supported beneath by a broad eminence. The cells vary considerably in size in different parts of a patch.

5. ? L. ciliata, *Linn.* Pl. VII, fig. 6.

Cellulis convexis, subhexagonis medio porum lunatum ostendentibus; superficie granulosâ, vel obscurè puncturatâ. Orificio lunato transversim elongato, elevato, libero, 4—6 spinis marginalibus supra armato; aviculario elevato, uno latere posito. Ovicellulâ subglobosâ, ostio simplici.

Cells quincuncial, convex, subhexagonal, surface granular, or obscurely punctured; orifice crescentic, elongated transversely, raised and free; 4—6 marginal spines above; a lunate pore above the middle of the cell; a raised avicularium on one side of the cell; ovicell rounded; peristome not thickened.

Cellepora ciliata, *Linn.; Fab.* (Faun. Grœnl., p. 434, No. 441).
Eschara vulgaris, var. *β*, *Moll.*, Seerinde, p. 62, pl. iii, fig. 11.
Lepralia ciliata, *Johnston; Busk,* Brit. M. Cat., part ii, p. 73, pl. lxxiv, figs. 1, 2.
L. insignis, *Hassall,* Ann. Nat. Hist., VII, p. 368, pl. ix, fig. 5.
Flustra Genisii, *Aud.*, Expl., p. 239, *Savign.*, Egypt, pl. ix, fig. 5.
Cellepora crenilabris, *Reuss* (op. c., p. 88, pl. x, fig. 22).

Habitat.—Cor. Crag on shell, *S. W., J. S. B.* Vienna Basin, *Reuss.* (*Recent*) cosmopolite.

The resemblance at first sight between the fossil form and the more ordinary condition under which *L. ciliata* occurs, will be found rather remote. But the transition from the delicate, transparent fucicolous *L. ciliata* of the south coast, growing within the laminarian zone, to the more robust, coarsely granular, thickened variety which occurs on shells from deep water, is too well marked in a sufficient series of specimens to leave any room for doubt as to the specific identity of the fossil and recent species. In specimens of the latter, dredged by the late lamented W. Thompson in deep water, (45 fathoms) in Belfast Bay, little or no difference can be perceived from the Crag fossil.

6. L. MORRISIANA (*n. sp.*) Pl. VII, fig. 8.

Cellulis ovatis, umbonatis, superficie raro punctatis, aviculario parvo utrinque armatis. Orificio semicirculari, supra spinis 6 marginalibus armato, labro inferiori recto. Ovicellulâ resupinatâ, ostio patulo, peristomate incrassato.

Cells quincuncial, ovate; surface sparsely punctured; orifice semicircular, with a straight border below; 6 marginal spines above; a small umbo in front of the cell above the middle; a small avicularium on each side of the cell in front. Ovicell resupinate, its opening gaping with a thickened border.

CELLEPORA TRISTOMA (?), *Goldfuss*, Pet. Germ., p. 102, pl. xxxvi, fig. 12 (no oral spines), occurs on *Terebratula grandis* at Anspruch.

Habitat.—C. Crag on *Terebrat. grandis, S. Wood. J. S. B.*

From the appearance of the minute rounded openings on the so-termed avicularian processes it is possible they may have supported vibracula like those of *L. Hyndmanni.*

(*b*) *Without oral spines.*

7. C. VIOLACEA, *Johnston.* Pl. IV, fig. 3.

Cellulis elongatis, subpyriformibus, marginem circa, subinde etiam per totam superficiem, punctatis, avicularium centrale, mandibulo sursum spectante, gerentibus; infra avicularium, foramen margine declivo ostendentibus. Orificio semicirculari, labio inferiori recto.

Cells elongated, subpyriform, punctured round the margin and sometimes over the whole surface; a central avicularium, the mandible pointing directly upwards; below the avicularium a central depressed perforation. Orifice semicircular, straight below.

L. VIOLACEA, *Johnst.*, B. Zooph., 2 ed., p. 325, pl. lvii, fig. 9. *Busk*, B. M. Cat. part ii, p. 69, pl. lxxxvii, figs. 1, 2.
ESCHARELLA VIOLACEA, *Gray.*

Habitat.—C. Crag, on various shells, *S. Wood.* (*Recent*) Britain (south and east coast), Orkney (?); Gibraltar Bay.

This fossil differs from the usual form of the recent *L. violacea* in the more decided marginal puncturation. Generally, in *L. violacea,* obscure traces of such punctures are seen only in the very young cells at the margin of the crust; the older cells, which have acquired the peculiar blackish-blue tint, so characteristic of the living species, exhibiting no signs of punctures either on the surface or at the margin. The cells occasionally become much thickened and bossy. That punctures may exist, however, in this species, is evidenced not only in the fact that in the young cells distinct punctures may be perceived around the border in almost every specimen where such cells exist, but also that specimens sometimes occur in which the whole surface is freely punctured. An instance of this kind, from Hastings, is in my possession.

8. L. PLAGIOPORA (*n. sp.*) Pl. IV, fig. 5.

Cellulis pyriformibus, marginem circa puncturatis, punctis canaliculatis; aviculario magno mandibulo sursum oblique spectante, armatis; atque foramen depressum infra avicularium ostendentibus. Orificio semicirculari, labio inferiori recto.

Cells pyriform punctate round the border, puncta channelled; a large avicularium on the front of the cell, whose mandible is pointed obliquely upwards; a central perforation below the avicularium; orifice semicircular, with a straight border below.

CELLEPORA HECKELII (?), *Reuss* (l. c.), p. 85, pl. x, fig. 10.

Habitat.—C. Crag on shell; *S. Wood.*

This might be taken as a variety of *L. violacea,* but the very different size and position of the *avicularium* (much better marked in some specimens than it is in the one figured) which appears to be a very constant character, show their specific distinction.

9. L. EDWARDSIANA (*n. sp.*) Pl. V, fig. 2.

Cellulis alte immersis, superficie puncturatâ, inequali; orificio suborbiculari, infra uno latere late sinuato; sinu canaliculato ad avicularium magnum laterale tendente; peristomate valde incrassato, elevato. Ovicellulâ parvâ, subpyramidali.

Cells deeply immersed, surface punctured, uneven; orifice suborbicular, below with a wide sinus on one side, leading towards a large avicularium placed on the same side of the cell immediately below the orifice; peristome much thickened and elevated; ovicell small, subpyramidal.

Habitat.—C. Crag, on shell; *S. Wood.*

10. L. UNICORNIS, *Johnst.* Pl. V, fig. 4.

Cellulis late ovatis, superficie puncturatâ umbone centrali munitis. Orificio orbiculari infra medio inciso. Aviculario sessili, mandibulo acuto sursum et ad latus externum oblique spectante, in partem superiorem cellulæ utrinque posito. Ovicellulâ sulcis radiantibus signatâ.

Cells broad-ovate; surface punctured; a central umbo; orifice orbicular with a sinus below; a sessile avicularium on one or both sides at the upper part of the cell, the mandible pointing upwards and outwards. Ovicells with radiating grooves.

BERENICEA COCCINEA, *Johnston,* in Transact. Newc. Soc., ii, p. 267, pl. xii, fig. 5.
LEPRALIA COCCINEA, *Johnst.*, B. Zooph., 1st ed., p. 278, pl. xxxiv, figs. 1–3.
— UNICORNIS, *Johnston,* Brit. Zooph., 2d ed., p. 321, pl. lvii, fig. 1.
— SPINIFERA (var.), *Busk,* B. M. Cat., part ii, p. 69, pl. lxxx, figs. 5, 6, 7, and pl. xci, figs. 1, 2.
CELLEPORA TETRAGONA, *Reuss,* Fossil Polyp. d., W., T. B., p. 78, pl. ix, fig. 19.

Habitat.—C. Crag, *S. Wood,* on shell. (*Recent*) Britain, Gibraltar Bay, *Landsb.* *Tertiary,* Vienna Basin, *Reuss.*

11. L. ANSATA, *Johnston.* Plate VII, fig. 2.

Cellulis ovatis seu oblongis, antice ventricosis, superficie foveolatâ, umbonatis. Orificio semicirculari, labio inferiori recto, medio inciso; aviculario elevato in partem superiorem cellulæ utrinque posito.

Cells oval or oblong, ventricose in front, surface pitted; orifice semicircular above, lower margin straight, with a central notch; an umbo close below the orifice; and on each side above a raised avicularium.

L. ANSATA, *Johnst.*, Brit. Zooph., 2d ed., p. 307, pl. liv, fig. 12.
L. SPINIFERA (var.), *Busk,* B. M. Cat., part ii, p. 69, pl. lxxxi, figs. 6, 7.
CELLEPORA DUNKERI, *Reuss,* op. cit., p. 90, pl. x, fig. 27.
C. PROTUBERANS (?), *Id.* ib., p. 89, fig. 26.

Habitat.—C. Crag, *S. W.* Vienna Basin, *Reuss.* (*Recent*) Britain.

12. L. Brongniartii, *Audouin.* Pl. VI, fig. 1.

Cellulis ovatis seu pyriformibus transversim rugulosis, distantibus, spatiis reticulatis distinctis. Aviculario parvo ad apicem orificii supra armatis. Ovicellulâ pyramidali, aviculario cristatâ.

Cells ovate or pyriform, transversely rugose, distinct, separated by reticulated spaces or large openings; orifice suborbicular transverse; a minute avicularium on the summit of each cell above and behind the orifice; ovicell pyramidal, crowned with an avicularium.

> Cellepora Brongniartii, *Audouin*, Explan., p. 240; *Savigny*, Egypt, pl. x, fig. 6.
> Lepralia Brongniartii, *Busk*, B. M. Cat., part ii, p. 65, pl. 81, figs. 1—5.
> — tenuis, *Hassall; Johnston.*
> — catenata, *Peach*, MSS.
> — assimilis, *Johnston; Gray.*
> — Jacotini, *Gray.*

Habitat.—C. Crag, *Sutton, S. W.* (on shell). (*Recent*) Britain, Mediterranean, on shells, stones, or fucus.

13. L. mamillata, *S. W.* Pl. VI, fig. 5.

Cellulis suberectis, magnis, supra liberis, coarctatis, infra ventricosis, superficie rugoso-granulatâ seu sulcatâ; basin circa serie unicâ vel multiplici punctorum ornatis. Orificio suborbiculari aculeum internum infra ostendente; peristomate antice et ad latera producto, postice late emarginato 2-4 spinis marginalibus superioribus. Ovicellulâ depressâ, globosâ, superficie granulosâ seu sulcatâ. Aviculario parvo utrinque ante ovicellulam posito.

Cells suberect, superiorly free and projecting; contracted above, ventricose below; surface coarsely granular or sulcate; a single or multiple row of pores around the base; orifice suborbicular, with a spinous process within the lower margin; peristome much produced in front and laterally, deficient posteriorly; 2-4 marginal spines above and behind; ovicell depressed spherical, surface granular or sulcate. A small avicularium on each side in front of the ovicell.

> C. mamillata, *S. Wood*, Ann. Nat. Hist., xiii, p. 19; *J. Morris*, Cat. B. Foss., p. 120.

I retain the name affixed by Mr. Wood to specimens in his collection, though not satisfied with him that it is the form intended by Blainville, under the same appellation.

The species is very distinct and well marked, at once recognisable by its great comparative size, in accordance with which the walls of the cells are very thick and strong. The peculiar production of the anterior part of the peristome into a sort of pointed spout, and the existence of an avicularium on each side in front of the ovicell, are amongst the other most striking peculiarities. It should be remarked that the avicularia are formed only on the fertile cells, no vestige of such organs being discernible in the cells not furnished with an ovicell.

14. L. BICORNIS (*n. sp.*) Pl. VIII, figs. 6, 7.

Cellulis ovatis, seu doliiformibus, umbonatis, superficie minute granulosâ, marginem circa serie punctorum unicâ ornatis. Orificio orbiculari, processu cylindrico ascendente, avicularium apice gerente, utrinque munito. Ovicellulis globosis.

Cells ovate or barrel-shaped, surface finely granular with a single row of punctures around the margin; orifice orbicular; an ascending cylindrical process on each side of the orifice, having an avicularium on the apex; an elongated ascending conical umbo in front of the orifice; ovicells globose.

Habitat.—C. Crag, on shell, *S. W.*

15. ? L. BIAPERTA, *Michelin* (*sp.*) Pl. VII, fig. 5.

Cellulis quincuncialibus, seu serialibus, ovoideis, convexis, confluentibus, vibracularium elevatum uno latere in partem superiorem gerentibus. Orificio orbiculari, infra sinuato, peristomate simplici.

Cells quincuncial or serial, ovoid, convex, confused; surface smooth; orifice orbicular, with a sinus below; peristome simple; a projecting vibracular process on one side at the top of the cell.

ESCHARA BIAPERTA, *Michelin,* Icon. Zooph., p. 330, pl. lxxix, fig. 3.

Bearing some resemblance to *L. Hyndmanni,* Johnst., the species to which M. Michelin probably refers, *L. biaperta* is distinguished from it—1st, by the peristome never being thickened or raised, as it usually is in *L. Hyndmanni;* 2d, by the absence of pores at the border of the cell; and 3d, in the far higher position on the cell of the raised and perforated process, which doubtless represents the support of a *vibraculum* similar to that of *L. Hyndmanni.* The species, however, must be regarded as suspiciously near to *L. Hyndmanni,* which, it should be remarked, enjoys a tolerably extensive range in the present state of the globe, being found as far south, at any rate, as Madeira. M. Michelin's figure of the cell corresponds so closely with nature, that little doubt can be entertained with respect to the identity of his species with that of the Crag; the only apparent discrepancy in his description is the statement, that in *L. biaperta* the cells are disposed in radiating lines, rather than in regular quincuncial order, as they appear to be in all the Crag specimens.

§ 2. Inarmatæ.

(*a*) *With oral spines.*

16. L. variolosa, *Johnst.* Pl. IV, figs. 4 and 8, and Pl. VIII, fig. 8.

Cellulis ovatis, immersis, in seriebus linearibus plerumque dispositis, marginem versus puncturatis seu areolatis, superficie granulosâ vel puncturatâ. Orificio orbiculari seu subquadrangulari, 2—4 spinis marginalibus approximatis supra armato; peristomate antice elevato, infra intusque denticulum bifidum ostendente. Ovicellulis altè immersis, ad marginem areolatis.

Cells oval, immersed, usually disposed in linear series, punctured or areolated round the margin, surface granular or punctured; orifice orbicular or subquadrangular, with two (or four) close-set marginal spines behind; peristome projecting in front; a bifid denticle within the orifice. Ovicells deeply immersed, areolated round the margin.

Lep. variolosa, *Johnst.*, Brit. Zooph., 2d ed., p. 278, pl. xxxiv, fig. 4; *Busk*, Brit. M. Cat., part ii, p. 75, pl. lxxiv, figs. 3, 4, 5, pl. lxxv.

Habitat.—C. Crag, on shell, *S. W.*

This is one of the more variable species of Lepralia, exhibiting such great diversity of aspect under different circumstances, as to cause considerable difficulty in its diagnosis. Three common varieties are represented in the Plates. At Pl. IV, fig. 4, is a variety without apparent spines, and at fig. 8, one in which the peristome is inordinately produced in front, whilst the two oral spines are perceptible; these are more clearly shown in the specimen figured in Pl. VIII, fig. 8, in which all the characters of the species are best exhibited.

17. L. Peachii, *Johnst.* Pl. V, figs. 6, 7, 8; Pl. VI, fig. 4.

Cellulis quincuncialibus seu seriatis, ovatis, ventricosis, supra suberectis, umbonatis, superficie glabrâ vel granulosâ, serie unicâ punctorum basim circa ornatis. Orificio supra arcuato, infra coarctato, infra dente medio lato labium intus, armato; 4—6 spinis marginalibus supra munito. Ovicellulâ parvâ, erectâ, spinis marginalibus duabus utrinque fultâ.

Cells quincuncial or in linear series; ovate, ventricose, raised above; surface smooth or granular; a single row of minute punctures around the base. Orifice arched above, contracted below, with a broad median tooth within the lower border and 4—6 marginal spines above; a strong pointed umbo close below the orifice; ovicell small, erect, with two marginal spines in front on each side.

L. CILIATA (?), MS., *S. Wood.*
LEPRALIA PEACHII, *Johnst.*, Brit. Zooph., 2d ed., p. 315, pl. liv, figs. 5, 6; *Busk*, Brit. M. Cat., part ii, p. 77, pl. lxxxii, fig. 4, and pl. xcvii.
— IMMERSA, *Johnst.*, op. c., p. 325, pl. lvii, fig. 8.
ESCHARELLA IMMERSA, *Gray.*
BERENICEA IMMERSA, *Fleming.*

Habitat.—Cor. Crag, *S. W.*, *J. S. B.*, on various shells, very abundant. (*Recent*) Britain, from Orkney to the Isle of Wight; Beaufort Dyke, 110—147 fms.

The identity of this form with the recent *L. Peachii* admits, I think, of no doubt. Like that species, it is very protean in habit, but the specific characters are usually sufficiently marked to render its discrimination easy. These are: 1, the presence in most cases of six oral spines; 2, the large and usually flattened, but sometimes conical umbo below the orifice; 3, the appearance of the stumps at any rate, of *two* oral spines on each side in front of the ovicell.

18. L. VENTRICOSA, *Hassall.* Pl. VI, figs. 3, 6, 8.

Cellulis supra suberectis, distantibus, constrictis, infra ventricosis, ad basim immersis; superficie granulosâ, basim circa serie punctorum unicâ plerumque ornatis. Orificio orbiculari, dente bifido, interno infra armato; peristomate valde elevato, antice producto, rostrato, 2 spinis marginalibus utrinque armato. Ovicellulâ parvâ, resupinatâ, subimmersâ, spinâ marginali unicâ utrinque fultâ.

Cells distinct and suberect above, immersed at the base; ventricose below, much contracted above; surface granular; a single row of punctures around the base; orifice orbicular, with a bifid denticle within the lower border; peristome much raised, produced in front into a prominent beak; four marginal spines, two on each side; ovicell small, reclined, subimmersed, with a single spine on each side in front.

LEPRALIA VENTRICOSA, *Hassall; Johnst.*, Brit. Zooph., 2d ed., p. 305, pl. liv, fig. 5; *Busk*, British M. Cat., part ii, pl. xci, figs. 5, 6; p. 78, pl. lxxxii, figs. 5, 6; pl. lxxxiii, fig. 5.

Habitat.—Cor. Crag, on various shells, *S. W.* (*Recent*) Britain, *ubique.*

Bearing a strong resemblance in most respects to large, coarse, overgrown specimens of *L. Peachii*, the present species may usually be readily distinguished by the great contraction of the upper part of the cell, and the production of the peristome often into a sort of funnel.

19. L. BOWERBANKIANA (*n. sp.*) Pl. VII, fig. 4.

Cellulis subseriatis, ovatis, oblongis, antice convexis, umbonatis; juniorum superficie delicatule scrobiculatâ, seniorum, presertim ad latera, puncturatâ. Orificio orbiculari, infra sinuato, tribusque spinis marginalibus supra munito.

Cells subserial, ovate, oblong, convex in front; surface of the young cells faintly scrobiculate, in the older punctate, especially at the sides; orifice orbicular, with a sinus below, and three marginal spines above; a conical umbo close below the orifice.

L. UNICORNIS, *Johnson* (MS.)

Habitat.—C. Crag, on *Terebratula grandis, S. W.*

This species bears a resemblance to some states of the recent *L. trispinosa,* from which it may be distinguished however: 1, by the invariable absence of any avicularium; 2, by the form of the orifice, whose border is always simply sinuated below, and never produced in the spout-like fashion of that part in *L. trispinosa.*

20. L. LOBATA (*n. sp.*) Pl. VI, fig. 7; Pl. XXII, fig. 4.

Polyzoario medio depresso, marginem versus incrassato, in lobis inæqualibus irregulariter diviso. Cellulis supra constrictis, infra latioribus, et ad basim alte immersis; superficie glabrâ. Orificio elevato, suborbiculari, labio inferiori, aviculario parvo, centrali, armato; spinis marginalibus duabus subinde connatis utrinque munito.

Polyzoarium depressed in the centre, thick and raised towards the margin, and partially divided into elevated lobes; cells contracted above, wider and deeply immersed at the base, surface smooth; mouth raised, suborbicular, lower border with a small avicularium in the middle; two marginal spines sometimes connate, on each side.

Habitat.—C. Crag, on *Pecten, S. W.*

The peculiar conformation of the polyzoarium in this species serves at once for its distinction. In tolerably perfect specimens the patch is small and thick, almost like that of an encrusting cellepore, cupped or depressed in the middle, and thicker towards the border, where it is usually divided into a certain number of elevations or suberect lobes.

The peristome differs very remarkably in different specimens, as may be seen upon comparison of fig. 7, Pl. VI, with fig. 4, Pl. XXII, though there can be no doubt of these figures representing different conditions of one and the same species, as shown by the existence of all intermediate forms in some part or another of the polyzoarium.

(*b*) *Without oral spines.*

21. L. PYRIFORMIS (?) *S. W.* Pl. V, fig. 3.

Cellulis elongato-ovatis seu pyriformibus, umbonatis; superficie obscurè punctatâ seu scrobiculatâ, longitudinaliter striatulâ. Orificio semicirculari, labio inferiori recto. Ovicellulâ anticè carinatâ, superficie integrâ.

Cells elongato-ovate or pyriform; surface obscurely punctate or dotted, with a fine longitudinal striation; a central umbonal projection; orifice semicircular, straight below; ovicell keeled in front, obscurely punctured.

LEP. GRANIFERA (?).

Habitat.—C. Crag, *S. W.*, on various shells.

This species, which appears to be that intended by Mr. S. Wood under the same appellation, bears a strong general resemblance to the recent *L. granifera*. The principal differences between them being: that in the fossil there is no median pore a short distance below the orifice, which is invariably present in *L. granifera,* in which also the punctures on the front of the cell are usually more confined to the marginal portions, and not scattered uniformly over the surface. The characters in which the two forms agree are: the form of the orifice, the general aspect and form of the cells and the longitudinal striation of the surface, and the form, &c., of the ovicell, so that with the exception of the median pore there seems to be every reason to conclude that the fossil and recent forms should be placed together. But as I have not yet met with a specimen of *L. granifera* in which that pore was absent, nor one of *L. pyriformis* in which it existed, it is perhaps better to regard them as distinct though closely related.

The lower border of the orifice in this species usually presents a denticulate appearance, which is due apparently to a sort of crystallization of the carbonate of lime.

22. L. HYALINA, *Linn.* (*sp.*) Pl. V, fig. 1.

Cellulis suberectis, subcylindricis, elongatis seu compressis, antice elevatis; pariete tenui, superficie glabrâ seu transversim obscurè rugulosâ. Orificio orbiculari, sæpius infra sinuato, margine posteriori elevato, acuto. Ovicellulâ globosâ, erectâ, puncturatâ.

Cells subcrect, subcylindrical, elongated or compressed, and raised in front; wall thin, transparent, smooth, or obscurely corrugated transversely; orifice orbicular, often with a sinus below, the posterior margin much raised, sharp. Ovicell globose, erect, punctured.

CELLEPORA HYALINA, *Linn.; O. Fabric; Esper; Lamx.; Bosc,* &c.
BERENICEA HYALINA, *Hassall.*
CELLEPORA PERSONATA, *Della Chiaje*, iii, p. 39, pl. xxxiv, figs. 17, 18.
ESCHARINA PERSONATA, *M. Edwards.*
LEPRALIA HYALINA, *Johnston*, B. Zooph., 2d ed., p. 301, pl. liv, fig. 1.

Var. β. Wall of cells thicker, and opaque.
LEPRALIA CYLINDRICA, *Hassall*, Ann. N. H., vii, p. 368, pl. ix, fig. 6.

Var. γ. Cells heaped, usually opaque.
CELLEPORA OVOIDEA (?), *Lamouroux*, Pol. Corall., pl. i, fig. 1, and Expos. Méth., pl. lxiv, figs. 4, 5; *Della Chiaje*, iii, p. 38, pl. xxxiv, fig. 33.

Habitat.—C. Crag, Sutton, *S. W.*, on shell.
(*Recent*) Britain, ubique; California, var. β, *Dr. Sinclair*; Cape of Good Hope; W. Greenland, 73·20 N., 57·20 W., *Dr. Sinclair*; var. γ, E. Falkland Islands, 4—10 fms., *Darwin.*

23. L. PAPILLATA (*n. sp.*) Pl. V, fig. 5.

Cellulis ovatis seu pyriformibus, bipapillaribus, superficie puncturatâ, transversim rugulosâ, sive æquali. Orificio orbiculari, infra inciso.

Cells ovate or pyriform; surface punctate, corrugated transversely or even; orifice orbicular, with a sinus below; two small papillary elevations immediately below the orifice.

Habitat.—C. Crag, Sutton (on small *Pecten*), *S. W.*

24. L. HAIMESEANA (*n. sp.*) Plate VIII, fig. 1.

Cellulis ovato-elongatis seu pyriformibus, septo elevato sejunctis; superficie glabrâ, serie unicâ punctorum minimorum marginem circa ornatis. Orificio supra arcuato infra coarctato, labio inferiori recto, denticulo lato, rotundato, interno ostendente.

Cells ovato-elongate or pyriform, separated by distinct septa; surface smooth, with a single row of minute punctures round the border; orifice arched above, contracted, with a straight border below; a wide, rounded denticle within the lower lip.

Habitat.—C. Crag, *S. W.*, on shells.

25. L. Malusii, *Audouin*. Pl. VIII, fig. 3.

Cellulis ovatis seu hexagonis; poris numerosis, stelliformibus, irregulariter sparsis ornatis, poroque centrali lunato signatis. Orificio supra arcuato, labio inferiori recto peristomate simplici. Ovicellulâ elevatâ, antice glabrâ, basim circa canaliculatâ seu perforatâ.

Cells ovate or hexagonal; surface perforated with numerous stellate pores; a central lunate pore. Orifice rounded above, straight below; peristome not thickened; ovicell prominent in front, smooth, grooved or perforated round the base.

Eschara Malusii, *Andouin*, Expl. i, p. 239; *Savign.*, Egypt, pl. viii, fig. 8.
Lepralia Malusii, *Busk*, Brit. Mus. Cat., p. 83, pl. ciii, figs. 1—4.
Lepralia biforis, *Johnston*, Brit. Zooph., 2d ed., p. 314, pl. lv, fig. 4.
Herentia biforis, *Gray*.
Cellepora Macry, *W. Thompson* (not *Della Chiaje*?—nor *M. Edwards*).

Habitat.—C. Crag, on *Terebrat. grandis*, *J. S. B.* (*Recent*) Britain, common; South Patagonia (48 fms.); Falkland Islands, *Darwin;* New Zealand, *Dr. Lyall;* on shells, stone and fuci.

The peculiar stelliform appearance of the pores in the recent *L. Malusii* is perhaps necessarily wanting in the fossil, in which the appearance of puncta is altogether very indistinct. But the general aspect of the cells, the form of the mouth, and the existence of the central lunate pore, as well as the very peculiar perforations round the attached base of the ovicell, which are very apparent in the fossil, though accidentally not shown in the figure, appear to be amply sufficient to prove its identity with the recent, cosmopolitan species.

26. L. reussiana (*n. sp.*) Pl. VIII, fig. 2.

Cellulis ovatis, supra contractis, superficie glabrâ; marginem circa serie punctorum minimorum unicâ ornatis. Orificio subquadrangulari seu oblongo, transverso; peristomate producto, integro, incrassato, denticulum latum internum infra ostendente.

Cells ovate, contracted at top, surface smooth; a single row of minute punctures around the border of the cell; orifice subquadrangular or oblong, transverse; peristome produced, entire, thick; a broad tooth within the lower border.

Habitat.—C. Crag, *S. W.*

27. L. INFUNDIBULATA (*n. sp.*) Plate VIII, fig. 4.

Cellulis ovato-ventricosis; orificio oblongo, transverso; peristomate integro, valde producto sive expanso.

Cells ovato-ventricose; orifice oblong, transverse; peristome entire, much produced and expanded.

Habitat.—Red Crag, on shell, *S. W.*

This may prove to be only a variety of *L. Reussiana*, though presenting some apparently strongly distinctive characters, such as the absence of the marginal puncta and of the oral denticle. From *L. labrosa* (*Alysidota labrosa*), *Busk* ('B. M. C.,' pl. xcii), it appears to be distinguished, not only by its habit, but also by the smoothness of the surface, and the circumstance that the peristome is entire posteriorly.

28. L. PALLASIANA, *Moll.* Pl. IX, fig. 7.

Cellulis ovato-ventricosis, superficie puncturatis, subinde verrucosis. Orificio supra arcuato, medium infra coarctato; peristomate simplici, incrassato; labio inferiori recto, integro.

Cells ovato-ventricose, surface punctured, sometimes verrucose; orifice arched above, contracted below the middle; peristome simple, thickened. Lower lip straight.

ESCHARA PALLASIANA, *Moll.*, Seerinde, p. 64, pl. iii, fig. 13.
FLUSTRA HIBERNICA, *Hassall*, Ann. Nat. Hist., vi, p. 172, pl. vii, fig. 1, and vii, p. 370.
LEPRALIA PEDILOSTOMA, *Hassall*, Ann. Nat. Hist., vii, p. 368, pl. ix, fig. 4.
— PEDIOSTOMA, *Johnston*, Brit. Zooph., 2d ed., p. 315, pl. liv, fig. 7; *Couch.*
CELLEPORA PALLASIANA, *Lamx.*, Polyp. Flex., p. 95, No. 190.
LEPRALIA PALLASIANA, *Busk*, B. M. Cat., part ii, p. 81, pl. lxxxiii, fig. 1, 2.

Habitat.—C. Crag, on shell, *S. W.* (*Recent*) Britain, south coast (very rare in the north); Jersey.

29. L. MEGASTOMA, *S. W.* (M.S.) Pl. VIII, fig. 5.

Cellulis ovatis, umbonatis, ad marginem poris canaliculatis ornatis. Orificio magno semiorbiculari, labio inferiori recto, integro, peristomate simplici.

Cells ovate, raised in the middle, with a single row of channelled pores round the border; orifice large, semicircular, with a straight lower lip and simple peristome.

Habitat.—C. Crag, *S. W.*, inside a large bivalve shell.

§§§ 2. AFFIXÆ.

A. MASSIVÆ.

Fam. V. *CELLEPORIDÆ*, Busk.

Polyzoarium e cellulis plus minusve verticalibus, confertis seu confusè superimpositis compositum.

Polyzoarium composed of cells more or less vertical to its axis or plane, heaped together or irregularly overlying each other.

Genus 1. CELLEPORA.

Polyzoarium calcareum, spongiosum, è cellulis urceolatis plus minusve verticalibus, confertis vel irregulariter quincuncialibus, superimpositis compositum.

Polyzoarium calcareous, spongy, composed of urceolate cells placed more or less vertical to its axis or plane, heaped together or irregularly quincuncial, and overlying each other.

CELLEPORA (pars), *O. Fab.*, 1780; *Gmelin* (pars), 1789; *Esper* (pars), 1791; *Lamarck* (pars), 1801; *Lamouroux* (pars), 1816, not 1821; *Blainville* (pars), 1834; *Reuss* (pars), 1847; *Hagenow* (pars), 1851; *Michelin*, 1847; *Johnston*.
CELLEPORARIA, *Lamouroux*, 1821; *D'Orbigny*, 1852.
SPONGITES, *Oken* (pars).
TUBIPORA, *Linn.* (pars).
MILLEPORA (pars), *Pallas*; *Solander*.
ESCHARA (pars), *Pallas*; *Ellis*; *Gmelin*.
MADREPORA (pars), *Esper*.
FLUSTRA (pars), *Solander*; *Stewart*.
REPTOCELLEPORARIA (sp.), *D'Orbigny*.

The species comprised in the genus *Cellepora,* defined as above, fall very naturally into two groups, which are distinct in habit and general appearance, though very closely alike in their internal constitution.

1. One of these groups, corresponding with the *Reptocelleporaria* of D'Orbigny, contains those species whose polyzoaries are adnate and incrusting, assuming more or less of a globose form, or that of thick, irregular, bossy masses, often of considerable size, though sometimes very minute. This group may be typified by the common *C. pumicosa* of our seas. The other subdivision embraces those species which affect an erect ramose mode of growth, consisting of a stem and irregularly dichotomous, tapering branches. These may be represented by *Cellepora ramulosa.*

Owing to the confused mode of growth of the polyzoarium in *Cellepora,* and the extreme diversities exhibited by the cells in different parts of one and the same specimen, it is in many cases difficult, even in recent species, to determine the true characters of any given fragment. In the case of fossils this difficulty is of course very greatly increased, and I have consequently found it almost impossible to assign positive characters in a great many instances. The definitions and distinctions of species here given must therefore be accepted with great hesitation, and regarded simply as the results of the best consideration of the subject the condition of the specimens has allowed.

SYNOPSIS OF SPECIES OF CELLEPORA.

1. Ramose, suberect.

1. C. coronopus	p. 57, Pl. IX, figs. 1 and 3.
2. C. ramulosa	p. 58, Pl. IX, fig. 2.
3. C. compressa	p. 58, Pl. IX, fig. 4.
4. C. cespitosa	p. 59, Pl. IX, fig. 5.

2. Adnate, incrusting, massive.

5. C. edax	p. 59, Pl. IX, fig. 6.; Pl. XXII, fig. 3.
6. C. tubigera	p. 60, Pl. IX, figs. 8 and 10.
7. C. scruposa	p. 61, Pl. IX, fig. 9.
8. C. parasitica	p. 61, Pl. IX, figs. 11 and 13.
9. C. dentata	p. 62, Pl. IX, fig. 12.

(a) Ramose, not encrusting.

1. C. CORONOPUS, *S. Wood.* Pl. IX, figs. 1, 3.

Polyzoario magno, e ramis cylindraceis apice subattenuatis composito. Cellulis ventricosis, glabris, rostratis, subinde basi punctatis, ostio orbiculari, peristomate antice sinuato.

Polyzoarium large, ramose, branches cylindrical, tapering at the point; cells ventricose; orifice, orbicular, with a narrow sinus in front; a large preoral rostrum; surface entire, smooth; sometimes a few minute punctures around the base.

CELLEPORA CORONOPUS, *S. W.*, l. c., p. 18.
SCYPHIA CELLULOSA (?), *Münster, Goldf.*, Petref. Germ., p. 9, pl. xxxiii, fig. 12.

Habitat.—C. Crag, very abundant, *S. W.*, *J. S. B.*

The appearances represented in Goldfuss's magnified figure of *Scyphia cellulosa* are so precisely those of the present species, that the two might, with little hesitation, perhaps be regarded as identical, were it not that *Scyphia cellulosa* is represented as hollow, whereas all the Crag specimens are solid.

The external characters again of *C. coronopus* agree in many respects with those of *Cellepora cervicornis* as figured by Mr. Couch ('Corn. Fauna,' pt. iii, p. 111, pl. xx, fig. 1); but as that species is described in the text as having the branches compressed, and the cells arranged quincuncially, it probably, notwithstanding Mr. Couch's opinion to the contrary, corresponds with *Cellepora cervicornis* of Dr. Johnston, which is in all probability in reality *Eschara cervicornis* ('Brit. M. Cat.'). But a recent species of *Cellepora*, in habit having a very close resemblance to *Cellepora coronopus*, does exist in the Northern Seas. Specimens of this form were collected by Mr. M. Andrew, on the coast of Norway, and described by me in the 'Annals Nat. Hist.,' 2d Ser. xviii, p. 32, pl. i, fig. 1, under the appellation of *Cellepora cervicornis*. At first sight it appeared natural to suppose that the Crag fossil and this species were the same, but the minute characters are amply sufficient to show that they are quite distinct. In *Cellepora cervicornis* (*mihi*) the cells are coarsely punctured and grooved; the mouth is of the same form as that of *C. coronopus*, but has on each side of it an avicularium, none of which appearances are any where traceable in *C. coronopus*. On the whole, therefore, this must be regarded as a distinct and, so far as I know, an extinct form.

2. C. ramulosa, *Linn.* Pl. IX, fig. 2.

Polyzoario ramoso; ramis cylindraceis attenuatis, apice bifidis. Cellulis ovatis elongatis, rarepunctatis, rostro magno avicularium uno latere ad basim ostendente munitis. Ostio suborbiculari peristomate simplici. Ovicellulâ globosâ, recumbente, punctatâ.

Polyzoarium ramose, branches cylindrical, tapering, forked at the extremities. Cells ovate, elongate, sparsely punctured; orifice suborbicular. A large ascending rostrum in front, with an avicularium on one side of it near the base. Ovicell globose, recumbent, punctured.

Millepora pumicosa (pars), *Pallas*, Elenchus, p. 254.
Cellepora ramulosa, *Linn.; Johnst.*, Trans. Newc. Soc., ii, p. 267, pl. xii, figs. 3, 4; Brit. Zooph., 2d ed., p. 296, pl. lii, fig. 4; *Couch.*, Corn. Faun., pt. iii, p. 110, pl. xx, fig. 2; *Busk*, Brit. Mus. Cat., p. 87, pl. cix, figs. 1, 2, 3.
Cellepora lævis, *Fleming; Couch; Johnst.*

Habitat.—C. Crag, Sutton, *S. W.*, *J. S. B.* (*Recent*) Britain, *ubique.*

This species may always be distinguished by the lateral or sublateral position of the avicularium, by which it is distinguished from *Cellepora pumicosa*, when it occurs, as it often does, in a massive or adnate form around the base of the erect branching stems. In recent specimens the characters are, in most cases, rendered far more distinct by incineration.

3. Cellepora compressa (*n. sp.*) Pl. IX, fig. 4.

Polyzoario subramoso, magno, depresso, massivo; ramis brevibus, compressis angulatis seu subcylindraceis, truncatis. Cellulis ventricosis, alte immersis, sparse punctatis, rostro parvo munitis. Ostio suborbiculari, labio antico recto, subinde aperturâ rotundâ minimâ utrinque ornato.

Polyzoarium large, subramose, depressed, massive; branches short, compressed, angular or subcylindrical, truncate; cells ventricose, deeply immersed, surface sparsely punctured; orifice suborbicular, straight below, with small hollow rostrum in front; and often a rounded opening on each side.

Habitat.—R. Crag, (?) C. Crag, *S. W.*, *J. S. B.*

This species will be far more readily distinguished by its habit and general appearance, than by the minute characters; which, however, even in small fragments are sufficiently distinct from those of *Cellepora coronopus*, to render the diagnosis comparatively easy.

4. CELLEPORA CESPITOSA (*n. sp.*) Pl. IX, fig. 5.

Polyzoario solido, tuberoso; lobis brevibus, subconicis, obtusis inæqualibus, numerosis. Cellulis prorsus immersis, plerumque rostratis, valdè irregularibus, sparse punctatis; ostio orbiculari infra sinuato; cellularum interstitiis cancellatis.

Polyzoarium massive, with numerous irregular, short, subconical eminences or lobes; cells wholly immersed, very irregular, surface sparsely punctured; orifice orbicular, with a sinus below; usually a small rostrum in front of the orifice, often absent. Numerous irregular intercellular rounded openings.

Habitat.—C. Crag, Sutton, *S. W.*

It is extremely difficult to find a cell sufficiently perfect to show the minute characters of this Cellepore. But its peculiar aspect suffices for its identification. It approaches nearest to *C. compressa,* but its growth is much smaller; the short branches are cylindrical and rounded at the extremity, and the surface is less coarsely cellular.

(*b*) *Encrusting, adnate, massive.*

5. C. EDAX (*n. sp.*) Pl. IX, fig. 6; Pl. XXII, fig. 3.

Polyzoario massivo, crasso, mamillato, conchæ parvæ turbinatæ formam gerente. Cellulis ovatis, rhomboidalibus, erectis seu subdecumbentibus, umbonatis, superficie scabrâ, puncturatâ. Ostio supra arcuato, medium versus, constricto, utrinque denticulato, labio inferiori recto.

Polyzoarium forming a dense thick botryoidal mass having the form of a small turbinate shell; cells ovate, rhomboidal erect or subdecumbent, umbonate; surface punctured, rough, mouth rounded above, contracted below the middle, with a small denticle on each side, and straight below.

Habitat.—C. Crag, *S. Wood,* on a species of *Natica and Turritella.* (*Recent*) Coast of Devonshire; *Rev. T. Hincks.*

This is a very peculiar and interesting form. The rather dense crust, which has a botryoidal aspect, appears to have been in all cases formed by superimposed layers of cells covering most usually small turbinate Natica-like shells in most instances of the same species but in other cases a small *Turritella.* The specimens consequently are all very much alike, resembling small thick univalve shells, with a comparatively small circular mouth. But it is curious that it is extremely rare to find in these masses any remains of the original shell. In by far the greater number of instances this appears to have been entirely removed, the sides of the spiral canal being formed by the backs of the polyzoan cells usually disposed in parallel rows, much as they are on the concave surface of some Lunulites. When any remains of the original shell are found, it appears to be reduced to extreme tenuity, and its outer surface to have been eaten away as it were by the parasitic incrustation. I am unable to determine the species of shell which appears to have constituted the most frequent nidus of this Cellepore, but it appears to have been of small size, with a circular mouth. It is to be remarked, also, that other shells, either entire or in fragments, together with minute pebbles, are occasionally found imbedded in the parasitic mass. A curious instance of an apparently living shell having been thus partially entombed is presented in a specimen affording lodgment to a minute *Anomia*, with a smooth subovate upper valve, and a very perfect under valve. The edge of the larger valve just appearing on the surface of the Cellepore, a small portion of the latter was cleared away, when the perfect *Anomia*, with the nacreous lustre quite perfect, and the valves in their undisturbed natural apposition fell out, leaving a cavity, one side of which, corresponding apparently to the lower valve, was smooth and accurately moulded to the surface of the imbedded shell, whilst the opposite was rough and porous, like the general surface of the polyzoary. From this it may probably be concluded that the *Anomia* was thus entombed alive, and that sufficient space was left for the movement of the upper valve. Not being certain that this is the var. γ of *Cell. pumicosa*, noted by Mr. S. Wood, under the term *C. pustulosa*, I have not introduced that synonym, and am the more inclined to omit it, since *C. edax* is altogether distinct from the *Cellepora pustulosa* of Goldfuss ('Petr.,' p. 102, pl. xxxvi, fig. 15). *Cellepora parasitica* of Michelin ('Icon. Zoophyt.,' p. 326, t. lxxviii, fig. 3), is in habit very similar to *C. edax*, but in that species the imbedded shell appears to be unaffected by the parasitic growth, and to retain its natural markings. The species of shell inhabited by it is also different, and the description given of the cells, insufficient as it and the figure may be, would lead to the conviction that the two cannot be identical, though undoubtedly closely allied.

Whilst these sheets are passing through the press, I have received, through the kindness of the Rev. T. Hincks, a specimen of a Cellepore found on the coast of Devonshire, in all respects identical with *C. edax* of the Crag. Like that species, the recent form presents the shape of a small turrited shell, probably a *Turritella;* but what is especially worthy of remark, the shell itself, so far as can be seen, is as completely removed as it is in the fossil Cellepore. That the destruction of the shell, cannot be regarded as accidental, but as due to a specific action in the parasitic growth, is rendered the more probable when it is found to take place in the recent as well as in the fossil state.

6. C. TUBIGERA (*n. sp.*) Pl. IX, figs. 8, 10.

Polyzoario adnato subhemispherico, seu conico. Cellulis distantibus, sparse punctatis; processu unico tubuloso ascendente, avicularium summitate gerente plerumque uno latere tantùm munitis.

Polyzoarium adnate, irregularly convex, or subconical. Cells distant, connected by ridges, sparsely punctured; orifice orbicular, with a sinus in front; cylindrical tubular processes supporting avicularia, arising from the front or side of a cell, or from the intercellular ridges.

Habitat.—C. Crag, on shell, *S. W.* (*Recent*) Britain, South and West Coasts, *G. B.;* Coast of France, *Jeffreys.* Lamlash Bay, Arran. G. West.

This species has been doubtlessly confounded with *Cellepora pumicosa,* with which it agrees very closely in external character; but the distinction between the two is obvious enough on closer examination. *C. tubigera* has a smaller mouth, with a sinus in front; and instead of the strong conical rostrum, with an avicularium in its inner aspect, so characteristic of *Cellepora pumicosa,* most of the cells are provided with slender sub-cylindrical ascending processes, having a small avicularium at or near the summit. The cells, also, are rather more punctured than they usually are in *Cellepora pumicosa.*

7. C. SCRUPOSA (*n. sp.*?) Pl. IX, fig. 9.

Polyzoario massivo, irregulari, adnato. Cellulis urceolatis?, contiguis, crassis superficie integrâ, subinde rostro minuto suborali armatis. Ostio orbiculari, antice sinuato.

Polyzoarium massive, irregular, adnate. Cells urceolate? contiguous; wall very thick; surface entire; orifice orbicular, with a sinus in front; sometimes a minute rostrum before the orifice.

Habitat.—C. Crag, on shell, ? *S. W.*

This species is given with much hesitation, for the only specimen at command is hardly in a state to admit of precise determination. The most striking peculiarity is the comparatively great thickness of the walls of the cells.

8. C. PARASITICA, *Michelin.* Pl. IX, figs. 11, 13.

Polyzoario incrustante, massivo, irregulari. Cellulis urceolatis, ventricosis, distantibus, subinde rostratis; spatiis inter cellulas punctatis. Ostio suborbiculari, antice sinuato.

Polyzoarium encrusting, massive, irregular; cells urceolate, ventricose, distant; intercellular spaces punctured; orifice suborbicular, with a sinus in front; occasionally a rostrum in front, or on one side of the cell.

C. PARASITICA, *Mich.*, Icon. Zooph., p. 326, pl. lxxviii, fig. 3.

Habitat.—Cor. Crag, on *Turritella planisphera;* Red Crag, on *Nassa, S. W.;* Touraine, on *Gorgonia* and univalve shells, *Michelin.*

The habit of this species, which is obviously quite distinct from *C. edax* and *C. pumicosa,* is well expressed in M. Michelin's words: "incrustans, involvens."

9. C. DENTATA (*n. sp.*) Pl. IX, fig. 12.

Polyzoario adnato, repente; lepraliæformi. Cellulis subglobosis in crustâ calcareâ denso ad dimidium immersis; rostro brevi, forti, conico avicularium gerente munitis. Ostio infundibuliformi, suborbiculari, antice dente lato interno armato.

Polyzoarium adnate, spreading; cells subglobose, half immersed in a dense calcareous layer; orifice infundibuliform, suborbicular, with a broad denticle within the anterior margin; a short, stout, conical rostrum supporting an avicularium in front of the orifice.

Habitat.—Cor. Crag, on shell, *S. W.*

A form intermediate between *Cellepora* and *Lepralia.* Agreeing with the former in the erect position of the cells and the ascending rostriform avicularium in front of the orifice, and with the latter in the nearly regular disposition of the cells in a single layer, except at the middle of the crust, when they become more irregularly heaped.

Fam. VI. *ESCHARIDÆ,* Busk.

Polyzoarium erectum, rigidum, compressum, foliaceum, ramosum, lobatum seu reticulatum; e cellulis decumbentibus ad unâm vel utramque faciem spectantibus compositum.

Polyzoarium erect, rigid, compressed, foliaceous, ramose, lobate, or reticulate. Cells disposed in the same plane, on one or both sides of the polyzoarium.

ESCHARIDÆ, *Busk,* B. M. C., p. 88; (pars) *Johnston; D'Orbigny,* Auct.
LEPRALIANA and RETEPORANA, *Gray.*

SYNOPSIS OF GENERA.

1. Two layers of cells.

   a. Layers of cells inseparably united by a distinct calcareous septum.

   1. Eschara.
   2. Melicerita.

b. Layers readily separable.

3. Biflustra.

2. Cells in a single layer.

a. Reticulate.

4. Retepora.

b. Continuous.

5. Hemeschara.

Genus 1. Eschara, *Ray*.

Polyzoario erecto, foliaceo, integro vel subdiviso, sive e ramis angustioribus aut latioribus composito, cellulas in utraque facie gerente. Cellulis decumbentibus, quincuncialibus, in seriebus longitudinalibus dispositis. Lamellis conjunctis.

Polyzoarium erect, foliaceous and expanded, or ramose and lobate, with wide or narrow divisions. Cells decumbent, disposed in longitudinal series quincuncially on both surfaces; the layers inseparable.

Eschara (pars), *Ray; Ellis; Pallas; Lamarck.*
— *Johnston; D'Orbigny; Hagenow; Reuss; M. Edwards; Busk*, &c.
Flustra (pars), *Linn.*
Millepora (pars), *Solander.*
Cellepora (pars), *Esper.*

The characters above given are sufficient to distinguish all the species of this genus in their complete or mature condition; but it must be remarked, that as in the case of *Flustra foliacea*, so in some species of *Eschara*, the polyzoarium sometimes, in fact usually, as it would seem, spreads out into an adnate crust on the surface of the stone or shell upon which the growth is affixed. Detached portions of such a crust are indistinguishable from a *Lepralia*, and it is not improbable that this mistake has been often made, and it is one to which the paleontological observer is peculiarly liable.

The genus *Eschara* is naturally subdivided into two sections, which though running into one another, are usually sufficiently distinct for all practical purposes. In one of these divisions the polyzoarium is broad, expanded and foliaceous, variously folded and contorted, but not subdivided into distinct lobes. Of this division *E. foliacea* affords a good type. In the other division the polyzoary is divided into branching lobes of various forms, and differing considerably in width in different species—sometimes broad, short, and expanded, sometimes constituting narrow or even ligulate branches, occasionally so slender as, except on careful inspection, to appear cylindrical. A transverse fracture, however, will, in doubtful cases, show the median plane parting the two layers of cells, and distinguishing any form of *Eschara* from a *Vincularia* or *Salicornaria*.

The cells in *Eschara* are of the open, urceolate form, decumbent, and generally confluent. In most cases they are of uniform character throughout the growth, but in some instances those at the margin of the branches or lobes differ from the others. Many, if not all the *Escharæ*, are furnished with avicularian organs, which are either situated in some part of the cell itself, or are what may be termed *intercellular*, replacing, in fact, one of the ordinary cells; and this appears to have been a frequent condition in the older fossil forms. In most *Escharæ* ovicells of the usual kind are met with, but in some these organs appear to be replaced by cells very different in form, and of far larger dimensions than the ordinary cells, and which are in some cases widely open, and in others closed in front by a cribriform calcareous plate. These larger cells, which have been termed by M. D'Orbigny "accessory cells" (cellules accessoires), were by that observer supposed to represent the habitations of male polypides; but as this explanation is irreconcileable with all we know respecting the sexual relations of the Polyzoa, it is clearly not admissible. The more probable supposition would appear, as above said, to be, that these are the fertile cells of the polyzoarium. I am unacquainted with any living *Eschara* furnished in this way, but it may be remarked that a very similar provision exists in the genus *Selenaria*, B., one of the living Lunulites.

The genus seems to have made its first appearance in the Jurassic period, to have been tolerably numerous in species in the Cretaceous and Tertiary, and probably at present to be still more prolific in species than at any former period, although, as remarked by M. Edwards, no fossil species has been clearly identified with one now existing; the *Eschara foliacea* of Michelin ('Icon. Zoophyt.,' pl. xiv, fig. 9) clearly not belonging to that species, if an *Eschara* at all. M. D'Orbigny remarks, that all the *Escharæ* of the Cretaceous period have the walls of the cell imperforate, whilst in the Tertiary and more recent forms they are usually perforated.

SYNOPSIS OF SPECIES OF ESCHARA (Fossil in the Crag).

(*a*) Foliaceous.

(*b*) Lobate or ramose.

(*a*). *Foliaceous.*

1. E. PERTUSA, *M. Edwards.* Pl. X, fig. 2.

Polyzoario complanato; cellulis elongatis angustis, seriebus pororum 4 vel 5 longitudinalibus signatis, rostroque ascendente avicularium supra gerente munitis. Ostio supra rotundato, medium versus constricto, utrinque denticulato, labio inferiori recto.

Polyzoarium expanded; cells elongated, narrow; surface punctured with four or five longitudinal rows of pores; orifice rounded above, contracted below, with a small condyloid denticle on each side below the middle, and a straight lower border. A projecting rostrum supporting an avicularium on its upper surface, immediately below the orifice; ovicells subglobose, smooth.

ESCHARA PERTUSA, *M. Edwards,* l. c., p. 9, pl. x, fig. 3; *S. Wood,* Ann. Nat. Hist., xiii, p. 16; *Michelin* (?), Icon. Zooph., pl. lxxix, fig. 2.

Habitat.—C. Crag, *S. W.*, *M. Edwards;* Douè (?), *Michelin.*

The peculiar features of this well-marked form are—1. The narrow, elongated shape of the cells. 2. The projecting rostrate avicularium in front of the orifice, which in many of the cells is expanded into a large, hollow, egg-shaped protuberance, supporting on its summit the much enlarged avicularium. These organs were regarded by M. M. Edwards as ovicells, but their avicularian nature is sufficiently manifest, and, moreover, true ovicells exist in the usual situation. With respect to the latter, it may be remarked that they often present a rounded perforation in front, but which, from its appearance, would seem to be due to attrition, and not to represent a natural aperture.

2. E. INCISA, *M. Edwards.* Pl. X, fig. 3.

Polyzoario undato-flexuoso; cellulis junioribus ovalibus, puncturatis; senioribus immersis, obsoletè punctatis. Ostio suborbiculari, infra sinuato. Ovicellulis altè immersis inconspicuis.

Polyzoarium contorted; cells when young oval, punctured; when old, deeply immersed, with the punctures obsolete or nearly so; orifice suborbicular with a sinus below; ovicells deeply immersed.

ESCHARA INCISA, *M. Edwards,* l. c., p. 5, pl. ix, fig. 2; *Michelin* (?), Icon. Zooph., p. 328, pl. lxxviii, fig. 7; *S. Wood,* l. c., p. 16.

Habitat.—C. Crag, Sudbourne, Sutton; *S. W.*, *M. Edwards;* Touraine, *Michelin.*

The form represented in our figure is referred with some little doubt to *E. incisa* of M. Edwards, and chiefly from the shape of the orifice. The only other fossil species having an orifice of the same or nearly similar form, are *E. sinuosa*, nob., and *E. monilifera*, M. E. The distinctions between the latter and *E. incisa* are too obvious to require remark. Those between *E. incisa* and *E. sinuosa* consist: 1. In the peculiar habit of the polyzoary in the latter, and its far greater thickness. 2. In the large size of the orifice of the cells, and its being always surrounded by large well-marked pores, with which the rest of the surface is also closely beset.

3. E. porosa, *M. Edw.* Pl. XI, fig. 4.

Polyzoario valde flexuoso, contorto, cavernoso. Cellulis ovalibus vel pyriformibus, presertim ad marginem punctatis. Ostio angustato, transversali, supra rotundato, labio inferiori recto, subinde mucronato. Ovicellulis immersis punctatis.

Polyzoarium much contorted, cavernous; cells oval or pyriform; surface punctured especially around the border; orifice rounded above, narrow and elongated from side to side, with a straight or slightly mucronate lower lip; ovicells immersed, punctured.

E. porosa, *M. Edwards*, l. c., p. 13, pl. xi, fig. 7; *S. Wood*, l. c., p. 17.

Habitat.—C. Crag, *S. W.*; Subapennine, *M. Edwards.*

This species is referred with some doubt to M. Edwards's *E. porosa*, but upon consideration of the general characters exhibited in his figures and description, there appears to be good reason for believing that the Subapennine and Crag fossils will be found identical.

4. E. sinuosa, (*n. sp.*). Pl. X, fig. 6.

Polyzoario pedunculato, e lobis distinctis, sinuosis composito; cellulis immersis, superficie presertim circa ostium punctatâ; ostio suborbiculari, labio inferiori inciso, subinde tantum perforato.

Polyzoarium disposed in sinuous distinct folds, arising from a contracted peduncle which is attached by an expanded base; cells wholly immersed; orifice suborbicular with a narrow sinus below, and sometimes a small opening instead of the sinus; surface punctured around the orifice and usually in the interspaces also.

Habitat.—C. Crag, *S. W.*

The peculiar habit of growth in this species renders its diagnosis, when tolerably perfect, very easy. Small fragments, however, could not be so readily distinguished from overgrown specimens of other species, as for instance in the very old condition of the recent *E. cervicornis.* Attention to the circular sinuated orifice which will be seen at the bottom of a funnel-shaped pit encircled by a row of puncta, will, however, in most cases be sufficient for its distinction.

5. E. CORNUTA, (*n. sp.*) Pl. IV, fig. 7, and Pl. X, fig. 5.

Polyzoario explanato irregulari; cellulis ovalibus seu rhomboidalibus, superficie granulosâ, ad marginem seriatim punctatis, rostro magno avicularium gerente munitis. Ostio magno, rotundato, supra paulatim constricto, labio inferiori subrecto, peristomate supra spinâ unicâ vel duplici et infra utrinque spinâ marginali forti conicâ armato.

Polyzoarium expanded irregular; cells oval or rhomboidal; surface granular; a single row of large channelled pores round the border; orifice large, round, and contracted above; lower border straight, or slightly hollowed; a large conical spine on each side of the orifice below, and one or two spines of less size above; a prominent rostrate avicularium on the front of the cell.

Habitat.—C. Crag, *S. W.*, *J. S. B.*

(*b*) *Lobate or ramose.*

6. E. SEDGWICKII, *M. Edw.* Pl. X, fig. 1.

Polyzoario e lobis latioribus composito; cellulis oblongis, supra latioribus, superficie porosâ, ad marginem seriatim punctatis; aviculario immerso centrali, vel haud raro laterali et ostium juxta munitis. Ostio permagno, suborbiculari, infra subinde constricto, labio inferiori submucronato. Ovicellulâ magnâ, altâ, subglobosâ.

Polyzoarium broadly lobate; cells oblong, expanded above, surface punctured with a distinct row of pores around the border and orifice. Orifice very large, suborbicular, sometimes contracted and submucronate below; an immersed avicularium usually in the centre of the cell in front, but sometimes placed on one or both sides near the orifice; ovicell large, lofty, subglobose.

ESCH. SEDGWICKII, *M. Edw.*, l. c., p. 10, pl. x, fig. 8; *S. Wood; Michelin* (?), Icon. Zooph., p. 328, pl. lxxviii, fig. 6.

Habitat.—Cor. Crag, Sudbourne, *S. W.*, *M. Edwards*; Doué, *Michelin.*

The incipient "capsules gemmifères" of M. M. Edwards, are the central avicularia, which may be regarded as the most distinctive character of this species. In the majority

The form represented in our figure is referred with some little doubt to *E. incisa* of M. Edwards, and chiefly from the shape of the orifice. The only other fossil species having an orifice of the same or nearly similar form, are *E. sinuosa*, nob., and *E. monilifera*, M. E. The distinctions between the latter and *E. incisa* are too obvious to require remark. Those between *E. incisa* and *E. sinuosa* consist: 1. In the peculiar habit of the polyzoary in the latter, and its far greater thickness. 2. In the large size of the orifice of the cells, and its being always surrounded by large well-marked pores, with which the rest of the surface is also closely beset.

3. E. POROSA, *M. Edw.* Pl. XI, fig. 4.

Polyzoario valde flexuoso, contorto, cavernoso. Cellulis ovalibus vel pyriformibus, presertim ad marginem punctatis. Ostio angustato, transversali, supra rotundato, labio inferiori recto, subinde mucronato. Ovicellulis immersis punctatis.

Polyzoarium much contorted, cavernous; cells oval or pyriform; surface punctured especially around the border; orifice rounded above, narrow and elongated from side to side, with a straight or slightly mucronate lower lip; ovicells immersed, punctured.

E. POROSA, *M. Edwards*, l. c., p. 13, pl. xi, fig. 7; *S. Wood*, l. c., p. 17.

Habitat.—C. Crag, *S. W.*; Subapennine, *M. Edwards.*

This species is referred with some doubt to M. Edwards's *E. porosa*, but upon consideration of the general characters exhibited in his figures and description, there appears to be good reason for believing that the Subapennine and Crag fossils will be found identical.

4. E. SINUOSA, (*n. sp.*). Pl. X, fig. 6.

Polyzoario pedunculato, e lobis distinctis, sinuosis composito; cellulis immersis, superficie presertim circa ostium punctatâ; ostio suborbiculari, labio inferiori inciso, subinde tantum perforato.

Polyzoarium disposed in sinuous distinct folds, arising from a contracted peduncle which is attached by an expanded base; cells wholly immersed; orifice suborbicular with a narrow sinus below, and sometimes a small opening instead of the sinus; surface punctured around the orifice and usually in the interspaces also.

Habitat.—C. Crag, *S. W.*

The peculiar habit of growth in this species renders its diagnosis, when tolerably perfect, very easy. Small fragments, however, could not be so readily distinguished from overgrown specimens of other species, as for instance in the very old condition of the recent *E. cervicornis*. Attention to the circular sinuated orifice which will be seen at the bottom of a funnel-shaped pit encircled by a row of puncta, will, however, in most cases be sufficient for its distinction.

5. E. cornuta, (*n. sp.*) Pl. IV, fig. 7, and Pl. X, fig. 5.

Polyzoario explanato irregulari; cellulis ovalibus seu rhomboidalibus, superficie granulosâ, ad marginem seriatim punctatis, rostro magno avicularium gerente munitis. Ostio magno, rotundato, supra paulatim constricto, labio inferiori subrecto, peristomate supra spinâ unicâ vel duplici et infra utrinque spinâ marginali forti conicâ armato.

Polyzoarium expanded irregular; cells oval or rhomboidal; surface granular; a single row of large channelled pores round the border; orifice large, round, and contracted above; lower border straight, or slightly hollowed; a large conical spine on each side of the orifice below, and one or two spines of less size above; a prominent rostrate avicularium on the front of the cell.

Habitat.—C. Crag, *S. W.*, *J. S. B.*

(*b*) *Lobate or ramose.*

6. E. Sedgwickii, *M. Edw.* Pl. X, fig. 1.

Polyzoario e lobis latioribus composito; cellulis oblongis, supra latioribus, superficie porosâ, ad marginem seriatim punctatis; aviculario immerso centrali, vel haud raro laterali et ostium juxta munitis. Ostio permagno, suborbiculari, infra subinde constricto, labio inferiori submucronato. Ovicellulâ magnâ, altâ, subglobosâ.

Polyzoarium broadly lobate; cells oblong, expanded above, surface punctured with a distinct row of pores around the border and orifice. Orifice very large, suborbicular, sometimes contracted and submucronate below; an immersed avicularium usually in the centre of the cell in front, but sometimes placed on one or both sides near the orifice; ovicell large, lofty, subglobose.

Esch. Sedgwickii, *M. Edw.*, l. c., p. 10, pl. x, fig. 8; *S. Wood; Michelin* (?), Icon. Zooph., p. 328, pl. lxxviii, fig. 6.

Habitat.—Cor. Crag, Sudbourne, *S. W.*, *M. Edwards*; Doué, *Michelin*.

The incipient "capsules gemmifères" of M. M. Edwards, are the central avicularia, which may be regarded as the most distinctive character of this species. In the majority of specimens these organs occupy the centre of most of the cells, whilst in other instances, far more rare apparently, they will be found situated on other parts of the cell, as close to the orifice and below it on one or both sides, or on a level with it, that is to say, quite at the summit of the cell on one side, when the avicularium is generally of far larger size, and presents the form of an elongated spoon-shaped process.

E. Sedgwickii sometimes occurs in the crustaceous form.

7. E. MONILIFERA, *W. Edwards.* Pl. XI, figs. 1, 2, 3.

Polyzoario pedunculato, palmato, seu multiformi. Cellulis immersis, pyriformibus, elongatis, fronte carinatis, pororum serie longitudinali unicâ, duplicive ad latera ornatis; ostio orbiculari, infra sinuato vel canaliculato, avicularium utrinque ostendente. Ovicellulis nullis. Cellulis fertilibus (?) magnis, immersis, irregulariter inter vulgares sparsis.

Polyzoarium pedunculate, palmate, or multiform; cells immersed, pyriform, elongated, carinate in front, with one or two longitudinal rows of punctures on each side; orifice orbicular, sinuated, or channelled below; an avicularium on each side of the mouth. No ovicells. Fertile (?) cells large, immersed, dispersed irregularly throughout the polyzoary.

E. MONILIFERA, *M. Edwards*, l. c., p. 7, pl. ix, fig. 1; *Michelin*, l. c., p. 327, pl. lxxviii, fig. 10; *S. Wood*, l. c., p. 16.

Habitat.—C. Crag, Sudbourn, *S. W.*; *J. S. B.*; Faluns, Touraine, *M. E.*; Cléons (Loire-Inférieure), Sceaux, Thouarcé (Maine-et-Loire), *Mich.*

This species, which from the great abundance in which it occurs in the Coralline Crag, may be regarded as the characteristic Polyzoon of that formation, has been so well described by M. M. Edwards that it is scarcely necessary to do more than refer to his observations respecting it. The polyzoary exhibits extraordinary diversities of form; its lobes or divisions varying from slender subcylindrical and ligulate branches, to broad, wavy, foliaceous expansions. All the various forms, however, agree in the circumstance that the growth springs from a contracted, usually hollow, peduncle, slightly expanding at the base, by which it is attached to shells and rocks. The cells in the younger portions are elongated, pyriform and raised in front, especially at the upper part, into a sort of angular ridge or keel, and the surface on each side of the cell is marked with a longitudinal row of pores, the rows belonging to two contiguous cells, being separated by a somewhat raised line. The orifice is placed at the summit of the cell, and looks obliquely upwards and forwards; it is suborbicular, and sinuated in front or below, the sinus being sometimes produced into a channel. And on each side of the lower border of the orifice is a perforated process or tubercle, supposed by M. M. Edwards, as in other species, to represent a gemmiferous capsule. The form of the opening, however, clearly indicates that these processes are avicularia. From their position and form, they are very characteristic of the species, even where most of the other characters are obliterated. No ovicells, like those in most other polyzoa, appear to exist in *E. monilifera;* but intermixed irregularly among the common cells, there will be observed in many specimens, though not in all, large openings, of a quadrangular form, four or five times the size of the mouths of a cell, and occupying in fact the entire front of a cavity at least twice the dimensions of a common cell. These openings are usually patent, but in many instances they are closed by a cribriform calcareous plate, and have below them a curious bracket-like shelf, at the upper angles, of which on either side may be noticed in some cases the traces of minute avicularia corresponding to those on each side of the mouth in the other cells. These peculiar cells, the "accessory cells" of D'Orbigny, may probably be taken, as before said, to represent the fertile cells of *E. monilifera.* One is represented, covered in by its cribriform plate, at *a* fig. 2, plate XI.

Very considerable differences of appearance in this *Eschara* are produced by age. In the older cells, as remarked by M. Edwards, the mouth, without much change of form, becomes immersed, and finally altogether filled up; the pores also are obliterated, and the surface appears solid, either marked by the ridges indicating the situation of the cells, or nearly smooth, with only indistinct undulating lines, more like those on the surface of a piece of a Corallium, than of the skeleton of any Polyzoon.

Genus 2. MELICERITA. *M. Edwards.*

Polyzoarium explanatum, e cellulis quincuncialibus in utrâque superficie et in seriebus transversis dispositis compositum. Lamellis conjunctis.

Polyzoarium composed of cells disposed quincuncially on both surfaces in transverse series; the two layers inseparable.

MELICERITA, *M. Edwards,* Sur l. Eschares foss., p. 25.
MELICERTINA, *Ehrenb.*
ULIDIUM, *S. Wood,* Ann. Nat. Hist., xiii, p. 17.

The distinction between this genus and that of *Eschara,* to which it is very closely allied, was first indicated by M. M. Edwards, who observes (l. c.) that the "mutual relation of the cells is essentially different from that which obtains in the latter genus." In *Eschara* each cell produces at its superior extremity another cell, so that the aggregate growth is eventually made up of parallel longitudinal series, the cells in the contiguous series being for the most part regularly alternate, and having their longitudinal axis coincident with that of the series to which they belong; the only interruption to this uniformity consisting in the circumstance that occasionally one of the cells in a series will give origin to two, from which are continued two distinct series, and so on. Thus in *Eschara* the mouths of the cells are placed one above another in the longitudinal direction of the series, and alternate with those of the contiguous series on each side.

In *Melicerita*, on the contrary, the cells are disposed in transverse series, the summit of each cell corresponding to the line of junction of the cells in the series above; so that the mouths of the cells are opposite those on each side of them. As remarked by M. M. Edwards, this constant difference in the disposition of the cells may be taken to represent a corresponding difference in the organization of the animal. The peculiar disposition itself is to be explained upon the supposition that the buds are thrown out in *Melicerita*, not from the summit of the parent-cell, but from one side of the summit.

Besides the Crag Fossil, I have been able to find only a single species referrible to this genus, which thus appears to be of very limited importance. The species in question is the *Eschara Acasta* of D'Orbigny ('Terr. Crét.,' pl. dclxii, figs. 7—9), which may be presumed to belong to the Cretaceous period.

1. M. Charlesworthii, *M. Edw.* Pl. X, fig. 4.

Polyzoario foliaceo, explanato; cellulis marginatis, hexagonis, fronte lineâ elevatâ utrinque ornatâ. Ostio transversali, semilunari, utrinque denticulato, dentemque latum bicuspidatum internum supra ostendente. Ovicellulis immersis, inconspicuis, aperturâ semilunari in apice cellulârum positâ; aviculariis immersis inter cellulas sparsis.

Polyzoarium foliaceous, expanded; cells with a raised border, hexagonal; orifice transverse, crescentic, having a condyloid tooth on each side below, and a broad bicuspid denticle within the upper border; usually a raised line on each side of the front of the cell which converge below; scattered intercellular avicularia. Ovicells immersed, inconspicuous, opening by a crescentic slit within the summit of the cell.

Melicerita Charlesworthii, *M. Ed.*, l. c.; *D'Orbigny; J. Morris.*
Melicertina Charlesworthii, *Ehr.*
Ulidium Charlesworthii, *S. Wood.*

In this species, as well as in *M. Acasta*, D'Orbigny (sp.), the cells are bordered by raised ridges, which subdivide the surface of the polyzoarium into hexagonal areas, as in *Salicornaria*, with which, in some respects, the present genus would seem to correspond. This character, therefore, might perhaps be admitted into the generic definition. The mouth of the cell, which is placed about the middle of the hexagonal area, is crescentic in form, transverse, and surrounded with a raised peristome; within it, at the lower border, will be observed two condyloid teeth, like those often so much developed in *Salicornaria*, and a broad bicuspid plate or denticle depends within the upper margin. On each side of the mouth is a raised line, the two meeting towards the lower part of the cell, also a particular in which *M. Charlesworthii* agrees with some *Salicornariæ*. Another point in which this agreement is perhaps still more manifest, is in the condition of the ovicell, which is itself, as in that genus, quite inconspicuous, though its orifice is manifest enough in a crescentic, or rather horse-shoe-shaped fissure, immediately within the angle which forms the summit of the cell-area. This opening is usually much enlarged by attrition or fracture, and then appears as a rounded orifice of considerable size.

Dispersed irregularly among the other cells, and apparently breaking their uniformity of arrangement, are smaller areas of irregular shape, containing an elongated, curved falciform opening. These are obviously large avicularia, which in this case replace the true cells, and do not belong to any individual cell. Many instances of a similar arrangement of avicularia exist also among the extinct *Escharæ*, especially among those belonging to the Cretaceous period.

Genus 3. Biflustra, *D'Orbigny.*

Polyzoario foliaceo seu ramoso; cellulis apertis, marginatis, quincuncialibus, in utrâque superficie in seriebus longitudinalibus dispositis. Lamellis, seriebusque cellularum facile disjungendis.

Polyzoarium foliaceous or ramose; cells open in front, with a distinct raised border, disposed quincuncially on both surfaces in longitudinal series. The two layers of cells readily separable, as are also the longitudinal series.

Biflustra, *D'Orbigny*, Recherches sur les Moll. Bryoz., Ann. d. S. Nat., 3d ser., xviii, p. 330.

M. D'Orbigny observes that his genus *Biflustra* stands in the same relation to Membranipora that Eschara holds with respect to *Cellepora* (*Lepralia*); that is to say, that it is composed of free *Membraniporæ* applied back to back. He also states that there are both living and fossil species, and that the former inhabit deep water in both hot and cold regions; one species coming from Newfoundland, and a second from the seas around Manilla. The only living form, however, with which I am acquainted, referrible to this genus, is one from Australia, and probably, therefore, identical with that from Manilla, alluded to by the French observer. It appears, so far as I know, not to have been described; and as it is in all respects identical with the Crag Fossil, it must be regarded as of considerable interest.

It forms large foliaceous, cavernous masses, of a beautiful white aspect, and exceedingly light and fragile. The polyzoarium is composed of very regular quadrangular cells, with granular margins, and widely open in front, whilst behind they are closed by a distinct wall. Each layer of cells being thus readily separable from the other, and not intimately united, as in *Eschara*. The dorsal surface of each layer, when they are separated, is smooth and longitudinally sulcate, or like a ridge and furrow roof, the ridges and furrows of the opposed surfaces fitting into each other. The longitudinal lines of cells are also easily separated laterally, though perhaps not quite so readily as in the other direction.

No description or figure of the recent species which was procured by Mr. M'Gillivray, in the voyage of the "Rattlesnake," has as yet been published. I have, therefore, given in Pl. I, fig. 1, magnified figures of portions of it, for comparison with similarly magnified figures of the fossil form (fig. 2). In the 'Paléontologie Française,' M. D'Orbigny describes and figures sixty fossil species of *Biflustræ*, a number which doubtless very far exceeds that of the truly distinct forms. Among these, none are foliaceous or expanded, all being either subcylindrical and closely allied to *Vincularia*, or compressed and ramose, many of which might perhaps, with equal justice, be referred to *Eschara*. In the figures no indication is afforded that the two layers are readily separable; but as M. D'Orbigny includes this peculiarity in the generic character, it is to be presumed that the species depicted do possess it.

The genus consequently may be subdivided into two groups.

(*a*) Polyzoarium foliaceous, expanded, subcylindrical, compressed.
(*b*) Polyzoarium ramose.

The genus, as above defined, would seem to have commenced in the Cretaceous period, during which it attained its greatest development, the species afterwards appearing to become isolated and far less numerous up to the recent epoch, when they seem to have dwindled down to one or two.

1. B. DELICATULA (*n. sp.*) Pl. I, figs. 2 and 4; Pl. II, fig. 7.

Cellulis quadrangularibus, oblongis, supra arcuatis; septis, laminâque granulosis; apertura ovatâ, suborbiculari seu ellipticâ; dentem serratum internum infra ostendente.

Cells quadrangular, oblong, arched above; septa and lamina granular; aperture ovate, suborbicular, or elliptical; a serrate denticle within the lower margin.

Habitat.—C. Crag; occurring abundantly in large irregular fragments, *S. W.*, *J. S. B.* (*Recent*), Australia, Manilla?

Genus 4. Retepora, *Imperato.*

Polyzoario foliaceo, reticulato, infundibuliformi seu contorto, subpedunculato. Cellulis decumbentibus superficie superiori seu internâ tantum se ostendentibus.

Polyzoarium foliaceous, reticulate, infundibuliform, or contorted, subpedunculate; cells decumbent, opening on the upper surface only.

Retepora, *Imperato; M. Edwards* (note in *Lamarck*, An. S. Vert., 2d ed., ii, p. 275); *Johnston; Busk; D'Orbigny; Risso; Reuss.*
— (pars), *Lamarck; Lamouroux; Blainville; Hagenow; Goldfuss.*
Millepora (pars), *Linn.; Pallas,* &c.

The peculiar conformation of the polyzoary in *Retepora,* renders the species of which it is composed very readily recognisable generically. It is far otherwise, however, with respect to the diagnosis of the species themselves. Even in recent and living forms, and under the most favorable conditions of age and growth, it is not always very easy to obtain a satisfactory view of the minute characters upon which alone the distinctions between different species certainly rest. In the case of fossil specimens this difficulty is of course greatly increased, owing to the usually fragmentary condition in which they occur, and to the circumstance that the minute characters are either worn off or concealed by encrusting matter, so as to be rendered indistinct. The characters, therefore, here assigned to what would appear to be distinct species, must be understood as liable to future correction. The careful consideration of numerous specimens has shown pretty clearly that the forms described are distinct, *inter se,* but whether better absolute characters for each may not hereafter be assigned, cannot be affirmed.

The only genus with which that of *Retepora* can be confounded is *Hornera,* several species of which affect a very similar habit of growth, and consequently were formerly regarded as congenerous with the true Retepores. The distinction between them appears to have been first indicated by M. M. Edwards (l. c.). One broad distinction, obvious to the naked eye, exists in the circumstance that in the true Retepores the polyzoary is composed of pretty nearly equal-sized branches, anastomosing so as to constitute elliptical meshes, whilst in the reticulate *Horneræ,* it consists of tolerably straight, subparallel, wider branches, connected at uniform distances by short transverse ramuscules, at right angles to the former, by which arrangement the meshes or fenestræ are rendered more or less oblong or triangular.

In *Retepora* the cells open on one side only of the polyzoarium; the opposite or dorsal surface being smooth, or sometimes very finely granulous, and divided, as it were, into sections by lines, (*vibices*) which are usually raised above the surface. These lines do not correspond with the outlines of individual cells, but seem, in cases where they are well developed, to be tubular, representing, in all probability, the radical tubes of some other cheilostomatous Polyzoa. There will, furthermore, be observed on the dorsal aspect, in some species, avicularia, variously placed with respect to the fenestræ, and whose situation appears to afford pretty constant specific characters.

1. R. CELLULOSA, *Linn.* (*sp.*) Pl. XII, fig. 1.

Polyzoario turbinato seu crateriformi, undulato, crispo; dorso vibicato et apud angulos fenestrarum inferiores, avicularia papilliformia exhibente. Cellulis subcylindraceis superficie glabrâ. Ostio suborbiculari, labio inferiori rostriformi, uno latere aviculario armato.

Polyzoarium turbinate or crateriform, undulated, curled. Cells subcylindrical, surface smooth; orifice suborbicular, lower lip projecting, with an avicularium on one side; dorsal surface strongly vibicate; a papilliform avicularium at the lower angle of the fenestræ.

RETEPORA ESCHARA MARINA, *Imperato,* Hist. Nat., p. 821, 1559.
MADREPORA FORMA ROSÆ, *Marsigl.,* Hist. d. l. Mer., p. 149, tab. xxxiii, fig. 161, 1725.
RETICULUM MARINUM., *Rumph.,* Amboin., vi, p. 247, t. lxxxvii, fig. 6, 1705.
MILLEPORA (sp.), *Ellis,* Corallin., p. 72, tab. xxv, fig. *d* D, 1755.
— RETEPORA, *Pallas,* Elench., p. 243, 1766; *Borlase,* Cornw., p. 240, pl. xxiv, fig. 8.
— CELLULOSA, *Linn.,* Syst. x; *Jameson,* Wern. Mem., i, 560; *Cavolini,* Pol. Mar., p. 64, tab. iii, figs. 12, 13, 1785; *Esper,* Mill., tab. i, 1791—8.
— FORAMINOSA, *Ellis* and *Solander,* Zooph., p. 138, pl. xxvi, fig. 2, 1786.
RETEPORA CELLULOSA, *Lamk.,* Ann. S. Vert., tom. ii, p. 182, 1815—22, 2d ed., tom. ii, p. 276, 1836; *Lamx.,* Exp. Meth., p. 41, tab. xxvi, fig. 2, 1821; *Blainville,* Man. d'Actin., p. 433; *Alas,* pl. lxxvi, fig. 1; *Busk,* B. M. Cat., part ii, p. 94, pl. cxxi, figs. 3—8; pl. cxxiii, figs. 5, 6, 7; *Reuss,* Foss. Polyp. W. Tertiar-beck, p. 47, tab. vi, fig. 34, 1847; *Michelin,,* Iconog. Zooph., p. 71, pl. xiv, fig. 10, 1847.
— RETICULATA, *Johnst.,* Brit. Zooph., 2d ed., vol. i, p. 253 (ex. syn.), 1847.
— FRUSTULATA (?), *Lamarck,* Ann. S. Vert., 2d ed., p. 279; *Defrance,* Dict. des Sc. N., t. 45, p. 282; *Blainville,* Man. d'Act, p. 434.

Habitat.—Cor. Crag, *S. W.; J. S. B.;* in the Leithakalke of Eisenstadt and Mörbisch, in Hungary; Tertiary Marls of Freden Luitherst and Diekholz, and of Astrupp, near Osnabrück; on the Superga, Turin; South of France, *Reuss;* Angers, *Menard;* Doué and Vihier (Maine-et-Loire); St. Laurent des Mortiers (Mayenne), Angles and Vedennes (Vaucluse), L'Etang de Thau, near Cette (Hérault), *Michelin.* (*Recent*) Mediterranean; Britain, south and west coast.

The distinguishing characteristics of *Retepora cellulosa* are—the existence on one side of the lower lip, or a little below it, of an elongated slit-like avicularium; the absence of a rostrate avicularium in front of the mouth; and the presence, pretty generally, of an avicularium usually raised on a small papilla at the lower angle of each fenestra on the back of the polyzoary. Although the fragments found in the Crag are small, very imperfect, and rather rare, yet the characters above mentioned have been satisfactorily made out. It is a living British species, but found, I believe, only on the south and south-west part of the coast, but it is abundant on the Coast of Spain and in the Mediterranean; and a form apparently undistinguishable from it occurs in the Southern Hemisphere, together with several others wholly distinct, though much resembling the European species in general aspect. In the absence of any precise account of the minute characters, it is impossible to decide upon the correctness of the various synonyms of fossil Retepores, and those, therefore, only have been introduced which appeared the most likely to be correct. For a similar reason, I have altogether omitted the forms noticed by Goldfuss, his descriptions and figures being wholly insufficient for their identification. His *R. vibicata* appears decidedly not to be *R. cellulosa*, the fenestræ being too wide, and the dorsal aspect very unlike that of the latter species.

2. R. Beaniana, *King*. Pl. XII, figs. 2, 5, 6, and 7.

Polyzoario infundibuli—seu hypercrateriformi, undulato; dorso subvibicato, avicularis, parvis, sparsis munito. Cellulis ovatis seu subcylindraceis, rostro gracili plerumque elongato et avicularium mandibulâ semicirculari paratum, apice gerente armatis. Ostio orbiculari spinâ marginali utrinque munito. Ovicellulâ fissurâ verticali ornatâ.

Polyzoarium infundibuliform or hypercrateriform, wavy; cells ovate or subcylindrical; orifice orbicular, with a slender rostrum projecting in front immediately below it, on the summit of which is an avicularium with a semicircular mandible; an oral spine on each side above; ovicell with a vertical slit in front; small avicularia scattered over the dorsal surface.

Millepora cellulosa, *Jameson*, Werner Mem., i, p. 560.
Retepora cellulosa, *Johnston*, Mag. Nat. Hist., vii, p. 638, fig. 69.
— beaniana, *King*, Ann. Nat. Hist., xviii, p. 237, 1846; *Johnst.*, Brit. Zooph., 2d ed., i, p. 353, fig. 67, 1847; *Busk*, Brit. M. Cat., part ii, p. 94, pl. cxxiii, figs. 1—5.

Habitat.—C. Crag, *S. W.* (*Recent*) Britain, N. E. *Bean, King;* Coast of Norway, *M'Andrew;* Arctic Sea, *S. E. Belcher.*

Owing to its being apparently wholly a northern form, the occurrence of *R. Beaniana* among the Crag fossils is of much interest. The principal characters by which it is distinguished from *R. cellulosa,* consist in the existence, in front of the orifice, of a prominent rostrum crowned with an avicularium, and of an oral spine at each upper angle. Of these characters, those which longest remain distinct in the older portions of a polyzoarium, are perhaps the anti-oral avicularium, and the narrow slit in front of the ovicell; but as the latter condition is not confined to this species, the avicularium is, of all the characters, that most to be relied upon.

3. R. NOTOPACHYS. Pl. XII, fig. 4.

Fenestris rhomboidalibus, angustis; cellulis ovalibus immersis, seu inconspicuis, aviculario rostriformi centrali munitis; ostio orbiculari, infra sinuato seu inciso, supra spinis duabus marginalibus armatâ, ovicellulâ magnâ, fronte apertâ. Ramis posticé convexis, superficie lineis transversis signatâ, substantiâ crassâ sublaminatâ.

Fenestræ rhomboidal, narrow; cells deeply immersed, oval, or inconspicuous; orifice orbicular, with a sinus below, and a marginal line on each side above; a prominent avicularium on the front of the cell in the centre; ovicell large, open in front; dorsal surface convex, marked with deep, usually transverse, lines; substance of branches behind very thick, laminated.

Habitat.—C. Crag, in a hollow in a mass of Cellepore, *J. S. B.*

The peculiarly thick aspect of the polyzoarium, and the comparatively small fenestræ distinguish this species at first sight, but it is characterised more especially by the extraordinary thickness and density attained by the calcareous substance on the back of the polyzoary, and which is disposed in crescentic laminæ.

Although unable to refer *R. notopachys* to any other fossil or recent species, it should be remarked that an undescribed recent form, strongly resembling it in some respects, exists, but whose habitat I am not certainly acquainted with, though believing that it is from the Mediterranean, or some part of the Coast of Spain. The only fragments of this and the following species yet met with are too imperfect to convey any notion of its general form.

4 R. SIMPLEX (*n. sp.*) Pl. XII, fig. 3.

Fenestris ovalibus angustis acutis; cellulis altè immersis, subovalibus; subinde poro unico centrali ornatis; ostio orbiculari infra sinuato, supra spinis duabus marginalibus munito; superficie ramorum dorsali glabrâ vibicatâ.

Fenestræ oval, narrow, pointed at each end; cells deeply immersed, or obscurely oval; orifice orbicular, with a sinus below, and a spine on each side above; dorsal surface smooth, vibicate; sometimes a pore in the centre of the cell in front.

Habitat.—C. Crag, *S. Wood.*

This species, if really distinct from the preceding, which is doubtful, appears to be distinguished from its congeners by the entire absence of anything like an avicularian organ. The fragments in which it occurs, however, are so small and so much worn, that its true characters must be regarded as still doubtful.

Genus 5. HEMESCHARA (*n. gen.*).

Polyzoarium foliaceum, contortum seu lamellosum, e strato simplici cellularum quincuncialium compositum.

Polyzoarium foliaceous, contorted, or laminar, composed of a single layer of cells disposed quincuncially, and opening on one surface.

SEMIESCHARA, SEMIESCHARIPORA, and MULTESCHARIPORA (pars), *D'Orbigny.*
LEPRALIA (sp.), *Busk*, Brit. M. Cat.
ESCHARA (pars), Auct.

There are a certain number of *Escharidæ* which, from their peculiar conformation, appear to merit a distinctive generic appellation. In some respects approaching *Membranipora* and *Lepralia,* they differ from those genera in the circumstance that the polyzoarium is not adnate by its entire surface to a foreign body; whilst from *Eschara, Melicerita,* and *Biflustra,* they are distinguished by its being constituted of only a single layer of cells, the polyzoarium forming a continuous thin lamina, on one surface of which the cells open, whilst their backs are exposed in the other. The lamina is often turned back, as it were, upon itself, so as to enclose a cavity which communicates with the exterior by two or more contracted openings; but sometimes it would seem to be more expanded, and variously contorted and laminated, whilst in other cases, again, it assumes an arborescent form, consisting of a hollow cylindrical stem and branches.

In the formation of the cells themselves, the species thus associated may be subdivided into two sections, corresponding with *Membranipora* and *Lepralia.* In one of these sections the front of the cells, as in *Membranipora,* is for the most part open, and surrounded by a raised border; whilst in the other the cells are entire and convex in front, as in *Lepralia* and *Eschara.* Among recent species, an excellent type of the latter section is presented in *L. marionensis,* Busk ('Brit. M. Cat.'), and of the former, numerous (perhaps too numerous) instances will be found in the 'Paleontologie Française.'

Of the tubular, arborescent forms, at least one living instance exists, though apparently as yet undescribed; and of fossil, two may be cited, *Semieschara cylindrica* and *S. arborea,* of D'Orbigny (l. c. pl. dccx).

One species only, referrible to this genus, occurs among the Crag fossils.

1. H. imbellis (*n. sp.*) Pl. IV, fig. 6, and Pl. X, fig. 7.

Polyzoario convoluto; cellulis ovatis, subumbonatis ad marginem presertim punctatis; ostio semicirculari, labio inferiori recto peristomate simplici.

Polyzoarium convolute; cells ovate, punctured especially round the border, subumbonate in front; orifice semicircular, with a straight lower border and simple peristome.

Eschara pertusa (?), *Michelin*, l. c., pl. lxxix, fig. 2.

Fragments of this species may be confounded with *Eschara cornuta*, *Lep. variolosa*, and *L. haimeseana*, and perhaps of *E. pertusa*, although little attention will suffice for their distinction. 1. The species is not adnate, although one layer overlies another. 2. From *E. cornuta* and *L. variolosa* it is distinguished by the unarmed orifice, whilst the absence of an introral denticle, and the presence of an umbonal projection on the front of the cell, distinguish it from *L. Haimeseana*.

§§§ 3. Liberæ.

Fam. VII. *SELENARIIDÆ*, Busk, 1853.

Polyzoarium liberum orbiculare seu irregulare, conicum sive depressum, supra convexum, infra planum vel concavum; facie convexâ tantum cellulosâ. Cellulis duplicis generis seriatim dispositis seu quincuncialibus.

Polyzoarium free (?), orbicular or irregular, conical or depressed, convex on one side, and plane or concave on the other; composed of a single layer of cells, usually of two kinds, which open on the convex surface only.

Selenariadæ, *Busk*, B. M. Cat., pt. ii, p. 97, 1852.
Escharidæ (pars), *D'Orbigny*, Ann. d. S. N., 3d ser., xvii, p. 284, 1852.
Polypiers foraminés (pars), *Lamarck*, An. S. Vert., 2d ed., ii, p. 299.
Cellariæa (pars), *Blainville*, Man. d'Actin., p. 448.
Milleporées (pars), *Lamoroux*, Exp. Meth., p. 44.
Asterodiscina, *Lonsdale*, Dixon's Geol., Sussex, p. 159.

Originally included by Lamarck among his "Polypiers foraminés," a heterogeneous group, containing also several genera of Foraminifera and true Corals, and by Lamouroux associated also with Foraminifera and some Corallines, in the order "Milleporées," the true systematic position among the Polyzoa, of the Selenariidæ or Lunulites, was first indicated by De Blainville ('Man. d'Actinol.,' p. 448, 1834), who placed them at the head of his family *Cellariæa*, and close to *Flustra*. It is not to be wondered at, that the striking resemblance borne by some of the more flattened or depressed species to the foraminiferous Orbitulites, should have suggested a relationship between them. No two things, however, as is now well known, are farther apart.

The most striking peculiarity, perhaps, of the Selenariidæ, is the peculiar form and constitution of the polyzoarium. In all other known Polyzoa, except in the case of *Cristatella mucedo*, the polyzoary is attached in some way to a foreign base, upon which it is immoveably fixed or rooted. This adhesion is effected in three principal modes.

1. By the adhesion to some foreign body of the initial or primordial cell, whence the whole of the rest of the growth arises by repeated gemmation; the fixing of the polyzoary, as it increases in size, being assisted by means of corneous fibres or tubes—the so-called "radical fibres"—of most of the articulated Polyzoa.

2. By the successive cells creeping along the surface of the foreign base, to which they are individually attached, as in *Membranipora*, and many other genera.

3. By means of a strong, rigid, calcareous peduncle, upon which the after-growth is supported like a tree upon its trunk. This mode of adhesion is presented in *Eschara*, *Retepora*, and others of the rigid, unarticulated Polyzoa.

In the Selenariidæ, however, no indication is, in most cases, apparent that the polyzoarium has ever been attached. It never exhibits radical fibres or a calcareous stem, nor, in fact, does any part of the surface show marks of its having been adherent. On the contrary, in perfect recent specimens, the entire surface of both the concave and convex surfaces is covered with a continuous chitinous epidermis.

Other considerations, moreover, would lead to the supposition that, at any rate, some of the Selenariidæ enjoy, to a certain extent, the power of locomotion, and which faculty, it may be remarked, is not singular in them, since there is no doubt that the curious fresh-water Polyzoon above noticed—*Cristatella mucedo*—is capable of creeping about on the surface of aquatic plants, by means of the fleshy under surface of its polyzoarium. But locomotion in the Selenariidæ, if any possess it, must be effected in a different way. A peculiar attribute of the whole family, almost without exception, is the possession of powerful vibracular organs, which in several species, as for instance in *L. Capulus*, B., and *L. gibbosus*, B., have the setæ so formed, as apparently to be well adapted for employment as agents in locomotion. In other species, however, as in *C. Lowei* and *canariensis*, and perhaps in all the other *Cupulariæ*, the vibraculum would appear to be more especially adapted to its usual function, viz., that of a defensive or cleansing organ. Whilst in the curious *Selenaria maculata*, B., the extraordinary conformation of the seta, which closely resembles in outward aspect the curling proboscis of a Butterfly, leaves its function very obscure.

When it is stated that the polyzoarium in the Selenariidæ is unattached permanently to foreign bodies, it should be remarked that in very many cases a particle of coarse sand, or fragment of shell, or, it may be, a fragment of a dead polyzoary of the same species, will be found in the apex of the cone; and from this point it would seem that the growth had started, as from a centre. The foreign particle, however, in all cases that have come under my observation, is of small size, and such as could be readily carried about with the rest of the growth.

It should also be noticed, that Hagenow ('Die Bryoz. d. Maästr. Kreidebild.,' p. 100) states that he has seen *L. semilunaris* and *L. Goldfussi*, attached by the entire surface upon Belemnites, but these, I think, must have been instances of accidental adhesion.

Besides the peculiar conformation of the polyzoary, one or two other points respecting the general structure of the Selenariidæ, should be adverted to. With no exception among living forms, and with very few, if in reality any, among the fossil, these Polyzoa are distinguished by the circumstance that the cells of which the polyzoary is composed are of two kinds, usually differing in size. The existence of these different kinds of cells has, of course, not escaped the notice of every one who has written on the subject of Lunulites; and although the true nature of the smaller or secondary cells was wholly unknown, they have been variously designated, as, "accessory cells" ("nebenporen"), "cellules avortées," "pores speciaux," &c., whilst some have confounded the opening of the smaller cell with the mouth of the true habitation of the polypide. With regard to the nature of the secondary cells, it has been supposed that they exhibited "a perfect analogy with the chambers in *Eschara* and *Escharina*, deemed to be receptacles for maturing gemmules;"[1] but as under the latter head two distinct things have been confounded, this analogy, though quite correct in part, morphologically throws no light upon the physiological function of the organs.

In fact, the question would probably never have been determined from the examination of fossil forms alone. And as, till very lately, but one living species had been discovered, and that described from a specimen in the same imperfect condition that all fossil ones are found in, the solution of the problem was extremely difficult, until an abundant supply of perfect recent specimens, of various species and genera, collected by Mr. M'Gillivray, in the voyage of the "Rattlesnake," allowed it to be decided in the most satisfactory manner. These specimens, which retained the chitinous parts of the skeleton as well as the calcareous, and in which, in fact, even the muscular tissue could be demonstrated after they had been moistened, proved that the smaller chambers are the cells of *vibracula*, and in the living state contain probably nothing but the muscular apparatus for the movement of the usually very long and strong seta, which has been adverted to above.

The constant presence, as it would seem, of this organ, and its apparent importance in the economy of the animal, naturally suggest its being employed in the classification of the Family. This idea appears to have occurred to Lamouroux, who, though acquainted only with two or three fossil forms, long ago suggested the subdivision of the Lamarckian

[1] Lonsdale, 'Q. Journ. Geol. Soc.,' i, p. 504, 1845.

Lunulites into *Lunulites* and *Cupularia,* regarding the two, however, only in the light of sub-genera. There can be no doubt of the propriety and advantage of such a division, which was consequently adopted by me in the 'Brit. M. Cat.,' in 1852, and is followed here, as will appear in the subjoined Synopsis of the genera.

With regard to the distribution of the Selenariidæ in time and space, it would seem, as regards the former, that they made their first appearance in the Cretaceous period, and are continued through the Tertiary up to the present time, in which the number of known species is about twelve.

The recent species at present known, and their distribution are—

(1) *Cupularia.*

1. C. GUINEENSIS, *B.*, B. M. Cat., p. ii, p. 98, pl. cxiv.
   Habitat.—New Guinea.
2. C. OWENII, *Gray,* B. M. Cat., p. ii, p. 99, pl. cxv.
   Habitat.—W. Africa; Madeira; Canaries.
3. C. LOWEI, *Gray,* MS., B. M. Cat., p. ii, p. 99, pl. cxvi.
   Habitat.—Madeira; Canaries.
4. C. STELLATA, *B.*, B. M. Cat., p. ii, p. 99, pl. cxviii.
   Habitat.—Philippines.
5. C. PYRIFORMIS, *B.*, B. M. Cat., p. ii, p. 100, pl. cxxiv.
   Habitat.—St. Vincent.
6. C. JOHNSONI, *Busk,* Q. J. M. Sci., vi, p. 67, Zooph., pl. xxiii, figs. 1—5.
   Habitat.—Madeira; Canaries.
7. C. CANARIENSIS, *B.*, Q. J. M. Sci., vi, p. 66, pl. xxiii. figs. 6—9.
   Habitat.—Madeira; Canaries.

(2) *Lunulites.*

8. L. GIBBOSA, *B.*, B. M. Cat., p. ii, p. 100, pl. cxi.
   Habitat.—Cape Capricorn, Australia.
9. L. CAPULUS, *B.*, B. M. Cat., p. ii, p. 100, pl. cxii.
   Habitat.—Cape Capricorn, Australia.
10. L. PHILIPPINENSIS, *B.*, B. M. Cat., p. ii, p. 101, pl. cxiii.
    Habitat.—Philippine Islands.
11. L. CANCELLATA, *B.*, B. M. Cat., p. ii, p. 100, pl. cxiii, figs. 4—7.
    Habitat.—Philippine Islands.

(3) *Selenaria.*

12. S. MACULATA, *B.*, B. M. Cat., p. ii, p. 101, pl. cxvii.
    Habitat.—Bass's Strait.

Of these twelve species it will be observed that eight are confined to the northern, and four to the southern hemisphere. Moreover, that of the former, five belong to the same Atlantic region, being, with one exception (*C. Owenii*), confined to the Madeiran group of islands; whilst three seem to be peculiar to the Philippines.

Of the four austral species, one only belongs to the genus *Cupularia* (*C. guineensis*), which approaches in type very nearly to the Atlantic *C. canariensis*, whilst the other three, belonging to the genus *Lunulites*, would appear to be peculiar to the Australian seas.[1] With respect to the latter, it is furthermore interesting to remark, that they alone, among recent Selenariidæ, represent the more ancient fossil forms; as, for instance, those found in rocks of the Cretaceous period.

The known number of fossil species which it seems at all possible to identify from the, with few exceptions, very imperfect figures and descriptions of writers, amounts to between thirty and forty; although this number may be regarded as liable to considerable deductions or additions, there being little doubt that many species have been confounded together or separated from each other upon insufficient grounds. These fossil forms may be arranged as under.

(1) *Crag.*

1. C. Owenii (?), *Gray.* } = C. denticulata, *Conrad.*
2. L. alveolatus, *S. W.* } = C. denticulata, *Conrad.*
3. C. canariensis, *B.*
4. Lunulites conica.
5. L. porosa (*n. sp.*)

(2) *Miocene, or more recent than Eocene.*

6. C. denticulata, *Conrad.* (*Crag.*)
7. C. intermedia, *Michellotti.*
8. C. umbellata, *Defrance.*
9. C. Vandebeckei, *Michelin.*
10. L. Androsaces, *Michellotti.*
11. L. conica, *Defrance.* (*Crag.*)
12. L. Cuvieri, *Defrance.*
13. L. punctata, *Leymerie.*

(3) *Eocene.*

14. L. sexangula, *Lonsd.*
15. L. distans, *Lonsd.*
16. L. contigua, *Lonsd.*
17. L. radiata, *Lamarck.*
18. L. urceolata, *Lamarck* (not *Goldfuss, Lamouroux*).
19. C. rhomboidalis, *Münster.*
20. C. Haidingeri, *Reuss.*

[1] Whilst these pages are passing through the press, I have been favoured by my friend, Mr. R. K. Parker, with some fossil Polyzoa from a miocene deposit in St. Domingo, amongst which occur *Cupularia canariensis*, and a form which seems to be identical with *Lunulites* (*Cupularia*) *umbellata*, Defrance, figured in Blainville's 'Man. d. Actinologie,' pl. lxxii, fig. 1.

(4) *Cretaceous.*

21. L. CLYPEIFORMIS, *D'Orbigny* (sp.)
22. L. DOMA, *D'Orbigny* (sp.)
23. L. HAGENOWI, *Bosquet.*
24. L. GOLDFUSSII, *Hagenow.*
25. L. MITRA, *Hagenow.*
26. C. MÜNSTERI, *Hagenow.*
27. L. SEMILUNARIS, *Hagenow.*
28. L. SPIRALIS, *Hagenow.*
29. L. BOURGEOISII, *D'Orbigny.*
30. L. CRETACEA (?), *Defrance* (? *D'Orbigny*).
31. L. TUBERCULATA, *D'Orbigny.*
32. L. PAPYRACEA, *D'Orbigny.*
33. L. REGULARIS, *D'Orbigny.*
34. L. PETALOIDES, *D'Orbigny.*
35. L. ROSACEA, *D'Orbigny.*
36. L. PLANA, *D'Orbigny.*
37. STICHOPORA CLYPEATA, *Hagenow.*
38. S. CONICA, *D'Orbigny* (? L. CONICA, *Defrance*).

The following may be regarded as uncertain, either as to position or genus.

39. L. SPONGIA (?), *Morren.*
40. L. DUCLOISII, *Lea;* Claiborne, Alabama.
41. L. BOUEI, *Lea;* Claiborne, Alabama.
42. L. QUINCUNCIALIS, *Dujardin.*
43. L. PINEA (?), *Risso; Defrance.*
44. L. DEPRESSA (?), *Conrad.*

From this list it will be at once apparent that the genus *Lunulites* preponderates very greatly among fossil Selenariidæ; and, moreover, that with the exception of one species, *C. Münsteri,* noticed by Hagenow as occurring in the Cretaceous formation at Rügen, no *Cupularia* is found before the Eocene period, in which again, there are but two at present known, *C. rhomboidalis,* Münst., *C. Haidingeri,* Reuss., which are clearly not identical. In the later Tertiaries, however, including the Crag, the number of *Cupulariæ* is equal, or nearly so, to that of the *Lunulites;* whilst in the recent period, the former would appear to preponderate. It should also be remarked, that the recent *Cupulariæ* not only exceed in number of species all the known fossil forms, but in size also, and that superadded to them we have a distinct genus, *Selenaria,* probably more perfectly organised than any. The recent Lunulites, also, though far fewer in number than their fossil congeners, would appear in like manner to exceed all, or nearly all of the latter, in their development. The only fossil Lunulite apparently at all approaching in size some of the recent species is *Lunulites radiata*, or some of the forms figured under that title. Among the representations of this species are some which bear a strong resemblance to *L. capulus*, B., though of far smaller dimensions.

SYNOPSIS OF GENERA.

(*a*) Each cell with a vibracular chamber at its apex or distal extremity.

1. CUPULARIA, *Lamx.*

(*b*) The cells and vibracular chambers disposed in separate, usually alternate rows, radiating from the centre.

2. LUNULITES, *Lamx.*

(*c*) Certain of the cells of a different conformation to the rest, furnished with a vibraculum.

3. SELENARIA, *Busk.*

(*d*) No apparent vibracular chambers distinct from the true cell.

STICHOPORA, *Hagenow.*

(*e*) Vibracula replaced by small avicularia; mouth of cell circular.

4. CONESCHARELLINA, *D'Orbigny.*

Of these four genera, two only are represented in the Crag fossils.

Genus 1. Cupularia, *Lamx.*

Cellulis singulis vibraculum apice gerentibus.
Each cell throughout the polyzoarium with a vibracular cell at its distal extremity.

Cupularia, *Lamouroux,* Exp. Meth., p. 44 (proposed as a sub-genus); *Busk,* B. Mus. Cat., P. i, p. 97.
Lunulites (pars), *Defrance; Deslongchamps; Goldfuss; Blainville; Lonsdale,* Journ. Geol. Society, i, p. 503; *Michelin; Reuss.*
— spiralis, *Hagenow,* Geinitz. Grund., p. 623.

1. C. denticulata, *Conrad.* Pl. XIII, fig. 1.

Polyzoario conico seu depresso, plerumque subelongato, oblongo, margine denticulatâ; cellularum areâ rhombicâ; aperturâ margine denticulatâ; laminâ granulosâ; vibraculi orificio auriculari, alte canaliculato. Superficie dorsali sulcatâ, glabrâ vel subrugosâ.

Polyzoarium conical or depressed, usually more or less irregularly oblong; area rhombic; aperture with a denticulate margin; lamina granular; vibracular opening auricular, deeply channelled; posterior surface sulcate, smooth, or rugose.

L. alveolatus (?), *S. Wood,* Annals N. H., xiii, p. 18.
C. denticulata, *Conrad,* Silliman's Journal, Oct., 1841, vol. xli; *Lonsdale,* Q. Jour. Geol. Soc., 1845, vol. i, p. 503 (with fig.)
C. Owenii, *Gray* (?), Spicilegia Zool., pt. i, p. 8, t. iii, fig. 15; *Busk,* B. M. Cat., p. ii, p. 99, pl. cxv; *S. W.,* Ann. Nat. Hist., xiii, p. 18.
C. Johnsoni, *Busk* (?), Q. J. M. Sc., vii, p. 67, Zooph., pl. xxiii.

Habitat.—C. Crag, Sutton, Ramsholt, *S. W.; J. S. B.;* Miocene formation, Williamsburg, *Lonsd.* (*Recent*) Coast of Africa, Madeira, Canary Isles, *Johnson; Macandrew.*

The very striking resemblance in all the most essential points between the species above cited as synonymous with *C. denticulata,* at any rate in the condition they present when all the animal parts are removed, renders it highly probable that they are all identical. At the same time, some not inconsiderable diversities exist, almost sufficient to lead to the supposition that they may be distinct. That is to say, that two separate species are represented by *C. Owenii,* Gray, and *C. Johnsoni, nob.,* for of the identity of the latter with the Crag fossil, I entertain, upon the most careful investigation, scarcely the shadow of a doubt. The typical specimens of *Cup. Owenii,* in the British Museum, are very flat and extremely delicate, the posterior surface being smooth and shining, or very slightly rugose in parts; whilst the upper part of the margin of the cell is not produced downwards so distinctly in the form of a horse-shoe as it is in *Cup. Johnsoni,* whose polyzoary, again, is very conical, in which respect the species seems to agree with the description of *C. denticulata.*

C. denticulata of the Crag appears to attain a larger size than the recent *C. Johnsoni,* and it varies very much in shape, more especially in the greater or less elevation of the cone, which in some cases is very much depressed, whilst in others its height equals, or slightly exceeds, the diameter. But one or two peculiarities will nearly in all cases be observed. The form of the disc is seldom if ever truly circular, but more or less oblong, and usually showing a disposition to become angular on one or two sides. A second peculiarity, which I have not noticed in the recent species, consists in the circumstance that in *C. denticulata* the cells are often disposed to run in parallel rows, from the side of which other parallel series run off at right angles; a disposition which does not appear to be manifested in the recent forms. When in tolerably perfect condition, no difficulty will be experienced in identifying specimens of *C. denticulata,* but when they are much worn, as is very frequently the case, in which state it is probably the *L. alveolatus* of Mr. S. Wood, the identification will not be found quite so obvious. In Pl. XIII, fig. 3, is a representation of the appearance presented by a worn specimen, in which it will be observed that the denticulate margin of the aperture is destroyed, the situation of the cell being indicated by a more or less quadrangular, oblong opening, above which the remains of the vibracular cavity will often be seen, represented by a shallow, cup-like depression, the intervening substance being rough, and usually more or less porous. In a more advanced stage of attrition, the vibracular cup is wholly removed, when the surface of the polyzoary throughout a considerable extent will exhibit nothing but parallel rows of oblong, shallow pits, some distance apart. In this state it would be very difficult in many cases, and in some perhaps impossible, to distinguish a specimen of *C. denticulata* from one of *C. canariensis,* without reference to the condition of the posterior surface, when the presence or absence of the large pores, and the subdivision or not of the ridges into quadrangular portions, will at once determine the species. In its worn condition, and in small fragments, *C. porosa* may also be mistaken for imperfect fragments of *C. denticulata,* but in *C. porosa,* the fossæ left by the worn-down cells are of a pyriform shape, and disposed very distinctly in oblique lines, whilst the vibracular cup is more usually wholly obliterated, owing to the circumstance that it is, when perfect, much shallower in that species than in *C. denticulata* or *C. canariensis.* The fine porosity, moreover, of the posterior surface in *C. porosa,* affords a further mark of distinction.

2. C. canariensis, *Busk.* Pl. XIII, fig. 2.

Polyzoario crateriformi, orbiculari, margine denticulatâ; cellularum areâ rhombicâ; aperturâ subquadrangulari, oblongâ, margine integrâ; vibraculi orificio auriculari, alte canaliculato. Superficie dorsali sulcatâ, liris in areas quadrangulares poris majoribus 3—6 ornatas partitis.

Polyzoarium cup-shaped, orbicular; area rhombic; aperture subquadrangular, oblong, margin entire; lamina finely granular; vibracular opening auricular, deeply channelled; posterior surface sulcate, the ridges divided into quadrangular portions, in each of which are 3—6 rather large pores.

C. canariensis, *Busk*, Q. J. M. Sc., vii, p. 66, Zooph., pl. xxiii, figs. 6—9.

Habitat.—C. Crag, Sutton, Ramsholt, *S. W.* (*Recent*) Madeira and Canaries, *Johnson, M'Andrew.*

3. C. porosa (*n. sp.*) Pl. XIII, fig. 5.

Polyzoario parvo, depresso, orbiculari, lapidis vel conchæ particulam haud raro apice includente; cellularum areâ subrhomboidali? aperturâ margine denticulatâ? vibraculi orificio —— ? Superficie dorsali delicatule sulcatâ, liris planatis, porosis, subrugosis.

Polyzoarium less than $\frac{1}{4}''$ in diameter, flattened, orbicular, often including a fragment of stone or shell at the summit; area subrhomboidal? aperture with a toothed margin? vibracular orifice —— ? posterior surface finely sulcate; ridges flattened, minutely porous, subrugose.

Habitat.—Cor. Crag, *S. W.*

The distinguishing characteristics in the more worn condition of *C. denticulata, canariensis,* and *porosa,* have already been adverted to, and it is unnecessary here to remark further upon them. *C. porosa* seems to be one of the smallest of the Selenariidæ, for specimens bearing all the marks of considerable age do not exceed, or rarely equal $\frac{1}{4}''$ in diameter. A very common circumstance in, and, so far as I am aware, peculiar to this species, is the existence at the summit of the disc, that is to say, on the convex side, of an angular particle of stone or shell, around and upon which the cells are formed, spreading over it like those of a Lepralia, and in some cases, entirely enclosing the foreign body, of which no part, it is to be remarked, is visible on the under or concave side, which is the usual site for similar particles in many other Lunulites.

Genus 2. Lunulites.

Cellulis radiatim in seriebus cum vibraculorum seriebus plus minusve regulariter alternantibus dispositis.

Cells arranged in more or less regular series, radiating from the centre; vibracula in linear series, alternating more or less regularly with those of the cells.

Lunulites, *Lamouroux; Busk*, B. M. Cat., p. ii, p. 100.
— (pars), *Auctorum*, including *Discoflustrellaria, D'Orbigny*.

1. L. conica, *Defrance*. Pl. XIII, fig. 4.

Polyzoario cupuliformi vel depresso, subacuminato, annulato, solido vel cavo; cellularum aperturis supra arcuatis, infra trigonis, suborbicularibus vel hexagonis, in annulis concentricis, regularibus, rugis elevatis sejunctis, dispositis. Superficie dorsali sulcis bifurcatis, undulosis signata; liris porosis.

Polyzoarium cupuliform, subacuminate, annulated, solid, or hollow; apertures arched above and three-sided below, suborbicular or hexagonal; disposed in regular circles around the cone, the circles being separated by prominent ridges; vibracula in series alternating regularly with those of the cells. Posterior surface sulcate, sulci bifurcating and wavy; ridges porous.

Lunulites conica, *Defrance*, Dict. des Sc. Nat., xxvii, p. 361; *Michelin*, Icon. Zooph., p. 323, pl. lxxvii, fig. 9.

Var. *a. Depressa.*

L. urceolata, *Goldfuss*, Petref. Ger., p. 41, pl. xii, fig. 7; (?) *Cuvier* and *Brongniart*, Descr. Géolog. d. Env. de Paris, pl. viii, fig. 9; (?) *Bronn.*, Syst. d. Urwelt. Pflanz., pl. vi, fig. 10; (?) *Lamarck*, Ann. S. Vert., 2d ed., ii, p. 300 (ex. syn. expart.); (?) *Michelin*, Icon. Zooph., p. 175, pl. xlvi, fig. 6 (not *Lamouroux*, Exp. Meth., p. 44, pl. lxxiii, figs. 9—12).

Cupularia urceolata (?), *Bronn.*, Leth. Geog., pl. xxxv, fig. 28.

Habitat.—C. Crag, Sutton, Red Crag, *S. W.*; Salles (Gironde), Ste. Maure, Manthelon (Indre-et-Loire), *Michelin*; ? Grignon, *Goldfuss, Cuvier*, and *Brongniart*; ? Parnes, Chaumont (Paris Basin); Faluns of Anjou and Touraine, *Michelin*.

The figure of *L. conica*, Defrance, contained in the 'Icon. Zoophyt.,' of M. Michelin, who had access to M. Defrance's collection, leaves no doubt of the identity of the Crag fossil with that species. Nor can there, I think, be much doubt that the form figured by Goldfuss (l. c.) corresponds with it also, and represents the depressed variety. The species figured in Cuvier and Brongniart (op. c.), whose figure is copied in Bronn (Syst. d. Urwelt. &c.), and which is also represented in Michelin, 'Icon. Zooph.,' pl. xlvi, fig. 6, and is doubtless the form intended by Lamarck under the name of *L. urceolata*, though at first sight differing very considerably from *L. conica* of Defrance, on closer inspection proves, I think, to be identical with it. The chief difference appears to consist in the truncated or blunt summit and depressed form of *L. urceolata*, whilst in *L. conica* the summit is usually more or less pointed. Not having had an opportunity of inspecting a specimen of the Grignon fossil, and consequently in ignorance of the character of the posterior surface, I cannot express a very decided opinion, but am strongly inclined, from the close resemblance between the two in the disposition of the apertures of the cells and of the vibracula in regular circles around the cone, to regard their identity as highly probable. *L. urceolata* of Lamouroux is, as he himself observes, more properly a *Cupularia*, and is, therefore, wholly out of the question, and it is very strange that it should have hitherto been so generally cited as a synonym of *L. urceolata*, Lamarck.

OF THE CYCLOSTOMATA.

The following "synoptical arrangement" will convey a sufficient idea of the mode in which, as it appears to me, the various genera of fossil and recent Cyclostomatous Polyzoa may be arranged; and it offers, perhaps, a classification as nearly natural as seems possible with our present very incomplete knowledge of the sub-order. Great difficulties attend the diagnosis of species in this class of Polyzoa, even in the recent condition; and these difficulties, far more than in the Cheilostomata, are necessarily enhanced in the case of fossil specimens.

Owing to the great comparative simplicity and uniformity of conformation in the individual cells, and the absence, for the most part, of adventitious organs, such as ovicells and vibracular or avicularian organs, our principal reliance in the distinction of genera and species must be placed on the general form of the polyzoary, and the mutual relation of the cells; but as in many cases these vary very greatly in different portions of one and the same polyzoary, it often happens, more especially in fossil forms, that it is almost impossible to determine whether two apparently distinct things may not be referable to one and the same species. These observations apply more forcibly, perhaps, to *Pustulipora*, *Idmonea*, and *Hornera*, than to any other genera, but should be taken into account in several others also.

SYNOPTICAL ARRANGEMENT of the POLYZOA CYCLOSTOMATA.

§ I. Articulatæ s. radicatæ		Crisiidæ	*Crisia* *Crisidia*
§ II. Inarticulatæ s. adfixæ	Cellulis distinctis	Idmoneidæ	*Hornera* Terebellaria Cricopora Cyrtopora *Idmonea* *Pustulipora*
		Tubuliporidæ	Mesenteripora *Tubulipora* *Alecto*
		Diastoporidæ	*Diastopora* *Patinella* *Discoporella* *Defrancia*
	Cellulis indistinctis	Cerioporidæ	Stellipora Fungella Heteropora Neuropora Alveolaria Spiropora Heteroporella
		Theonoidæ	Theonoa Fascicularia Lopholepis Apsendesia
		Frondiporidæ	*Frondipora* Truncatula Distichopora Plethopora.

NOTE.—The families and genera in *italics* contain living species.

Sub-order II. CYCLOSTOMATA. *Busk.*

Cellulis tubulosis, rigidis, ex parte liberis, et distantibus, seu connatis et immersis. Orificio terminali inermi.

Cells tubular, rigid, wholly immersed and connate, or partially free and distant; mouth terminal; unfurnished with any moveable appendage; usually of the same diameter as the cell.

TUBULIPORINA, *Milne Edwards; Hagenow; Johnston.*
AULOPORINA (pars), *Ehrenberg; Johnston.*
MYRIOPORINA (sp.), *Ehrenberg.*
CERIOPORINA (pars), *Bronn.*

§ I. ARTICULATÆ s. RADICATÆ.

Polyzoario ex internodiis inter se articulatis composito; perque tubulos corneos radicales affixo.

Polyzoarium divided into distinct internodes, usually connected by flexible joints; attached by horny tubes.

Fam. I. CRISIIDÆ, M. Edwards.

The only family.

Genus 1. CRISIDIA, *M. Edwards.*

Internodiis unicellularibus.
A single cell in each internode.

No species occurs among the Crag fossils.

Genus 2. CRISIA, *Lamouroux*.

Internodiis multicellularibus.
More than one cell in each internode.

1. C. DENTICULATA (?) *Lamk.* (sp.) Pl. I, fig. 8.

Cellulis connatis; orificio paullulùm producto; articulis nigris.
Cells closely aggregated; orifice short, tubular; joints black.

CELLARIA DENTICULATA, *Lamarck.*
CRISIA LUXATA, *Fleming; Blainville.*
— DENTICULATA, *M. Edwards; Johnston.*
— PATAGONICA (?), *D'Orbigny* (teste *Johnston*).
— EBURNEA, *Van Beneden.*

Habitat.—C. Crag, *S. Wood.*

The small and imperfect fragments apparently belonging to this species among the Crag fossils are hardly sufficient to allow of its certain identification, though enough to justify its being placed at any rate provisionally with the common recent species, which, or some very closely allied forms, such as *Crisia elongata* of Milne Edwards, and *C. patagonica*, D'Orbig., are found in all parts of the globe.

§ II. INARTICULATÆ s. ADFIXÆ.

Polyzoario continuo, inarticulato; ramoso vel simplici. Aut erecto et per basim calcaream affixo, aut adnato vel incrustante.

Polyzoarium continuous throughout, or not divided into distinct internodes; fixed immoveably by a calcareous base, or immediately adnate upon foreign bodies.

Fam. I. *IDMONEIDÆ,* Busk.

Polyzoario erecto, simplici seu ramoso; ramis cylindricis, vel subcompressis; liberis, sive inter se conjunctis.

Polyzoarium erect, simple or branched; branches cylindrical or subcompressed; free or anastomosing.

1. Hornera. *Lamx.*

Polyzoario erecto, aut explanato et retiformi, vel ramoso. Cellularum orificiis ad unam ramorum faciem tantum spectantibus. Superficie anteriori inter orificia plerumque reticulatâ, fibrosâ seu sulcatâ.

Polyzoarium ramose; branches dichotomous and free, or united by short transverse ramules so as to constitute a retiform expansion; cells opening on one side only of the branches, which surface is marked with wavy anastomosing ridges, in the more or less rhomboidal interstices of which the openings of the cells are situated.

Hornera, *Lamouroux,* Exp. Meth., p. 41, 1821; *M. Edwards* (pars); *Reuss* (pars); *Blainville; Defrance; Michelin; Hagenow.*
Retepora (pars), *Lamarck; Goldfuss;* &c.
Siphodictyum, *Lonsdale.*
Millepora (pars), *Linn.; Ellis* and *Soland.; Esper.;* &c.

Taking the common Mediterranean *Hornera frondiculata,* Lamx. ('Expos. Method.,' p. 41, pl. lxxiv, fig. 7—9, or Milne Edwards, 'Mém. s. les Crisies, &c.,' p. 17, pl. ix, fig. 1), as the type of the genus, it may be defined very naturally as above. This definition, however, will exclude from it, besides *Idmonea,* one or two recent forms, which although agreeing with *Idmonea, Hornera,* and *Frondipora,* in having the openings of the cells on one side only of the branches, yet in other respects approach *Pustulipora* so much more nearly that they should undoubtedly, if not erected into a distinct genus, be associated with *Pustulipora.* But as no instance of a polyzoarium constructed on this type is met with among the Crag fossils, though one appears to have existed in the Cretaceous period (*H. tubulifera,* 'Hag. Maast. Kreideb.' p. 26, pl. ii, fig. 1), it is unnecessary to say more about it in this place, further than to observe that in the forms in question the anterior surface of the branches does not exhibit the peculiar reticulated or fibrous aspect, so characteristic of the true *Horneræ,* though perhaps not entirely limited to them.

The genus thus constituted appears to be a very natural one; and it is divisible also into two very natural groups, according as the branches are free or mutually connected by anastomosing ramuscules. In the latter case the growth bears a strong resemblance to that of a Retepore, with which genus consequently the *Horneræ*, or many of them, were formerly associated by Lamarck and others.

Of the genus as thus restricted, five or six recent species exist, divisible like the fossil into the "ramose" and "fenestrate." Three belonging to the former, and two or three to the latter.

The three ramose living *Horneræ* with which I am acquainted are:

1. H. FRONDICULATA, *Lamouroux*.
2. H. BOREALIS (*mihi*, MS.)
3. H. TRIDACTYLITES (*mihi*, MS.)

The first is the well-known Mediterranean form, originally figured by Ellis, subsequently named *Hornera frondiculata* by Lamouroux, and which has since been figured and described by Milne Edwards (' Mém. s. les Crisies,' &c., l. c.).

The second, is a species collected by Mr. M'Andrew on the Coast of Norway and Finmark, and by Captain Beaufort in lat. 61° 35′ N., 90° 42′ W., and which is not improbably the same as that mentioned by Lamouroux as occurring in Kamtschatka. This I formerly described and figured in the 'Ann. Nat. Hist.,' 2d ser. 18, p. 34, pl. i, fig. 7, under the erroneous appellation of *H. frondiculata,* from which subsequent investigation has shown it to be wholly distinct.

Of the third species I have specimens collected by Mr. Darwin on the shores of Patagonia and Tierra del Fuego, and by Mr. M'Gillivray in the Australian seas, but no description or figures of it have as yet been published. It probably represents the form noticed by Lamouroux as found in the Indian and Australian seas. It differs in all respects from the other two.

Of the fenestrate kind I am acquainted with two forms, apparently distinct species, both of which I believe to be, and one certainly is, Australian. No account of this species, of which very perfect specimens were brought by Mr. Gould from *South Australia,* has yet been published, although figures of it have been prepared. I propose to call it *Hornera gouldiana*.

Several fossil forms of *Hornera* have been noticed, and some of them figured; but from the want of precision in the details of the figures, and the absence of any determinate specific characters in the descriptions, it is extremely difficult to arrive at any satisfactory conclusions with respect to them. The best figures are those contained in Milne Edwards's excellent 'Memoir on the Crisiæ,' &c.; but even these are by no means sufficiently precise to convey a correct idea of the specific differences or resemblances.

I have, therefore, had the utmost difficulty in coming to any conclusion satisfactory to myself with respect to the fossil species of *Horneræ* contained in the Crag, and I would hardly venture even now, after the most laborious endeavours to ascertain the truth, to assert that all the species I have marked as distinct, are really so, or that some of them, at any rate, besides *H. frondiculata* and *reteporacea,* may not be found, upon due comparison, to be identical with other previously described fossil forms. No genus in the whole of this Memoir has required more time or closer examination, and it is only after the most mature consideration that I have arrived at the not very certain conclusions here stated.

The same difficulty, however, as already observed, would be experienced in the investigation even of the living forms, were the inquiry limited to small detached and broken fragments, or to much-worn and injured specimens, such as are, for the most part, offered by the fossil remains. As in several other cyclostomatous genera, more especially among those belonging to the inarticulate section, the aspect of the polyzoary in *Hornera* differs so extremely in different parts, according to age, &c., that the mere inspection of fragments derived from different portions of one and the same individual growth, could not fail, from their extreme diversity, to lead to the conclusion that they belonged to distinct species or even genera. It may readily be conceived how much this difficulty is enhanced in the case of fossil specimens.

The earliest fossil forms clearly belonging to this genus are found, according to Hagenow, in the Cretaceous beds of Rügen and in Sweden, but no species of *Hornera* as here understood, is noticed by him in the Maastricht beds. *Hornera contortilis* of Mr. Lonsdale, found in the Cretaceous strata of New Jersey, however, appears to be a well-marked instance of the genus.

The number of species increases considerably in the Tertiary epoch, and more especially in the more recent strata, in which the genus seems to have attained its maximum development, at any rate in number of forms, if all that are enumerated be really distinct.

The best marked Tertiary fossil forms, of which we have any published available means of judging, are—

1. Fenestratæ.

1. H. flabelliformis, *Blainville* (sp.)
Retepora flabelliformis, *Blainv.; Michelin,* Icon. Zooph., p. 314, pl. lxxvi, fig. 1, = ? H. Ferussacii, *Michelin,* ? Eocene. Miocene.

2. H. scobinosa, *Michel.* (sp.)
Retepora scobinosa, *Mich.* l. c., p. 316, pl. vi, fig. 3. Miocene.

3. H. reteporacea, *M. Edwards,* Mém. s. les Crisies, &c., p. 21, pl. x, fig. 2. Crag.

2. Ramosæ.

4. H. striata, *M. Edwards,* l. c., p. 21, pl. xi, fig. 1. Crag. *Michelin,* l. c., p. 317, pl. lxxvi, fig. 7.

5. H. affinis, *M. Edwards,* l. c., p. 19, pl. x, fig. 1. Upper tertiaries of Sicily.

6. H. hippolyta, *Defrance*, Diction. d. Sc. Nat., t. xxi, p. 43, pl. xlvi, fig. 2; *Blainville*, Man. d'Actin., p. 419, pl. lxviii, fig. 3; *Bronn.*, Leth. Geogn., p. 880, pl. xxxvi, fig. 1; *M. Edwards*, l. c., p. 20, pl. xi, fig. 3.
   H. hippolytus, hippolythus, hippolithus, *Michelin*, Icon. Zooph., p. 168, pl. xlvi, fig. 18; *Reuss*, Foss. Polyp. d. W. Tert. B., p. 42, pl. vi, figs. 23, 24; Grignon.
7. H. lævis, *M. Edwards*, l. c., p. 20, pl. xi, fig. 2; Miocene, Dap.
8. H. andegavensis, *Michelin*, l. c., p. 318, pl. lxxvi, fig. 8.

Of which I have been able, with tolerable but not absolute certainty, to identify with Crag fossils—

1. H. reteporacea, *M. Edwards*.
2. H. striata, *M. Edwards*.
3. H. affinis, *M. Edwards*.
4. H. andegavensis, *Michelin*.
5. H. hippolyta, *Defrance*.

§ 1. Fenestratæ.

Polyzoario retiformi, plus minusve foliaceo, e ramis in plano unico dispositis, perque ramusculos breves transversos, crebros conjunctis composito.

Branches in one plane, connected by transverse ramuscules, so as to form a fenestrated frond.

1. H. infundibulata. Pl. XIV, fig. 1.

Polyzoario undulato, infundibuliformi; ramis gracilibus, subcylindricis. Superficie *anteriori*, porosâ, fibrosâ; *posteriori* sulcis longitudinalibus porosis ornatâ. Cellularum orificiis orbicularibus, sparsis.

Polyzoarium wavy, infundibuliform; branches slender, subcylindrical; mouths of cells orbicular, exserted or level; intermediate surface on the front of the branches fibro-punctate; *posterior* longitudinally costate, with punctures along the sulci.

Habitat.—C. Crag, *S. Wood.*

The polyzoarium of this species forms tolerably regular infundibuliform growths, attaining in the largest specimens observed about an inch in diameter. The posterior surface is marked with parallel raised lines, between which the surface is concave, but scarcely to be termed sulcate, and these spaces are furnished with rather distant, elongated pores.

2. H. RETEPORACEA, *M. Edwards.* Pl. XIV, fig. 2.

Polyzoario contorto, cavernoso; ramis contiguis, subcylindricis. Cellularum orificiis confertis, irregulariter dispositis, prominulis sive superficie æquatis, orbicularibus, expansis. Superficie *anteriori* porosâ; *posteriori* scrobiculatâ seu cribriformi (non sulcatâ).

Polyzoarium much contorted, cavernous; branches close, subcylindrical; mouths of cells crowded, disposed irregularly, exserted or level, orbicular, expanded; *anterior* surface porous; *posterior* pitted or cribriform (not sulcate).

H. RETEPORACEA, *M. Edwards*, l. c., p. 21, pl. x, fig. 2; *S. Wood* (?); *J. Morris* (?).

Habitat.—C. Crag, *M. Edw.*; *S. Wood.*

This is the only species among the Crag *Horneræ* in which the dorsal surface is not sulcate or costate, but, on the contrary, uniformly pitted, the pits in many cases becoming deep pores, giving the surface a cribriform aspect. In this character, as well as in the convoluted mode of growth, the present form agrees with *H. reteporacea* of M. Edwards, who says of it, that the "face dorsale des branches est comme reticulée," although this appearance is not represented in his figure.

3. H. CANALICULATA (*n. sp.*) Pl. XIV, fig. 3.

Polyzoario explanato, flabelliformi (?); ramis crassis, subdistantibus; fenestris magnis, ellipticis seu ovatis. Cellularum orificiis immersis, sursum spectantibus; subquincuncialibus. Superficie *anteriori* obscure reticulatâ, rarissime punctatâ; supra orificia fossam canaliculatam non raro etiam porum unicum ostendente; *posteriori* subplanâ, granulosâ, longitudinaliter sulcatâ; sulcis poris distantibus, elongatis munitis.

Polyzoarium expanded, flabelliform (?); branches thick, rather distant; fenestræ large, elliptical or oval; mouths of cells immersed, looking upwards; with a canalicular depression, and usually a pore above; irregularly quincuncial; intermediate surface very rarely perforate, very obscurely reticulate; dorsal surface flattened, expanded at the border of the fenestræ, coarsely granular, deeply and irregularly sulcate; sulci with elongated, distant pores.

Habitat.—C. Crag, *S. Wood*; *J. S. B.*

4. H. rhipis (*n. sp.*) Pl. XIV, fig. 4.

Polyzoario explanato, flabelliformi; ramis subcylindricis, contiguis; fenestris parvis irregularibus. Cellularum orificiis in seriebus transversis plerumque dispositis, integris seu infra emarginatis, subovatis, prominulis, peristomate tenui expanso circumdatis. Superficie *anteriori* poris raris, distantibus ornatâ; *posteriori* granulosâ, delicatule sulcatâ, poros minimos, distantes subinde ostendente.

Polyzoarium expanded, flabelliform, simple; branches subcylindrical, closely contiguous; fenestræ small, irregular; mouths of cells disposed in irregular transverse rows, entire or emarginate below, suboval, margin prominent, thin, expanding; *anterior* surface punctate, puncta rare, distant; *dorsal* finely granular, finely sulcate, without pores, or with very few minute ones.

Habitat.—C. Crag, *S. Wood; J. S. B.*

This species can only be confounded with *H. canaliculata*, from which, however, it is undoubtedly distinct. The more striking features by which they may be distinguished are:

1. In general aspect the polyzoary in *H. canaliculata* is constituted of far larger or wider branches, which are further apart and connected by fewer transverse ramules than in *H. rhipis*.

2. The dorsal surface of the branches in *H. canaliculata* is remarkably flattened or almost concave, deeply and coarsely scored by bifurcating, irregular sulci, which are furnished with large, tolerably frequent, elongated pores, whilst in *H. rhipis* the dorsal surface is not so flat, and almost even or marked with fine shallow sulci, which very rarely exhibit here and there a minute perforation.

3. A striking difference is observable in the condition of the mouths of the cells, which in *H. canaliculata* are disposed irregularly, or in some parts pretty regularly, in quincuncial order, depressed and usually emarginate above, in which direction they are continuous as it were, with a shallow ascending channel, whence the specific name; whilst in *H. rhipis* the mouths of the cells are placed with tolerable regularity in *transverse* rows, are entire or continuous all round with a thin, somewhat expanded border, which is contracted below sometimes almost into a sort of narrow spout, the intermediate surface being irregularly punctured.

Another character, apparently distinctive of the two, may also be found, though with more difficulty, in the circumstance that the walls of the tubes in *H. canaliculata* are closely perforated with minute puncta, which, so far as I can perceive, are wanting, or at any rate far less numerous, in the tubes of *H. rhipis*, in which species it is also to be remarked that the tubes themselves are much less than in *H. canaliculata*.

With respect to the general aspect of the two, or any characters that can be thence drawn, little can be said, for *H. canaliculata* has hitherto occurred only in broken fragments, from which no very certain deductions as to the general habit of the growth can be drawn.

Finding it impossible to reconcile the characters of either of these species to any hitherto described, I have abstained from any conjectural synonymy, and would only remark that the only species with which it is probable one or other of them may have some relation is *Retepora* (*Hornera*) *flabelliformis* of Michelin ('Icon. Zoophyt.,' p. 314, pl. lxxvi, fig. 1).

§ 2. Ramosæ.

Ramis undiquaque se tendentibus, liberis, seu raro ramusculis transversis, distantibus irregulariter conjunctis.

Branches spreading in all directions, free, or very rarely and irregularly united by transverse ramuscules.

5. H. humilis (*n. sp.*) Pl. XIV, figs. 5, 6.

Polyzoario parvo, erecto; ramis brevibus, dichotomis, curvatis, inæqualibus, e trunco brevi centrali undiquaque surgentibus. Superficie *anteriori* reticulate sulcatâ, sulcis porosis; *posteriori* sulcis porosis delicatulis ornatâ. Cellularum orificiis orbicularibus, irregulariter dispositis.

Polyzoarium very minute, consisting of short, dichotomous, curved, unequal branches, diverging on all sides from a short trunk, which is affixed by a circular expanded base; *anterior* surface reticulato-sulcate, with pores in the sulci; mouths of cells orbicular, scattered; *posterior* finely sulcate, with rather large puncta in the sulci.

Habitat.—C. Crag, *S. Wood; J. S. B.*

This abundant species is at once recognisable by its minute size and peculiar mode of growth, as well as by the regular fine striation of the posterior surface, and more especially of the common trunk and its expanded base. Considerable differences are observable in the minute characters, in some cases almost sufficient to justify the suspicion that more than one species may be included, but upon consideration these differences all appear to be reducible to a common type. The polyzoarium consists of short, cylindrical or subcylindrical, forked branches, springing from a common stem, of considerably greater diameter and expanding gracefully at the base. The celliferous surface is usually the uppermost, but in some instances, as at fig. 5, the openings of the cells seem to be mostly placed on the under side. The posterior or opposite surface is more or less distinctly and regularly sulcate or fluted, the surface being otherwise smooth, and the bottom of the sulci furnished with small rounded pores.

On the anterior aspect the surface between the scattered openings of the cells is uneven, usually retaining but indistinct traces of its original wavy fibrillation, or obscurely reticulate and punctured. The mouths of the cells are depressed, and either simple and orbicular or surrounded with a distinct annular peristome.

6. H. PERTUSA (*n. sp.*) Pl. XIV, fig. 7.

Polyzoario parvo, depresso, elongato; ramis brevibus, inæqualibus. Superficie *anteriori* porosâ; *posteriori* irregulariter sulcatâ, sulcis poros crebros magnos ostendentibus; cellularum orificiis orbicularibus, immersis, in seriebus longitudinalibus irregulariter dispositis.

Polyzoarium small, depressed, irregularly branched, elongated in one direction. *Anterior* surface very porous; mouths of cells orbicular, depressed, disposed irregularly in longitudinal series; *posterior* irregularly sulcate, with large frequent pores.

Habitat.—C. Crag, *S. Wood.*

Notwithstanding the general character of the growth in this species, in which it appears to approximate to the succeeding, it seems from its more minute characters to demand specific recognition.

7. H. HIPPOLYTA (?), *Defrance.* Pl. XIV, figs. 8, 9.

Polyzoario depresso; ramis cylindricis, divaricatis, gracilibus, inæqualibus. Superficie *anteriori* punctis perparvis ornatâ; *posteriori* longitudinaliter costulatâ, sulcis porosis. Cellularum orificiis in seriebus transversis, irregularibus dispositis, prominulis, integris supraque porum rotundum plerumque ostendentibus.

Polyzoarium ramose, depressed; branches cylindrical, divaricate, slender, uneven; mouths of cells usually disposed irregularly in transverse rows; raised, orbicular, usually with a pore above each; *anterior* surface nearly smooth, finely punctured; *posterior* finely sulcate; sulci with rare, minute puncta.

HORNERA HIPPOLYTA, *M. Edwards*, l. c., p. 21, pl. x, fig. 2.
— HIPPOLYTHUS, *Defrance*, Dict. d. Sc. Nat., xxi, p. 432, p. xlvi, fig. 3; *Blainville* (?); *Michelin.*
— HIPPOLITHUS, *Reuss.*

Habitat. — C. Crag, *S. Wood;* Grignon (Seine-et-Oise), Hauteville (Manche), *Michelin; M. Edw.*

8. H. LUNATA (*n. sp.*) Pl. XVI, fig. 4.

Polyzoario erecto (?); ramis furcatis, subcylindricis. Superficie *anteriori* indistincte fibro-reticulatâ, porosâ; *posteriori* obscure sulcatâ, minute punctatâ. Cellularum orificiis lunatis vel suborbicularibus, integris, superficie æquatis.

Polyzoarium erect (?) composed of forked, subcylindrical branches; mouths of cells lunate or suborbicular, simple, even with the surface; *anterior* surface indistinctly fibro-reticulate, punctured; *posterior* obscurely sulcate, finely punctate.

Habitat.—C. Crag, *S. Wood.*

The peculiar form of the mouth in this species renders it easy of recognition. As it occurs but sparingly and only in small broken fragments, the real character of the growth cannot be ascertained, but from what is apparent it was probably of small size, and consisted of irregular, tolerably straight, forked branches.

9. H. FRONDICULATA, *Lamouroux.* Pl. XV, figs. 1, 2; Pl. XVI, fig. 6.

Polyzoario subexplanato; ramis irregularibus e trunco forti surgentibus, cylindricis, teretibus vel subcompressis. Superficie *anteriori* reticulato-fibrosâ, porosâ vel cribriformi; posteriori reticulato-fibrosâ, costulis granulosis, glabrisve, sulcis poros elongatos gerentibus. Cellularum orificiis prominulis, emarginatis seu potius bifidis.

Polyzoarium irregularly branched, usually in one plane, and springing from a strong stem; branches cylindrical and tapering, or compressed; *anterior* surface strongly fibro-reticulate, irregularly punctured or cribriform in the rhomboidal spaces enclosing the mouths of the cells; mouth of cell exserted, emarginate, thence bifid; *posterior* surface reticulate-fibrous, granular or smooth, with elongated pores in the fissures.

HORNERA FRONDICULATA, *Lamx.; Milne Edwards; Blainville* (not *Busk*), Ann. N. H. 2d ser., xiii, p. 34.
RETEPORA FRONDICULATA, *Lamarck.*
MILLEPORA TUBIPORA, *Ellis* and *Solander*, p. 139, pl. xxvi, fig. 1.
MILLEPORA LICHENOIDES, *Linn.; Pallas; Esper.*
HORNERA AFFINIS, *M. Edwards*, l. c., 19, pl. x, fig. 1.
HORNERA ANDEGAVENSIS, *Michelin*, Icon. Zoophyt., p. 318, pl. lxxvi, fig. 8.

Habitat.—C. Crag, *S. Wood*; Upper Tertiaries of Sicily, *M. Edwards;* Doué, *Mich.*

The remarkable difference in the appearance of this species, as shown in our figures of the natural size (figs. 1, 2, Pl. II, and fig. 6, Pl. III), and that represented, for instance, in M. M. Edwards' figure of the recent *H. frondiculata,* would startle any one not acquainted with the protean habits of this perplexing genus. But having an abundant supply of well-preserved specimens of the true Mediterranean *H. frondiculata*, I have been able beyond all doubt to satisfy myself that it is perfectly correct to associate the small palmate forms depicted in figs. 1, 2, Pl. XV, with the large and expanded growth usually represented as that of *H. frondiculata;* nor can any hesitation, I think, be felt in placing *H. affinis*, M. Edwards, in the same category. With respect to *H. andegavensis*, Michelin, the mere comparison of the figure of that species in the 'Iconographie Zoophytologique' with a branch of *H. frondiculata* will at once show their complete identity, which appears to have been strongly suspected even by M. Michelin himself. Mere differences in the size and disposition of the branches are obviously, in this species, of no importance whatever. The chief specific characters appear to be—

1. The ramification being for the most part in the same plane, or nearly so.

2. The emargination of the border of the mouth, which thence assumes a bifid aspect.

3. The coarse perforation of the dorsal surface.

As before stated, I had formerly confounded with this species one which occurs in the Northern Seas, but which differs in all the above respects very widely from the true or Mediterranean form. The mouth, for instance, in *H. borealis* is cut off obliquely, so as to exhibit a single acute point, whilst to show the importance of attention even to a single minute character, in *H. tridactylites* (*nob.*) the oral margin is furnished with two, three, or more, acute denticles. All this renders it the more difficult to determine fossil species, in which the apparently important character derivable from the condition of the oral margin is, usually, wholly obliterated.

10. H. STRIATA, *M. Edwards*. Pl. XV, fig. 3; XVI, fig. 5.

Polyzoario cæspitoso; ramis cylindricis. Superficie *anteriori*, reticulato-fibrosâ et in areolas rhomboidales divisâ; *posteriori* sulcis, e lineâ media longitudinali oblique divergentibus ornatâ; sulcis minute punctatis; costis glabris vel subgranulosis. Cellularum orificiis in seriebus longitudinalibus plus minusve regulariter dispositis, parvis, orbicularibus, ad partem ramorum inferiorem annulo elevato incrassato, subinde uno latere acuminato marginatis.

Polyzoarium cespitose; branches cylindrical; mouths of cells disposed more or less regularly in longitudinal series, small, orbicular, those towards the lower part of the branches with a raised, slightly thickened, annular border, which is sometimes produced into an acute angle on one side; a pore above and below the mouth. *Anterior* surface marked with smooth reticulated ridges, forming nearly regular diamond-shaped areolæ; *posterior* sulcate, the sulci usually diverging obliquely from an imaginary median line, and finely punctate; surface between the sulci smooth or subgranular.

HORNERA STRIATA, *M. Edwards*, l. c., p. 21, pl. xi, fig. 1; *Michelin*, Icon. Zooph., p. 316, pl. lxxvi, fig. 7.

Habitat.—C. Crag, *S. Wood;* Doué, *Michelin.*

11. H. RHOMBOIDALIS (*n. sp.*) Pl. XV, fig. 4.

Ramis cylindricis, furcatis. Superficie *anteriori* reticulatâ, *posteriori* granulosâ vel rugosâ, seriebus punctorum obliquis ornatâ. Cellularum orificiis orbicularibus, peristomate paullulum incrassato marginatis, porumque supra gerentibus.

Polyzoarium composed of cylindrical, forked branches; *anterior* surface strongly and regularly reticulate; mouths of cells orbicular, border annular, slightly thickened, a pore above each; *dorsal* finely granular or rugose, punctured in oblique rows.

Habitat.—C. Crag, *S. Wood.*

Genus 2. IDMONEA, *Lamouroux.*

Polyzoario ramoso; ramis plerumque dichotomis liberis, vel subinde conjunctis; postice rotundatis, antice carinatis. Cellularum orificiis, in seriebus alternis, transversis vel obliquis et in carinâ mediâ angulatim conjunctis dispositis.

Polyzoarium ramose, branches dichotomous or irregularly divided; free or anastomosing; mouths of cells disposed in parallel, transverse or oblique, usually alternate, rows, on each side of the front of the branches, which is angular or carinate in the middle.

IDMONEA, *Lamx.*, Exp. Meth., p. 80, 1821; *Defrance; Blainville; M. Edwards; Johnston; Lonsdale; Reuss; Michelin; Hagenow.*
IDMONEA (pars), *Rœmer; D'Orbigny.*
RETEPORA (pars), *Lamarck; Goldfuss; Hagenow.*
RETICULIPORA, CRISINA, STICHOPORA, TUBIGERA, SATEROCAVA, SEMICELLARIA, *D'Orbigny.*

1. IDMONEA PUNCTATA, *D'Orbig.* (*sp.*) Pl. XV, fig. 5; Pl. XVI, fig. 3.

Polyzoario ramoso seu fenestrato; ramis subcylindricis; cellularum orificiis parvis, orbicularibus, prominulis, 3—4 singulis in seriebus. Superficie *anteriori, posteriorique* punctatâ.

Polyzoarium ramose or fenestrate; branches subcylindrical; mouths of cells small, orbicular, prominent, 3—4 in each series; surface, both *anterior* and *posterior*, uniformly punctured.

LATEROCAVA PUNCTATA (?), *D'Orbigny*, pl. DCCLXXII, figs. 11, 12.

Habitat.—C. Crag, *S. Wood;* Cretaceous (?), *D'Orbigny.*

2. I. FENESTRATA (*n. sp.*) Pl. XV, fig. 6.

Polyzoario irregulariter fenestrato vel reticulato; ramis subtrigonis non raro posticè angulatis. Cellularum orificiis quadrangularibus, prominentibus, 5—6 singulis in seriebus. Superficie *anteriori* cellularum planatâ delicatule maculatâ; *posteriori* minute reticulatâ, sulcatâ, porisque elongatis ornatâ.

Polyzoarium irregularly fenestrate or reticulated; branches subtrigonal, often angular behind; mouths of cells projecting quadrangular, 5—6 in each series; front of tubes flattened, surface finely dotted; dorsal surface very finely reticulate, sulcate, with elongated pores.

Habitat.—C. Crag, *S. Wood, J. S. B.*

Approaching in some respects the *Idmonea triquetra* of Lamouroux, as well as a recent species met with in South Africa, which if not identical with the Caen Fossil is undistinguishable from it without direct comparison, the present species not only in habit but in other particulars also appears to differ so materially from either, as to justify its distinction from them.

In *I. triquetra* (including the recent form above alluded to under that title) the front of the branches is acutely angular, whilst in *I. fenestrata* it is rather rounded than angular. The front of the tubular cells also in *I. triquetra,* though scarcely convex, is not nearly so much flattened as in *I. fenestrata;* nor is the dorsal surface in *I. triquetra* pitted like that of *I. fenestrata,* being either smooth or very finely sulcate. But a more obvious distinction exists in the general habit of the polyzoarium. In *I. triquetra* the branches are very much thicker and curiously curved, as is well shown in Lamouroux's figure, and in no specimen of the recent form, in fragments whose aspect precisely resembles that of *Idmonea triquetra,* do the branches ever anastomose so as to constitute the elongated elliptical meshes of *I. fenestrata.*

There does not appear to be any other fossil *Idmonea* with which the present species is likely to be confounded, unless perhaps it might be with *I. maculata,* Hag. (' Maastr. Kreideb.,' pl. ii, fig. 3). The resemblance, however, is only in general habit, which is certainly somewhat alike; but in *I. maculata* the cells are said to be 3—5 serial; and the anterior angle of the branches appears to be carinate, whilst the dorsal is described as smooth, and finely streaked. One or two of the species of *Idmonea* figured under various generic names by D'Orbigny, might be thought to resemble *I. fenestrata*, but it seems scarcely worth while to discuss these similarities.

3. I. DELICATULA (*n. sp.*) Pl. XV, fig. 8.

Polyzoario ramoso; ramis gracilibus furcatis, postice rotundatis, antice subangulatis, Cellulis 5—6 singulis in seriebus; seriebus subalternantibus non raro oppositis, mediâque in lineâ conjunctis. Superficie *anteriori* cellularum convexâ, minutissime punctulatâ.

Polyzoarium composed of slender forked branches, rounded behind, subangular in front; cells 5 or 6 in each series; series subalternate, often opposite and meeting in the median line; front of cell convex, very finely dotted; dorsal surface of branches smooth, striated, dotted.

Habitat.—C. Crag, Sutton, *S. Wood.*

Owing apparently to the extreme thinness and fragility of their walls the openings of the cells in nearly every specimen of this most abundant species are so much worn away, that in fact the whole front of the cell is usually laid open, so that the surface presents a sulcate aspect—the sulci being interrupted at each successive series of cells. The dorsal surface when entire is quite smooth, and marked only by parallel longitudinal lines indicating the walls of minute elongated tubules; and owing to the delicacy of their walls these tubules, like the cells, are in many cases laid open, consequently in the majority of specimens the dorsal surface exhibits a finely sulcated appearance.

4. I. INTRICARIA (*n. sp.*) Pl. XV. fig. 7.

Polyzoario e ramis cylindricis confusê intertextis et irregulariter conjunctis, e pedunculo communi basi dilatato surgentibus, composito. Cellularum orificiis in seriebus lateralibus, irregularibus, obliquis dispositis, non raro etiam sparsis. Superficie *anteriori* subconvexâ, punctulatâ, glabrâ; *posteriori* glabrâ, lineis reticulatis signatâ, punctulatâ.

Polyzoarium composed of intricately interlaced and anastomosing subcylindrical branches, springing from a common peduncle, which is expanded at the base; openings of cells in irregular, oblique, lateral series, and often scattered; *anterior* surface subconvex, dotted, even; *dorsal* smooth, marked with anastomosing lines, dotted.

Habitat.—Cor. Crag, Sutton, *S. Wood.*

The usually scattered or irregular disposition of the mouths of the cells gives fragments of this species, in many cases, the aspect, so far as that goes, of a *Hornera.* In other parts, however, the distinct serial arrangement of the openings on the sides of a branch, and the evenness of the surface, show that it is more properly referable to *Idmonea*. In specimens of sufficient size, it is readily distinguishable by its peculiarly intricate mode of growth, not unlike, in miniature, that of *Intricaria bajocensis*, and in which it is nearly paralleled by a recent Australian *Idmonea* or rather *Pustulopora*, which has not yet received a name.

Genus 3. PUSTULOPORA, *Blainville.*

Polyzoario ramoso; ramis cylindricis clavatis seu teretibus, e cellulis elongatis superne liberis, et undequâque spectantibus composito.

Polyzoarium ramose; branches cylindrical, clavate or terete; composed of tubular cells, which open on all sides of the branch.

PUSTULOPORA, *Blainville*, Man. d'Act., p. 418, 1834 (pars); *M. Edwards; Hagenow* (sp.) Maastr. Kreid. (*not Gein.* Grundr.) *Reuss; Michelin.*
ENTALOPHORA, *Lamouroux*, Expos. Meth., p. 80, 1821; *D'Orbigny* (pars).
CERIOPORA (pars), *Goldfuss* (?); *Hagenow* (?) *Gein.* Grund.

I have adopted Blainville's name for this genus, more for the reason that it has come into general acceptation, especially since its accurate definition by Milne-Edwards, than because I am satisfied it should have precedence of *Entalophora*, a term under which it appears quite clear that Lamouroux had intended to include similar forms. The prior appellation, however, having fallen into abeyance, except by M. D'Orbigny, whose genus *Entalophora*, moreover, is not confined to Cyclostomatous forms only, it seemed unadvisable, merely for the sake of somewhat pedantic propriety, here to revive it.

As it is very doubtful whether Goldfuss had any knowledge of forms really appertaining to the genus *Pustulopora* as now understood, I have not included his term *Ceriopora* among the list of synonyms; and the same observation applies to the *Ceriopora* of Hagenow, as defined in 'Geintz. Grundr.' p. 593.

1. PUST. CLAVATA (*n. sp.*) Pl. XVII, fig. 1.

Ramis clavatis.

Branches clavate or thickened at the extremity; surface entire; tubes not annulated.

Habitat.—C. Crag, *S. Wood.*

The only forms with which this species can well be confounded, are:

P. GRACILIS, *Milne-Edwards*, Mém. s. les Crisies, &c., p. 28, pl. xi, fig. 4 (not *Michelin*, Icon. Zoophyt., p. 210, pl. liii, fig. 2).
P. ECHINATA, *Ræmer; D'Orbigny*, l. c., pl. DCXXII, fig. 36; *Michelin*, Icon. Zoophyt., p. 211, pl. liii, fig. 5.
ENTALOPHORA LINEARIS, *D'Orbigny*, op. cit., pl. DCXXII, fig. 6.

Habitat.—C. Crag, *S. Wood.*

But from all of these, as well as from the recent *P. proboscidea*, Milne-Edwards, and another recent Austral form, for which the name *P. delicatula* is proposed, the difference in size and habit, besides which in this genus we have scarcely any available characters, is so great as to leave no reasonable doubt that the Crag fossil is specifically distinct.

2. P. PALMATA (*n. sp.*) Pl. XVIII, fig. 2.

Polyzoario palmato, compresso; ramis ad basim compressis, superne cylindricis; cellulis obscurè annulatis.

Polyzoarium palmate, compressed, branches compressed at bottom, cylindrical above; tubes obscurely annulate.

Habitat.—C. Crag, *S. Wood.*

The cylindrical branches at once distinguish this species from *Entalophora pavonina* of D'Orbigny ('Terr. Cret.,' pl. DCXX, fig. 12), which is the only other fossil or recent form with which it could well be confounded. Even in small fragments it is distinguished from the preceding by the unevenness of the surface and the uncovered condition of the tubes.

3. PUSTULOPORA SUBVERTICELLATA, (*n. sp.*) Pl. XVIII, fig. 1.

Polyzoario e ramis gracilibus, cylindricis seu subcompressis, plerumque teretibus, furcatis, e trunco communi surgentibus composito. Cellulis immersis, extremitate vix prominulis. Superficie glabrâ porisque minimis ornatâ. Cellularum orificiis non raro in verticello dispositis.

Polyzoarium composed of slender, cylindrical or slightly compressed, usually tapering forked branches springing from a common stem not thicker than themselves; tubes completely immersed except at the extremity, which though uncovered scarcely projects above the surface, which is consequently nearly level, and everywhere studded with fine pores; openings of cells often irregularly verticellate.

Habitat.—C. Crag, *S. Wood.*

This most abundant species might almost as properly be arranged with *Cricopora*, Blainv., as with *Pustulopora*, but as, upon the whole, the openings of the cells are more generally irregularly distributed than disposed in regular whorls, it is perhaps better to leave it in association with *Pustulopora.* It presents a remarkable character in the fact that the surface of the branches is pretty nearly level, owing to the space between the cells being overlaid with what appears to be a secondary deposit, which covers the tubes completely, and allows only a small portion immediately below the opening to be seen. This deposit, however, like the walls of the tubes themselves, is perforated by pores, which though still minute appear to be larger than in most other species where the same kind of porosity also exists. The outlines of the cells are shown through the deposit by dark-coloured, transparent lines, which give the surface a peculiar and very characteristic aspect.

Genus 4. MESENTERIPORA, *Blainville.*

Polyzoario foliaceo; cellulis in stratis duobus laminâ mediâ calcareâ sejunctis dispositis et ad utramque faciem spectantibus.

Polyzoarium foliaceous; cells in two layers parted by a calcareous septum and opening on both surfaces.

MESENTERIPORA, *Blainville*, Man. d'Act., p. 432; *D'Orbigny; S. Wood.*
DIASTOPORES BISERIALAIRES, *M. Edwards*, l. c., p. 40.
DIASTOPORA (pars), *Lamouroux; M. Edwards; Hagenow; Reuss; Michelin.*
BIDIASTOPORA (pars), *D'Orbigny.*
DITAXIA, *Hagenow*, Maast. Kredeb, p. 49.
CERIOPORA (pars), *Goldfuss.*

The expanded or foliaceous Cyclostomata are subdivided by Milne-Edwards into two great groups, distinguished by the character that in the one the tubes are almost wholly immersed and in the other partially free. To the former group he applies generally the appellation "Diastopores," and to the latter that of "Tubulipores." This division is natural, but it seems convenient that it should be carried still further, and in the doing of this with respect to the "Diastopores" no better classification can be adopted than that suggested by the same author, viz. into—1. "*Diastopores simples;*" 2. *D. enveloppantes;* 3. *D bisérialaires.* The groups thus formed, which may be regarded as of generic value, having to be provided with names it does not appear difficult to fit them with appropriate appellations from those already in use, as applied to some of the species, and thus to avoid the necessity of burdening science with new terms. I propose, therefore, to term the simple Diastoporæ of Milne-Edwards, *Diastopora;* the enveloping, or laminated forms, *Berenicea;* and the biserial, *Mesenteripora*, under which of course will fall *Ditaxia* of Hagenow.

1. M. MEANDRINA, *S. Wood.* Pl. XVII, fig. 2; Pl. XVIII, fig. 4; and Pl. XX, fig. 2.

Subglobosa, cavernosa, varie flexuosa seu contorta, laminis coalescentibus.

Polyzoarium subglobose, cavernous, foliations contorted, anastomosing.

Diastopora meandrina, *S. Wood,* Ann. N. H., xiii, p. 14.
D. eudesiana, *M. Edwards* (?), l. c. p. 33, pl. xiv, fig. 1.
Ditaxia compressa (?), *Goldfuss; Hagenow,* Maast. Kreideb., p. 50, pl. iv, fig. 10.
Mesenteripora neocomiensis (?), *D'Orbigny,* Terr. Cret.

Habitat.—C. Crag, *S. Wood; J. S. B.*

Another fossil species, *M. Michelinii,* Blainville, might be suggested as synonymous with the above, but as this is figured and described as having the foliations *not* anastomosing, I have not placed it even doubtfully in the list. Of the species given above with a mark of doubt, perhaps *Ditaxia compressa* of Hagenow, = (?) *Diast. Eudesiana* of Milne-Edwards, affords the nearest resemblance to the Crag form. But this may arise, perhaps, merely from the circumstance that they are the most correctly drawn figures, for in the absence of figures conveying a sufficient idea of the general habit, it is impossible to determine their identity or not with *M. meandrina.*

As in several other Cyclostomata, more especially of those belonging to the present family, the mouths of the tubes in this species are eventually closed with a calcareous lid, having, usually, a minute central perforation.

Genus 5. Tubulipora, *Lamarck.*

Polyzoario decumbente, plerumque adnato, integro aut diviso, e puncto excentrico procedenti. Cellulis superne liberis, ascendentibus, infra coalitis.

Polyzoarium adnate or decumbent; entire, or divided into lobes or branches; cells partially free and ascending, radiating from an excentric point.

Tubulipora (pars), *Lamarck; Blainville: Milne-Edwards; Johnston; Lonsdale; Michelin; Reuss,* &c.
— *Lamouroux; Hagenow,* Maast. Kreid.
Ceriopora (pars), *Hagenow,* Gein. Grundr.
Phalangella (sp.), *Gray,* Append. List. Brit. Rad., p. 149.
Obelia (pars), *Gray.*
Diastopora (sp.), *M. Edwards.*
Criserpia (?), *M. Edwards.*

Under the genus *Tubulipora* are here understood species in which the polyzoarium is sometimes closely adnate, sometimes affixed only by the base and simply decumbent, or else partially erect, and in which the tubes, though immersed at the base, are, in the perfect state, free for a considerable part of their length. The growth of the polyzoarium commences at a single cell or a pair of cells, whence it radiates so as to form either a flabelliform entire expansion, or one subdivided into irregular lobes or into linear branches; the point of origin being, however, always marginal or distinctly excentric, by which circumstance it is distinguished from that of the closely allied genus *Patinella* (nob.), in which the starting point may be described as centrical. In *Diastopora* and *Berenicea* the growth is also excentric, the former being distinguished from *Tubulipora* by the discoid, margined polyzoary in which the cells are immersed quite or nearly to the extremity, and the latter by the polyzoarium forming a series of superimposed layers. Whilst its near ally *Alecto* is mainly distinguished by the creeping, irregularly branched polyzoary, whose cells are deeply immersed, and do not ascend in the same way as do those of *Tubulipora*.

1. Tubulipora phalangea, *Couch*. Pl. XVIII, fig. 6.

Adnata, integra, vel sublobata. Cellulis suberectis, seriatis, e lineâ longitudinali mediâ ad utrumque latus curvatis.

Polyzoarium adnate, entire or sublobate, with a mesial division down each lobe; tubes slender, erect, serial.

Tubulipora phalangea, *Couch*, Corn. Faun., iii, p. 106, pl. xix, fig. 7; *Johnston*, Brit. Zooph., p. 273, pl. xlvi, figs. 1, 2.
— verrucaria (?), *M. Edwards*.
Phalangella phalangea, *Gray*.
Tubulipora palmata, *S. Wood*.

Habitat.—C. Crag, *S. Wood*. (*Recent*) Britain.

Mr. Couch's account of this species conveys so good an idea of it that it will be sufficient to quote what he says of its distinction from *T. serpens*, the only other species with which it could be confounded: "It is encrusting, circumscribed, oval, and the oval is divided at the margins into from two to five lobes or festoons. Through the centre of each lobe runs a line or depression from which the tubes diverge on either side, as in *Tubulipora serpens*. The tubes are comparatively long, and are not in contact with each other as viewed from above. They are numerous, and arranged in perpendicular rows; each row is formed of a single series of tubes, which are in contact with each other. This arrangement presents the appearance of a number of Pan's pipes placed perpendicularly, the sets being separated from each other. *Tubulipora serpens* is a branched species, and is generally parasitical on other corallines, while this is an encrusting species and never branched."

2. T. flabellaris, (?) *Fab.* (*sp.*) Pl. XVIII, fig. 3; Pl. XX, fig. 9.

Crustacea, flabelliformis, adnata; cellulis e puncto unico irregulariter radiantibus.

Polyzoarium crustaceous, fan-shaped, adnate; tubes radiating irregularly from a single point.

TUBIPORA FLABELLARIS, *Fab.*, Faun. Grænl. p. 430; *Johnston,* Brit. Zooph., p. 274, pl. xlvi, figs. 5, 6.
DISCOPORA PALMATA (?), *Risso.*
DIASTOPORA VASSIACENSIS, *D'Orbigny,* Terr. Cret., pl. DCXXXV, figs. 12, 13.
„ PLUMULA (?), *Reuss,* Foss. Polyp., d. W. T. B., p. 51, pl. vii, fig. 11.

Habitat.—Cor. Crag, *S. Wood.* (*Recent*) Britain.

Genus 6. ALECTO, *Lamx.*

Polyzoario repente, adnato, irregulariter ramoso seu lobato; cellulis in ordine simplici vel in seriebus transversis, plus minusve regularibus dispositis.

Polyzoarium creeping, adnate, irregularly branched; cells in single series, or disposed in more or less irregular transverse rows.

(*a*) Cells uniserial.
Sp. 0.
(*b*) Cells multiserial.

1. A. REPENS, *S. Wood.* Pl. XX, figs. 5, 8.

Ramis linearibus parvis abrupte curvatis, subalternantibus, subdichotomis, superficie granulosâ. Cellulis bi-, tri-, subinde multiserialibus.

Branches linear; cells bi-, tri-, rarely multiserial; minute, abruptly curved; irregularly alternating, subdichotomous; surface finely granular.

T. REPENS, *S. Wood,* Ann. Nat. Hist., vol. xiii, p. 141.
T. FIMBRIATA (?), *Michelin* (ex syn.), Icon. Zooph., p. 322, pl. lxxvii, fig. 7.
IDMONEA RAMOSA, *D'Orbigny,* p. 632, figs. 1, 2.

Habitat.—C. Crag, on the inside of a small Pecten; (?) R. Crag, on the inside of a shell, *S. Wood;* (?) Doué, *Michelin.*

2. A. DILATANS, *W. Thompson.* Pl. XX, figs. 6, 7.

Lobis ad marginem dilatatis. Cellulis multiserialibus, superficie nitidissime punctulatâ.

Branches dilated at the ends; cells multiserial, surface smooth, dotted.

ALECTO DILATANS, *W. Thompson; Johnston.*
DIASTOPORA ECHINATA, *Reuss*, Foss. Polyp., d. W. T. B., p. 52, pl. vii, figs. 14, 15.
IDMONEA DIVARICATA (?), I. DEPRESSA (?), I. CENOMANA (?), I. ELEGANS (?), *D'Orbigny.*

Fam. IV. *DIASTOPORIDÆ*, Busk.

Polyzoario disciformi vel indefinito, adnato, sessili, vel stipitato.
Polyzoarium discoid or indefinite, adnate, sessile, or pedunculate.

Genus 7. DIASTOPORA.

Polyzoario adnato, discoideo vel flabelliformi, plerumque excentrico. Cellulis prorsus immersis; orificiis horizontalibus vel obliquis, ellipticis.

Polyzoarium adnate, discoid or flabelliform, usually excentric; tubes wholly immersed; openings horizontal or oblique, elliptical.

'DIASTOPORES SIMPLES,' *M. Edwards*, l. c., p. 39.
DIASTOPORA (pars), *Lamouroux* (?); *Milne-Edwards; Blainville* (?); *Reuss; Hagenow; Michelin; D'Orbigny*, &c.
— *Johnston.*
TUBULIPORA (pars), *Johnst.; Auct.*

1. D. SIMPLEX, (*n. sp.*) ? Pl. XX, fig. 10.

Polyzoario discoideo, adnato, cellulis antice convexis, superficie nitidè punctulatâ.

Polyzoarium discoid, closely adnate, tubes not flattened in front; surface finely dotted.

Habitat.—C. Crag on shell, *S. Wood.*

Of published figures the nearest I am able to find resembling the present form is that of *D. obelia*, Johnston;[1] but as the species that author had in view grows in undefined

[1] It is difficult to perceive what reason can have induced the learned author of 'Brit. Zoophytes' to confound his *D. obelia* with the *Obelia tubulifera* of Lamouroux. The latter is a *Tubulipora* (mihi), and has not a feature in common with the *D. obelia* of Johnston.

irregular patches, it would hardly appear that the two could be identical. But there is another form still existing in our seas of which no account seems yet to have been given, whose aspect, in some respects, far more nearly approaches that of *D. simplex*, though differing in the important particular that the upper side of the tubes is distinctly perceptible and depressed, or even channelled, whilst in *D. simplex* what is visible of that surface is convex and even.

One or two tertiary fossil species approaching the present in some respects are figured by Reuss, and one in particular, *D. flabellum* (op. c. pl. vii, fig. 9) might almost be regarded as a variety of it. The identification, however, is far too uncertain to justify its adoption at present.

Genus 8. Patinella, *Gray* (*subg.*).

Polyzoario disciformi, concavo. Cellulis ad marginem disci ascendentibus, orificio simplici, orbiculari; superficie integrâ, glabrâ, subinde obscurè annulatâ.

Disc concave or depressed in the centre; tubes ascending towards the margin; mouth simple, circular; surface not perforated.

Madrepora (sp.), *Linn.; Pallas; Olivi.; Esper.*
Millepora (sp.), *Ellis* and *Solander.*
Discopora (pars), *Fleming* (not *Lamarck*); *Busk*, Brit. Cyclop., art. "Polyzoa," p. 16.
Tubulipora (pars), *Lamarck; Milne-Edwards;* auct.
Patinella, *Gray*, Supplement to List Brit. Rad., p. 137.
Rubula (?), *Defrance.*
Rosacilla (? pars), *Rœmer.*
Discosparsa (sp.), *D'Orbigny.*

1. P. proligera, (*n. sp.*)? Pl. XIX, fig. 1; Pl. XX, fig. 3.

Sessilis; cellulis plerumque coalitis, ad centrum tantùm subinde ex parte liberis; disci margine supra proliferâ.

Polyzoarium sessile; tubes rarely distinct and only towards the centre; cellular border wide and thick, proliferous from the upper surface.

Habitat.—C. Crag, *S. Wood.*

The only species bearing any resemblance to the present in its peculiar proliferous habit is one named by M. D'Orbigny ('Terr. Cret.,' pl. dcclvii, figs. 5—10) *Discosparsa marginata.* His *Semimultea cupula* (ib. pl. dccxli, figs. 1—4), appears also to throw out buds from the upper surface, but more from the centre than towards the margin. With these exceptions I have been unable to find a similar condition in any other form.

The true characters of the species are apparent only in a few specimens, in which the centre of the disc exhibits the proper openings of the cells, which are disposed much in the same way as in much-worn and thickened specimens of *Patinella patina*. One peculiarity of *P. proligera* is the great width, thickness, and rotundity of the cellular border, in which also the alveolar orifices of the cells are peculiar, from their large size and elongated, rhomboid shape, and by which peculiarity even small fragments of the species may often be distinguished without difficulty.

The discs are frequently much contorted, of which an instance is represented in Pl. XX, fig. 3.

Genus 9. DISCOPORELLA, *Gray*.

Polyzoario sessili vel adnato, disciformi convexo vel subconico rarissime depresso. Cellulis horizontalibus plerumque in lineas radiantibus vel irregulariter dispositis, orificio denticulato vel emarginato ; superficie interstitiali cancellatâ.

Polyzoarium sessile or adnate ; discoid, centre usually elevated or subconical, rarely depressed ; tubes horizontal, usually disposed in radiating lines, or irregularly ; mouth toothed or emarginate ; intertubular surface cancellous.

DISCOPORELLA, *Gray*, List Brit. Rad., Suppl., p. 138.
DISCOPORA (pars), *Fleming* (not *Lamarck*) ; *Busk*, Brit. Cyclop., art. "Polyzoa," p. 16.
MADREPORA (pars), *Fabr.* ; *Esper*.
TUBULIPORA (pars), *M. Edwards* ; *Johnston* ; auct.

1. D. HISPIDA, *Johnst.* (?) Pl. XVIII, fig. 5.

Adnata ; cellulis in lineis radiantibus dispositis, orificio bi- tridenticulato.
Polyzoarium adnate ; cells in radiating lines, with a bi- tridenticulate mouth.

DISCOPORA HISPIDA, *Fleming* ; *Blainv.*, *Hassall* ; *Couch*.
TUBULIPORA HISPIDA, *Johnst.*
— ORBICULUS (?), *Lamarck*.

Habitat.—C. Crag, *S. Wood* ; (*Recent*), Britain.

This is but doubtfully identified with the recent form, although the presumption is very strong that it is the same with one of the probably several species confounded under the appellation.

2. D. GRIGNONENSIS (?), *M. Edw.* (*sp.*) Pl. XX, fig. 4.

Sessilis vel adnato. Cellulis elongatis sparsis; orificio emarginato.
Polyzoarium sessile or adnate; cells elongate, scattered; mouth notched.

TUBULIPORA GRIGNONENSIS, *M. Edwards,* Mém. sur les Crisiés, p. 13, pl. xiii, fig. 2.

Habitat.—C. Crag, *S. Wood.*

Genus 10. DEFRANCIA, *Bronn.*

Polyzoario disciformi, solitario seu sociali, convexo vel concavo, stipitato vel sessili. Cellulis in costis elevatis e centro radiantibus et ad peripheriam disci latioribus, dispositis.

Polyzoarium discoid, solitary or associated, convex or concave, pedunculate or sessile; cells disposed in distinct elevated ridges, radiating from the centre and increasing in width towards the periphery.

DEFRANCIA, *Bronn.* (? 1825); *Hagenow; D'Orbigny; Reuss* (pars); *Busk.*
TUBULIPORA (pars), *M. Edwards; Michelin* (sp.)
LICHENOPORA, *D'Orbigny* (pars); *Michelin* (non *Defrance*).
BICAVEA, UNICAVEA, *D'Orbigny.*
CERIOPORA (pars), *Goldfuss;* (*Hagenow* in Geintz. Grund.); *Auct.*
PELAGIA, *Lamouroux; Michelin.*
STELLIPORA (?), *Hag.*

Habitat.—C. Crag, *S. Wood;* Grignon, *Milne-Edwards; Michelin.*

The species belonging to this genus are numerous, and appear to have existed from a very ancient period, some, according to Hagenow, being found in the oolitic, more in the cretaceous, and fewer again in the tertiary formations, whilst several exist in the living state.

The polyzoarium may be either *solitary,* or a number may grow together in such close contiguity as to become fused, as it were, into a common mass, usually of a more or less globose form, though sometimes expanded and encrusting; these may be termed the *associated.*

In the solitary species, again, the discoid or expanded portion may be either *sessile* and immediately adnate, or *pedunculate;* and any of these divisions may be furthermore split up into lesser groups, according as the surface between the elevated costæ upon which alone the cells open, is *smooth* and entire, or *porous.* The importance of the latter character was first pointed out by Dr. Hagenow ('Maast. Kreideb.,' p. 42), and was employed by me in an 'Account of the Polyzoa collected on the Coast of

Norway and Finmark,' ('Annals N. H.,' 2 ser. xviii, p. 35.) It will be found of great convenience in the primary distinction of species.

The subdivisions of the genus may consequently be thus synoptically expressed :

(*a*) Solitariæ.

a. Pedunculatæ.

1. Interspaces smooth.
2. Interspaces porous.

β. Sessile.

1. Interspaces smooth.
2. Interspaces porous.

(*b*) Sociales.

a. Globosæ.

1. Interspaces smooth.
2. Interspaces porous.

β. Crustaceæ.

1. Interspaces smooth.
2. Interspaces porous.

(*a*). Solitariæ.

a. Pedunculatæ. 1. Interspaces smooth.

1. D. striatula, (*n. sp.*) Pl. XVII, fig. 5.

Stipitata. Superficie disci inferiori stipisque glabrâ, integrâ, lineis parallelis, longitudinalibus delicatulis, ornatâ, obscure annulatâ.

Under surface of disc and surface of peduncle smooth, imperforate, marked with delicate, parallel longitudinal lines, and faintly annulated.

Habitat.—C. Crag, Sutton ; *S. Wood.*

In some conditions of the recent *D. truncata* (so termed) inhabiting the Northern Seas in deep water, a superficial inspection might confound that species with the present, though very little closer observation will show that the two are quite distinct. In the so termed *D. truncata,* of which figures will be found in the paper above referred to on the Norway Polyzoa, the surface between the costæ, and the outer surface of the entire growth are like a honeycomb, and the tubes connate quite to the mouth, whilst in *D. striatula* a considerable portion of the tubes is free, and the surface imperforate. The only other recent pedunculate *Defrancia* with which I am acquainted, and which so closely resembles *Ceriopora stellata* of Goldfuss that I have designated it by the same specific appellation, occurs in the same locality as *D. truncata,* but no mistake can arise with respect to it.

The most nearly allied fossil forms are:

1. Defrancia Michelinii, *Hag.* = Ceriopora diadema, *Goldf.*, from the Cretaceous beds of Maastricht.
2. D. Brongniartii, *M. Edwards* (sp.), also a Cretaceous fossil.

But the differences between these and *D. striatula* are so obvious as not to require any special remark.

β. *Sessile.* 2. Interspaces cancellous.

D. rugosa, (*n. sp.?*) Pl. XIX, fig. 3.

Disciformis, adnata; superficie cancellatâ; cellulis magnis, paucis, valde elevatis.

Discoid, adnate; surface coarsely cancellated; tubes large, few much elevated.

Habitat.—C. Crag, *S. Wood.*

It is difficult to assign any well-marked characters to this species, of which the specimens are too imperfect for complete description, and it may consequently be found to correspond with some already recorded form.

Fam. V. *CERIOPORIDÆ,* Busk.

Polyzoario solido seu lamelloso; erecto seu decumbente, simplici vel ramoso. Cellulis contiguis, confertis.

Polyzoarium, solid or lamellar; erect or decumbent (sometimes encrusting?); simple or branched. Cells contiguous, crowded.

Genus 11. Fungella, *Hagenow.*

Polyzoario stipitato, capitato; capitulo simplici vel lobato. Cellulis coalitis, omnibus sursum spectantibus.

Polyzoarium pedunculate, capitate; capitulum simple or divided into lobes; the contiguous tubes opening irregularly on the upper surface.

FUNGELLA, *Hag.*, Maast. Kreideb., p. 37.
FRONDIPORA (sp.), *Michelin; (? Blainville).*

1. F. QUADRICEPS, (*n. sp.*) Pl. XVII, fig. 3.

Capitulo quadrifido; lobis singulis medio excavatis seu depressis. Cellularum orificiis in cristis irregularibus e centro radiantibus plerumque positis, subinde autem totam superficiem occupantibus; stipe porosâ, infra attenuatâ.

Capitulum quadrifid; each lobe depressed in the centre; openings of cells disposed to run in crests radiating from the centre, or uniformly over the surface, stem porous, attenuated downwards.

Habitat.—C. Crag, Sutton; *S. Wood.*

This species bears so close a resemblance to *Fungella prolifera,* Hag. ('Maast. Kreideb.' p. 37, pl. iii, fig. 6), that it is difficult at first sight to perceive that there is much if any difference between them. The following distinctions, however, will be found to exist. In *F. prolifera* the stem is described as smooth, longitudinally striated and ringed transversely, whilst in *F. quadriceps* the surface of the stem is entirely covered with distinct elongated pores. The fourfold division of the capitulum appears to be a constant character in *F. quadriceps,* but which, though shown in the figure, is not specially adverted to in the text. Neither does Dr. Hagenow notice the depressed centre of each lobe and the radiating disposition of the openings of the cells, often so manifest in *F. quadriceps,* and showing the close relationship of the genus to *Defrancia.*

2. F. MULTIFIDA? (*n. sp.*) Pl. XVII, fig. 4.

Stipe brevissimo, ad basim incrassato. Capitulo in lobis bifidis numerosis subcompressis vel rotundis diviso. Cellularum orificiis æqualibus per totam superficiem dispositis. Stipis superficie glabrâ, lineis delicatulis areas hexagonas circumscribentibus ornatâ.

Peduncle very short and thick, expanded at the base; capitulum divided into numerous bifid subcompressed or circular lobes, which are convex on the surface; openings of the cells of uniform size and disposition; surface of base and peduncle smooth, divided into hexagonal areas by reticulating lines.

FRONDIPORA MARSILLII, *Michelin,* Icon. Zooph., p. 68, pl. xiv, fig. 4 (not *Blainville*).

Habitat.—C. Crag, *S. Wood.*

It is with great hesitation that I place this form in the genus *Fungella* at all, inasmuch as I think it very probable that it represents merely the young or incipient condition of *Fascicularia tubipora*. I should have had no doubt about this had that well-marked and gigantic species occurred among those described by M. Michelin, whose figure and description of *Frondipora Marsillii* (strangely confounded by him with the wholly dissimilar *F. Marsiglii* of Blainville), shows beyond dispute that that species is identical with ours. But since *Fascicularia tubipora* is not noticed by Michelin, and could hardly, had it existed in the beds examined by him, have been overlooked, this circumstance leads to the suspicion that his *F. Marsillii* could not be the young state of that species.

3. Fungella infundibulata. Pl. XVII, fig. 6.

Polyzoario infundibuliformi, vel cyathiformi. Cellularum orificiis ad marginem capituli incrassatum et rotundatum positis. Stipis superficie alte sulcatâ.

Polyzoarium infundibuliform or cupped; cells opening all round the thickened, rounded margin of the cup; peduncle strongly sulcate.

Habitat.—C. Crag, Sutton; *S. Wood.*

The peduncle in this species of *Fungella* is deeply and irregularly grooved, owing, manifestly, to the destruction of the wall of the cells constituting its exterior. The interior of these open tubes exhibits a closely punctate surface, like that of the interior of the tubes in *F. quadriceps* and *F. multifida*, though the puncturation seems to be closer in *F. infundibulata* than in the others.

Genus 12. Heteropora, *Blainville.*

Polyzoario erecto, cylindraceo, simplici vel ramoso. Superficie aperturis duplicis generis, *orificiis* nempe et *ostiolis* ornatâ.

Polyzoarium erect, cylindrical, undivided, or branched; surface even, furnished with openings of two kinds; the larger representing the *orifices* of the cells, and the smaller the *ostioles* of the interstitial canals or tubes.

Heteropora, *Blainville*, Man. d'Actin., p. 417, 1834; *Lamarck; Lonsdale; Hagenow*, 1851; *Reuss; Michelin; J. Morris.*
Ceriopora (pars), *Goldfuss; Hagenow*, 1846; *D'Orbigny.*
Millepora (pars), *Lamouroux.*
Entalophora (pars), Ceriocava, Multicrescis, Semicrescis *D'Orbigny.*

As remarked by Mr. Lonsdale,[1] "the genus *Heteropora*, established in 1834 by M. de Blainville on three species of Prof. Goldfuss's *Ceriopora*, has not been described either by its founder or by other authorities with sufficient fulness to enable an opinion to be formed of its complete characters, or of the nature of the minor openings, one of the assigned essential structures." Nor consequently could its true systematic position be regarded as fully established. Though unnoticed among the rest of the Tubuliporidans by M. Milne-Edwards in his excellent Memoirs on those Polyzoa, published in 1838, it would seem that he had surmised its true relations when he edited the second edition of Lamarck in 1836. It is there placed among the heterogeneous "Polypiers foraminés," of Lamarck, together with its natural allies *Pustulopora, Chrysaora, Theonoa,* and *Terebellaria,* whence it may be concluded that its true affinities were at any rate beginning to be appreciated. But to Mr. Lonsdale is undoubtedly due the merit of clearly indicating upon sufficient grounds the real position of the genus, which has been tacitly accepted by all subsequent writers.

The essential character of the genus has been drawn from the existence on the surface of the Polyzoarium of two kinds of pores, a *larger* and a *smaller*. The former representing the orifices of the true polypide-cells, and the latter those of interstitial canals or tubular passages of greater or less length, and which are of smaller size though far more numerous than the true cells, and in some instances differ from them not only in size, but also in structure. The true nature of these interstitial passages is at present obscure; and as no living species belonging to the genus has, so far as I know, yet been met with, one important source of information respecting the relations of these canals to the rest of the economy is wanting. We may be allowed, however, to presume that these passages are analogous in function to the openings of other kinds which are found, affording communication apparently between the polypide-cell and the circumambient water in many other cases, such as the canals which lead from the bottom of the cells to the under surface in several species of *Cupularia* and *Lunulites,* the pores and openings of various kinds in numerous species of *Eschara, Lepralia,* &c.; and, to come to nearer allies, to the minute pores which exist in the walls of the cells in all the *Crisiidæ, Pustulopora, Idmonea,* &c., but more particularly to the perforations which are so manifest both in front and behind in the *Horneræ.* In fact, in transverse fractures of some species of this genus, minute tortuous canals may be traced from the smaller pores on the anterior surface into the interior of the branch; resembling, except in their diminutive size and paucity of numbers, the interstitial canals of *Heteropora.* This view of the nature of the interstitial canals is further borne out by the circumstance that in one or two of the species here referred to *Heteropora,* for want of a more eligible situation, the small size and comparative fewness of the ostioles and passages, conjoined with a strongly marked disposition to reticulation on the surface, a close approach is made to *Hornera.* Heteroporæ of this kind are represented by *H. reticulata.*

[1] 'Miocene Fossils of N. America,' Q. J. Geol. Soc., vol. i, p. 500, 1845.

The cell-tubes in *Heteropora,* when traced internally, are seen to enter the branch at first nearly horizontally, and gradually curving downwards, to descend vertically in the centre of the branch, which thence comes to be occupied by a sort of pith, composed of pretty nearly equal-sized, polygonal contiguous tubes. The interstitial canals rarely appear to enter into this pith, usually terminating where the cell-tubes begin to assume the perpendicular direction. In cases such as that of *H. pustulosa* (Pl. XX, fig. 1, *d*), or of *Heteroporella radiata* (Pl. XIX, fig. 2, *d*), where the interstitial canals are of large size, nearly equal in fact to the cells themselves, they may be distinguished from the latter by their peculiar moniliform aspect, an appearance which is due to the existence of partial, transverse, nearly equidistant septa. As it is not impossible that this peculiar condition of the tubes might give rise to the mistaking of one of these Polyzoa for a true coral, such as *Favosites* or *Chætetes* for instance, it will be as well to explain how it appears to arise. In *Heteroporella radiata,* and in *Heteropora pustulosa,* and in other species also, of what may be termed true *Heteroporæ,* the ostioles will often be found completely closed by a calcareous, depressed lid, which in the majority of cases, however, is perforated in the middle. Now it would seem that the imperfect septa above noticed in the canals, represent the remains of these hymen-like lids, which have been left behind at successive stages of growth.

In *H. clavata* the interstitial orifices, or many of them, exhibit a stellate appearance, owing to the projection into their interior of numerous minute rays; affording thus another curious, false resemblance to a true coral. This appearance, however, is not peculiar to *Heteropora,* for a similar condition exists in the beautiful pores, for instance, which ornament the front of the cells in *Lepralia Malusii,* and may be observed in certain pores, no doubt of exactly the same nature as those in *Heteropora* in at least one recent species of *Discoporella.*

The species furnished with these two kinds of orifices appear to be naturally divisible into two groups, which may perhaps be regarded as generic, according as they are encrusting or at least adnate, or massive, erect, and cylindrical. For the former I venture to propose the term *Heteroporella, n. g.,* and to restrict that of *Heteropora* to the latter.

1. Heteropora pustulosa (*n. sp.*)? Pl. XX, fig. 1; Pl. XIX, fig. 6.

Irregulariter ramosa; ramis curvatis, teretibus. Orificiis peristomate incrassato, quadrifido munitis et ostiolis 5 foveolatis circumcinctis; tubulis interstitialibus, moniliformibus, et in diametro cellulis propè paribus.

Polyzoarium branched irregularly; branches curved, tapering; cell-orifices with a thickened, annular, quadrifid border; ostioles depressed, foveolate, about 5 around each orifice; interstitial tubes nearly as large as the cells, moniliform, not punctured.

> HETEROPORA TORTILIS (?), *Lonsdale*, l. c., p. 500, with fig.
> MULTIZONOPORA RAMOSA (?), *D'Orbigny*, Terr. Cret., pl. DCCLXXII, figs. 1, 3.
> HETEROPORA INTRICATA (??), *Mich.*, l. c., p. 320, pl. lxxv, fig. 6.
> ENTALOPHORA IRREGULARIS (?), *D'Orbigny*, l. c., pl. DCXVII.
> HETEROPORA DICHOTOMA, *S. W.*, MS.

Habitat.—Sutton; *S. Wood; J. S. B.*; (?) Cretaceous and Oolite, *D'Orbigny* and *Michelin*.

Of the above synonyms those which appear the most likely to prove correct are *Heteropora tortilis*, Lonsdale, and *Multizonopora ramosa*, D'Orbigny, which probably corresponds with his *Entalophora irregularis*, but is clearly not the same as *H. ramosa* of Michelin. The specific name consequently could not be adopted, even were the identity of his form with the Crag fossil satisfactorily established. All that need be remarked respecting it is that the representation of the natural size of *M. ramosa* given by M. D'Orbigny suits very exactly to *H. pustulosa*, and that there is nothing in his diagrammatic, magnified figure against the supposition that they may be the same.

With respect to *H. tortilis* of Mr. Lonsdale, it may be remarked that his excellent account and very intelligible figures show that the two forms are at any rate closely allied. The geological position also of *H. tortilis* is an additional argument in favour of its correspondence with the Crag fossil. The chief difference seems to exist in the absence in *H. tortilis* of the peculiar annular thickening of the mouths of the cells in the better preserved portions of the specimens which forms a striking character in *H. pustulosa*, and which, had it existed in his species, could hardly not have escaped the observant eye of Mr. Lonsdale, who, on the contrary, expressly says of the American species that the edges of the larger orifices are "sharp."

2. HETEROPORA CLAVATA, *Goldfuss* (*sp.*) Pl. XIX, fig. 7.

Polyzoario simplici, clavato, inferne valde attenuato. Superficie cancellatâ. Cellularum orificiis orbicularibus, simplicibus, superficie æquatis vel depressis, ostiolis quinque magnis circumcinctis.

Polyzoarium simple, club-shaped, much attenuated at the base; surface cancellous; cell-orifices circular, simple, level or depressed; ostioles large, about 5 around each cell-orifice.

> CERIOPORA CLAVATA, *Goldfuss*, Petr. Germ., p. 36, pl. x, fig. 15.
> HETEROPORA ANAMOLOPORA, *Reuss*, Foss. Polyp., d. W., *T. B.*, p. 34, pl. v, figs. 17, 18 (not *Hag.*).
> CERIOPORA THELEOIDEA (?), *Hag.*, Maast. Kreideb., p. 52, pl. v, fig. 5.

Habitat.—C. Crag, *S. Wood.*

The regular clavate form of this species, apparently at all ages, will at once serve to distinguish it from any of its congeners. In Plate XIX, fig. 6, the young state of *H. pustulosa* is represented, and at a time when the division into branches has but just commenced. In outward form, therefore, it may be conceived that at a still earlier period that species might be confounded with the present; but even then no difficulty in the diagnosis is, I think, to be apprehended, if the minuter characters are attended to. In referring this species to the *C. clavata* of Goldfuss, I am guided solely by the general aspect, so that the identification should not be taken for more than it is worth. Dr. Reuss's *H. anamolopora* (a tertiary form) is clearly the same as *C. clavata,* Goldfuss, and it is difficult to understand how he could have confounded it with the wholly distinct *C. anamolopora* of Goldfuss.

2. H. RETICULATA (*n. sp.*)?[1]

Ramosa; ramis dichotomis, cylindraceis, truncatis; superficie sulcatâ seu reticulatè fibrosâ. Cellularum orificiis simplicibus, parvis, orbicularibus, superficie æquatis, distantibus, sparsis. Ostiolis minimis elongatis irregulariter inter et circa orificia dispositis. Cellulis angustis æqualibus, parietibus imperforatis; tubulis interstitialibus perangustis.

Polyzoarium dichotomously branched; branches cylindrical, truncate; surface sulcate or fibro-reticulate; cell-orifices simple, small, orbicular, level with the surface, wide apart, scattered; interstitial orifices very small, elongated, disposed some around the larger orifices, others in the longitudinal sulci and reticulations on the surface; tubes of cells narrow, of uniform diameter, walls not perforated; interstitial canals very narrow.

CERIOPORA DICHOTOMA (?), (pars), *Goldfuss*, Petrefact. Germ., p. 34, pl. x, fig. 9, *d, e,* and ? *f.*
HETEROPORA DICHOTOMA, *Hagenow*, Maast. Kreideb., p. 47, pl. v, fig. 15; *Reuss*, Foss. Pol., d. W., *T. B.*, p. 35, pl. v, fig. 20 (not *Michelin*).

Habitat.—C. Crag, *S. Wood; J. S. B.*

If regard were paid only to the figures in Goldfuss, above cited, and which represent merely the natural size and general aspect, no hesitation could be felt in assigning the Crag fossil to the same species as the one there represented, and which appears to be quite distinct from that represented in the same figure under *a, b, c.* But doubts arise with respect to this identification, when we come to examine the excellent and minute figures of the Goldfussian species, and even taken, as it would seem,

[1] By accident it was discovered that no figure of this species had been prepared until the last plate was completed.

from the same specimen by Hagenow ('Maast. Kreideb.,' pl. v, fig. 15). In these figures, if they really represent the form intended in fig. 9 *d*, and *e*, of Goldfuss, which is not quite clear, the minute characters are not those of the Crag fossil, nor can they be in any way reconciled with them. The entire absence of any reference by Dr. Hagenow to the peculiar reticulate sulcation of the surface, which is so obvious and striking a characteristic of our *H. reticulata*, leads to the supposition that so careful and accurate an observer could not have had that form under observation. And the same remark will apply to Reuss' figure of *H. dichotoma*, which is clearly the same as Hagenow's. In this doubtful state of the question, and considering, moreover, that the variety marked *d* and *e* in Goldfuss's figure cannot be regarded as the typical form of his species, which is rather that marked *a*, *b*, *c*, it seems advisable to designate the Crag fossil by a distinctive appellation, and for the present to drop that of *dichotoma*, which evidently, as originally constituted, includes at least two, and perhaps three, distinct forms.

At the same time Goldfuss' figure so closely resembles that of *H. reticulata*, that I am very strongly inclined to think that direct comparison of his specimen with the Crag species would show that they are really identical. His species, it is true, belongs to the Cretaceous period, but there seems no reason to doubt that some one or other of the forms assigned by him to it also existed in the Tertiary period, and it may, therefore, be presumed that the one now in question may have survived up to that of the Crag deposit.

The peculiar characteristic of *H. reticulata* is the coarsely sulcate or reticulate aspect of the surface, which bears, in some respects, a strong resemblance to that of a *Hornera*, whence, as well as from the smallness of the interstitial pores and canals, this species may be regarded as intermediate between *Hornera* and *Heteropora*.

3. H. LÆVIGATA? *D'Orbigny*, (*sp.*) Pl. XIX, fig. 5 (young state).

Ramosa; ramis elongatis cylindraceis, fortibus, teretibus. Superficie scrobiculatâ, ad ramorum basim nitide reticulate-fibrosâ. Cellularum *orificiis*, simplicibus, orbicularibus, superficie æquatis, in zonis annularibus vel irregulariter sinuosis aggregatis; *ostiolis* parvis, in scrobiculis positis; cellulis parietibus rugulosis, perforatis; tubulis interstitialibus perangustis moniliformibus.

Polyzoarium composed of elongated, cylindrical, strong, tapering branches; surface pitted, and at the base of the branches finely fibro-reticulate; orifices of cells simple, orbicular, level with the surface, assembled into zones, either annular, or meandering irregularly over the surface; ostioles small, situated in the pits; cell-tubes wrinkled, walls perforated; interstitial tubes very small and moniliform.

CERIOPORA DICHOTOMA (?), *Goldfuss*, pl. x, fig. 9, *a*, *b*, *c*.
ZONOPORA LÆVIGATA, *D'Orbigny*, Terr. Crét., pl. DCCLXXI, figs. 7, 8.
MULTIZONOPORA LIGERIENSIS (?), Id. ib., pl. DCCLXXII, figs. 4—6.

Habitat.—C. Crag, Sutton, *S. Wood;* Cretaceous, *D'Orbigny;* (?) *Goldfuss.*

Though not much inclined to adopt any of M. D'Orbigny's species, about which, at any rate, the doubt always exists whether they are his own or not, his figures above cited leave so little doubt of their representing a form identical with the Crag fossil, that I have no hesitation in referring them to the same species.

With respect to the synonym cited from Goldfuss, as there are no means of judging correctly with respect to the *Heteropora* really intended by him, except what are afforded by his very defective figures, it is impossible to determine whether the present species is represented in his plate or not. All that can be said is, that the external resemblance, and the apparent zonular disposition of the cell-orifices, would lead one to suppose that it may be so.

In the same way that the preceding species might be regarded as intermediate between *Hornera* and *Heteropora,* so may this be looked upon as a link between these two genera and *Cricopora,* and perhaps as affording an additional proof of the artificiality of the not very satisfactory classification we are at present compelled to adopt of these Polyzoa.

The distinctive specific characters are found in the partially pitted and partially fibro-reticulate condition of the surface; the peculiar zonular disposition of the cell-orifices; the curious wavy formation of the cell-walls, which is well shown in Pl. XIX, fig. 5; and the smallness or shortness of the interstitial pores and canals.

Genus 13. Heteroporella (*n. gen.*)

Polyzoario disciformi et adnato, sive incrustante et indefinito; superficie porosâ, aperturis duplicis generis ornatâ; *orificiis* nempe cellularum, et *ostiolis* interstitialibus.

Polyzoarium discoid and adnate, or indefinite and incrusting; surface uniformly porous, with openings of two distinct kinds.

Reptomulticava (?), *D'Orbigny.*

The relations of this genus have been noticed in the remarks appended to the account of *Heteropora,* with which the present agrees in all respects except its habit. In *Heteropora* the growth is erect, and usually, though not always, branched, whilst in *Heteroporella* it is expanding and discoid, or indefinite and incrusting; the one, in fact, standing in the same relation to the other that *Lepralia* does to *Eschara.* Consequently, the same explanation with respect to the two kinds of pores will apply to *Heteroporella* as was offered in the case of *Heteropora.*

1. H. RADIATA (*n. sp.*) Pl. XIX, fig. 2.

Disciformis, subadnata. Superficie inferiori integrâ rugisque concentricis ornatâ. Cellularum orificiis, subovalibus, simplicibus superficie æquatis; ostiolis interstitialibus parvis, orbicularibus, foveolatis.

Polyzoarium discoid, adnate by a broad base, the unattached part of the under surface covered with a thick, entire, calcareous layer, marked with annular ridges; mouths of cell-tubes suboval, simple, even with the surface; intermediate orifices small, circular, placed at the bottom of funnel-shaped depressions.

Habitat.—C. Crag, Sutton, *S. Wood.*

Were it not for the existence of the interstitial tubes, which are of a moniliform character, as in *Heteropora pustulosa,* this form would be hardly distinguishable from a *Defrancia* or *Discopora,* with which it is undoubtedly closely allied.

2. H. PARASITICA (*n. sp.*) Pl. XXII, fig. 5.

Incrustans, indefinita (?) Cellularum *orificiis* orbicularibus, simplicibus, superficie æquatis; *ostiolis,* orbicularibus, simplicibus, sparsis.

Incrusting, indefinite (?). Orifices of cells circular, simple, even with the surface; intermediate openings circular, simple, irregularly scattered among the others.

Habitat.—Cor. Crag, on shell, *S. Wood.*

This is a very doubtful form, but as I am unable to refer it to any known species, it may be, provisionally at any rate, regarded as independent. In the figure the orifices of the cells appear as if surrounded with an annular thickening, but this is not apparent in the specimen, at any rate so distinctly as it is represented by the artist. The entire surface between the openings appears irregularly areolated, and as if formed by the closed orifices of cells, sealed up, as it were, by calcareous matter, as may frequently be observed in other cyclostomatous Polyzoa.

Fam. VI. *THEONOIDÆ,* Busk.

Polyzoario massivo, subgloboso vel irregulari; cellulis contiguis, confertis.

Polyzoarium massive, subglobose, or irregular; cells contiguous, crowded

Genus 14. Alveolaria, (*n. gen.*)

Polyzoario massivo globoso; superficie in areas hexagonas vel polygonas septis longitudinaliter sulcatis subdivisâ. Cellularum orificiis per totam aream distributis.

Polyzoarium massive, globose; surface divided into hexa- or polygonal areas by raised lines, which are finely sulcate longitudinally. The interior of the area uniformly occupied by the openings of the cells.

1. A. semiovata, (*n. sp.*) Pl. XIX, fig. 4; Pl. XXI, fig. 3 (section).

Sp. unica.

Blumenbachium, *Sowerby*, König Icon., 75, fig. 69.

Habitat.—C. Crag, *S. Wood; J. S. B.*

This is one of the most curious and peculiar forms of cyclostomatous Polyzoa met with in the Crag, and apparently confined solely to that formation. In its massive, hemispherical form and general aspect, when worn smooth and covered with extraneous matters, it resembles the two species of *Fascicularia,* with which it is associated, but in its real structure it differs most widely from them, as well as from any hitherto known Polyzoon.

In Pl. XIX, fig. 4 (*a*), a polygonal cup-shaped object, cellular within, and smooth or slightly wrinkled on the exterior, and at (*b*) in the same figure, the entire upper surface of one, and portions of the same surface of seven other similar cup-shaped growths will be seen in close apposition. They represent, in fact, a number of hexagonal or pentagonal hollows, separated by raised lines, and, on close inspection, it will be seen that these ridges are not simple, but that each is marked with a fine longitudinal furrow, indicating the lines of contact of two contiguous alveoli. The entire growth, in short, is composed of an aggregation of cup-shaped bodies, resembling that figured at (*a*); and in well-preserved specimens, which appear to be very abundantly met with, the real structure may be readily made out, even when they are of very large size; and besides these, many specimens in an earlier stage of development will be found, showing the process of growth still more satisfactorily.

Genus 15. FASCICULARIA, *Milne-Edwards.*

Polyzoario massivo globoso sessili, e fasciculis cellularum prorsus coalitarum et e basis centro ad peripheriam undequaque radiantibus composito.

Polyzoarium globose, massive; constituted of distinct bundles of contiguous tubes; the bundles radiating from the centre of the base, in all directions, towards the periphery.

FASCICULARIA, *Milne-Edwards,* 1836 (*M. S.*); *Lyell; S. Wood.*
THEONOA (sp.), *S. Wood;* (sp.) *Auct.* ?
MEANDRIPORA, *D'Orbigny.*
APSENDESIA (pars), *Blainville; Lamx.* (?).

This genus, which, though named, does not appear hitherto to have been fully described, may be regarded at present as quite peculiar to the Crag, and in all probability to the Coralline Crag, for though found in the Red Crag there can be little doubt, as observed by Mr. S. Wood, that these stray specimens have been introduced from the underlying coralline beds.

The peculiarity of the structure of the polyzoarium consists in its being made up of radiating bundles of tubes, which bundles, in one of the two species, are cylindrical, and of pretty nearly uniform dimensions throughout, whilst in the other they are more irregular in size and form. A striking distinction, also, is observable in the mutual relation of the bundles of tubes to each other in the two species. In one, the cylindrical bundles are united, at regular distances apart, by what may be termed tabular, horizontal septa, indicating probably periodical lines of growth, and which lines are thus concentric to one another. In the other species the bundles of tubes anastomose more irregularly, approaching each other and coalescing for some distance, and then separating again. In consequence of which the appearance of periodical lines of growth, though obvious enough, is not so distinct as in the other species, and the aspect of the surface is also rendered widely different, which presents in the one case rounded eminences, on which the tubes open, and in the other undulating anastomosing ridges.

The only genera with which the present can be confounded, are *Apsendesia* and *Theonoa* of Lamouroux. With respect to the former, as defined by that author himself, there seems, upon reference to his description and figure[1] of the typical species *A. cristata,* —"subglobosa vel hemispherica; laminis exsertis, rectis, diversè convolutis, uno latere lamelliferis"—to be no reason whatever to regard it as in any way allied to Fascicularia, except in outward configuration; nor, in fact, is it certain that it is a Polyzoon at all. It is otherwise, however, with the genus as defined by M. de Blainville,[2] who, as it would

[1] 'Exp. Meth.,' p. 81, pl. lxxx, figs. 12—14.
[2] 'Man. d'Actin.,' p. 408.

seem, after inspection of specimens derived from the Lamouroux Collection, characterises the genus as follows: "Cellules subpolygonales, petites, poriformes, irrégulièrement disposées, et occupant le bord supérieur et externe de crêtes ondees, sinueuses, lisses d'un côté, plissées d' l'autre, constituant un polypier calcaire, globuleux ou hémisphèrique, divergeant de la base à la circonference."

It is probable, that in drawing up this character, the learned author had in view not so much, if perhaps, at all the *Apsendesia cristata* of Lamouroux, as two other forms associated by himself with it, and which would appear to constitute, as it seems to me, two distinct genera, or at any rate one. These species are *A. dianthus*, Blainv., and *A. cerebriformis*, Blainv. The former derived from the Jurassic beds at Caen, and probably really representing the *Ap. cristata* of Lamouroux; and the latter procured from the tertiary beds of Anjou, and which, in all probability, is the same as *Fascicularia aurantium*, Milne-Edwards, of the Crag.

Lamouroux describes his genus *Theonoa* as constituted of a massive, conical or coarsely cylindrical, undulated, simple or lobed polyzoarium, whose surface is covered with numerous holes or deep depressions, very irregular in their form and disposition, and not perforated at the bottom, whilst the intermediate, raised portions of the surface are occupied by the openings of the cells.

This account would point at some resemblance in structure, perhaps, between *Theonoa* and *Fascicularia*, but in the absence of more precise indications with respect either to *Apsendesia* or *Theonoa*, it seems better to adopt the appropriate appellation suggested by Milne-Edwards, and since employed by several geological writers, in preference to either of the older terms.

1. Fascicularia tubipora (*n. sp.*) Pl. XXI, fig. 1.

Cellularum fasciculis distantibus, cylindraceis, septis transversis, concentricis, pari intervallo distantibus, connexis. Superficie polyzoarii tuberosâ, tuberibus cancellatis, interstitiis glabris, areolisque hexagonis ornatis.

Tubes assembled into distinct cylindrical bundles, united at uniform distances apart by horizontal, tabular, concentric laminæ; surface covered with rounded eminences, upon which the cells open uniformly all over; intermediate surface smooth, and marked with hexagonally reticulating lines.

Habitat.—C. Crag, *S. Wood; J. S. B.* Red Crag ?, *S. W.*

The masses formed by this species, which seems to be very abundant, vary in size from one inch or less, to upwards of six in diameter. When worn smooth on the surface, and covered, as is often the case, with an adherent layer of sand, they look like anything else than what they are. In this condition it is next to impossible, in many cases, to distinguish them from *F. aurantium.* But if one of the masses be split vertically, the peculiar arrangement of the bundles of tubes, closely resembling that of *Tubipora musica,* will at once solve all doubts. In cases where the surface is less worn, the circular eminences afford an obvious character.

In speaking of *Fungella multifida* (p. 119), it is suggested that that species may probably merely represent the young state of *Fascicularia tubipora.* This is a matter for future determination, but the mere inspection of the figures will show sufficient ground for the suspicion that they may stand in the relation suggested.

2. F. AURANTIUM, *Milne-Edwards.* Pl. XXI, fig. 2.

Cellularum fasciculis confertis, sæpius irregulariter coalitis; polyzoarii superficie rugosâ; rugis anastomosantibus sinuosis, cancellatis; interstitiis striatis.

Tubes assembled into compound bundles, which anastomose irregularly with each other, and project on the surface in elongated, tortuous, anastomosing ridges, upon which the cells open; intermediate surface striated.

APSENDESIA CEREBRIFORMIS (?), *Blainville,* Man. d'Actin., p. 409; *M. Edw.* in *Lamarck,* 2d ed., ii, p. 290; *Michelin,* Icon. Zooph., p. 314, pl. lxxv, fig. 5.

FASCICULARIA AURANTIUM, *Milne Edwards,* (*M. S.,* 1830); *Sir C. Lyell,* Man. Elem. Geol., 5th ed., p. 172, fig. 154; *J. Morris.*

Habitat.—C. Crag, *S. Wood; J. S. Bowerbank;* Valduc (Bouches-du-Rhône), Doué (Maine-et-Loire), *Michelin.*

ADDENDA AND CORRIGENDA.

1. ESCHARA SOCIALIS (*n. sp.*) Pl. XXII, fig. 1.

Polyzoario pedunculato, e centro disci orbicularis, incrustantis surgenti. Cellulis sub-ovalibus seu hexagonis, immersis, inæqualibus, sparse punctatis. Orificio orbiculari, infrâ emarginato. Aviculario parvo mandibulâ acutâ ascendenti, ad unum latus prope orificium posito.

Polyzoarium pedunculate, springing on a slender peduncle from the centre of an orbicular, incrusting, discoid expansion. Cells oval or hexagonal, immersed; surface uneven, sparsely punctured. Orifice orbicular, notched below. Usually a small avicularium with an acute mandible pointing upwards, on one side, close to and below the orifice.

Habitat.—C. Crag, *S. Wood*, on shell.

This is a very curious form, and for some time it was uncertain where to place it. The only specimens met with are very imperfect, and present the aspect of several short, broken stumps, arising in close contiguity from the centre of circular expansions, firmly adnate to the surface of a shell. What the form of the perfect growth may be it is at present impossible to say. In most cases the cells have become completely solidified, or filled up by earthy matter, so that all vestige of the orifice, and nearly so of the internal cavity, is absent. Owing to this circumstance, the surface of the broken peduncle presents a curious appearance. This portion of the polyzoary seems to be made up of solid conical prisms, at the apex of which may sometimes be observed all that remains of the cavity of the cell, but in nearly all cases a transverse septum, separating the prisms on the two sides of the peduncle, may be noticed, as in others of the branched Escharæ. The only species of Eschara with which this can be supposed to have any connexion is *E. incisa*, but at present no sufficient ground exists for their being associated.

2. Lepralia edwardsiana (p. 44).

When the above appellation was given to this species, I had overlooked the circumstance that M. D'Orbigny had given it, in 1839, to a species of *Lepralia* (*Escharina*) from the Coast of Patagonia.[1] I propose, therefore, to term the Crag fossil *L. milneana*, which will equally recal the name of the eminent naturalist and physiologist to whom we are so deeply indebted for our knowledge of recent and fossil Polyzoa, as well as in all other branches of zoological science.

3. Flustra dubia (*n. sp.?*) Pl. I, fig. 3.

Cells subpyriform, pointed at the summit. Many closed in front?

Habitat.—C. Crag, *S. Wood.*

Only one minute fragment of this curious growth has been met with in Mr. Searles Wood's Collection. It has been assigned to the genus *Flustra* for want of any more appropriate allocation—but it is extremely doubtful whether it will not, on further investigation of larger specimens, be found to be erroneously placed there, and to represent a distinct generic type. From its extreme fragility it would seem so far to have agreed with *Flustra* as to have been more or less flexible when living.

[1] 'Voy. d. l'Amer. mérid.' ("Polypiers," p. 12, pl. v, figs. 1—4).

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N.B.—In most cases two enlarged figures are given of each species, one of which is magnified twenty-five and the other fifty diameters.

PLATE I.

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3. *Flustra* (?) *dubia*, p. 131.
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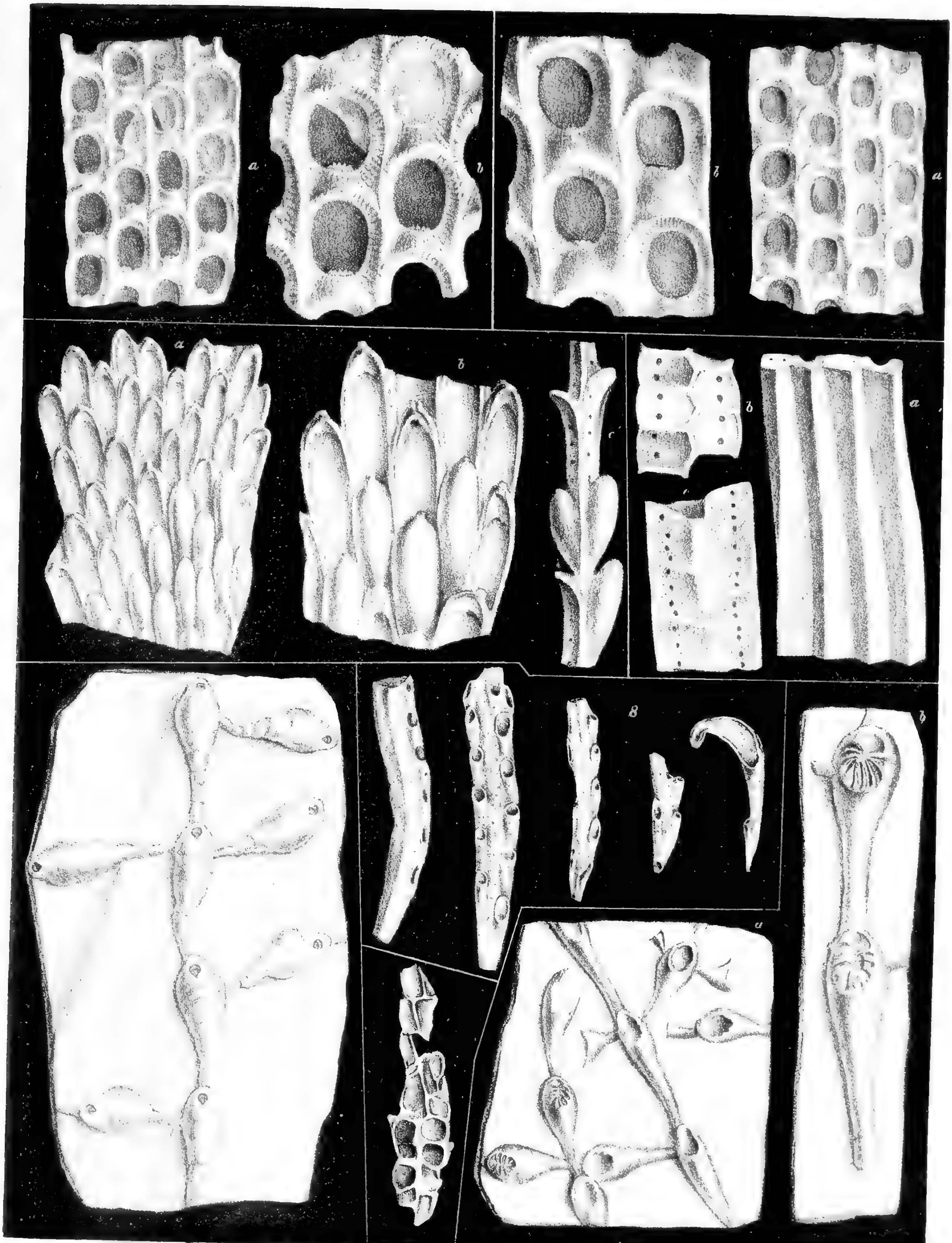
PLATE 1



G Busk & G West ad nat del. G West lith

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PLATE II.

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1. *Membranipora tuberculata*, p. 30.
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    - *d*. Back of detached portion, magnified 25 diameters.

PLATE II

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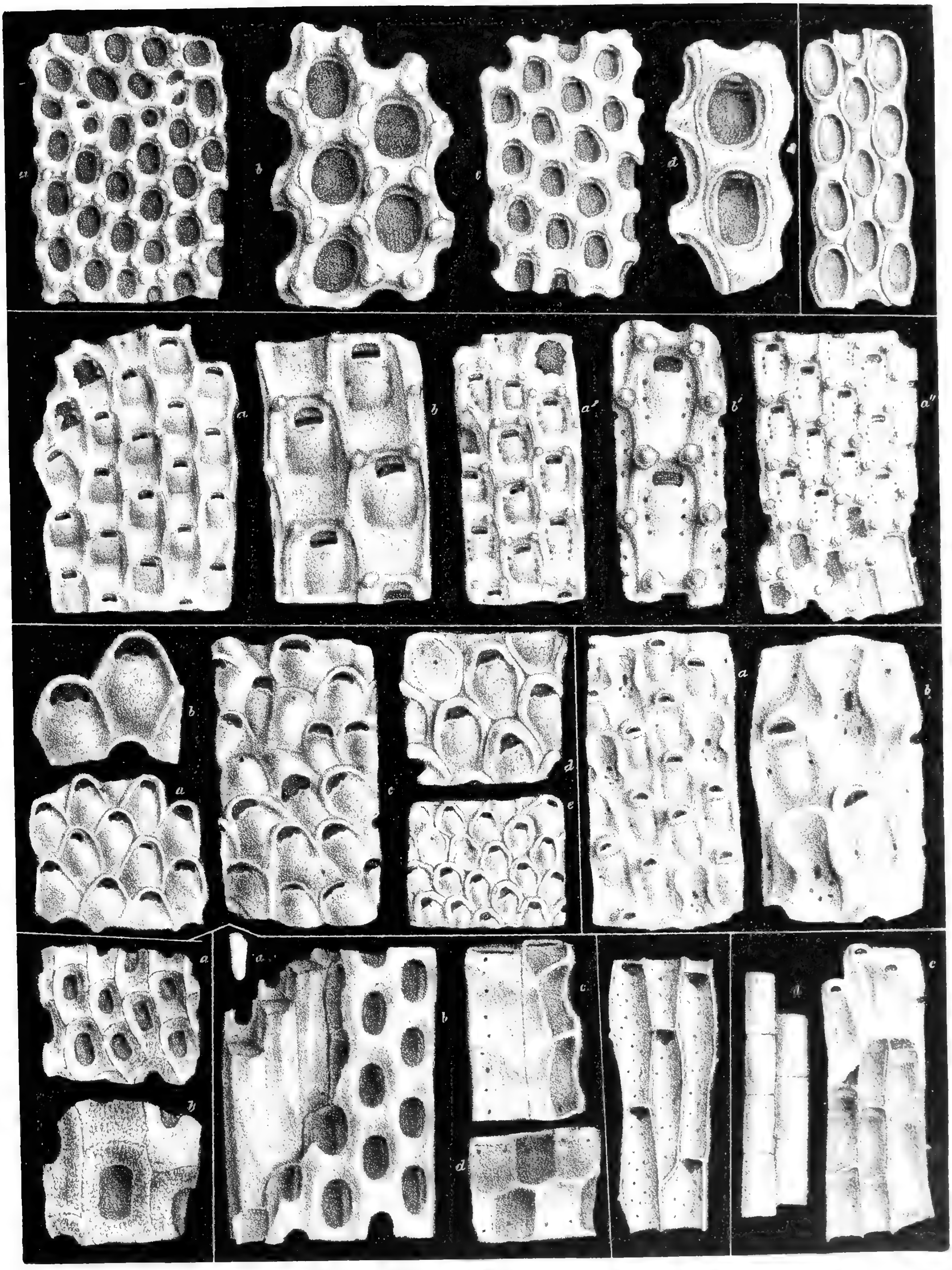

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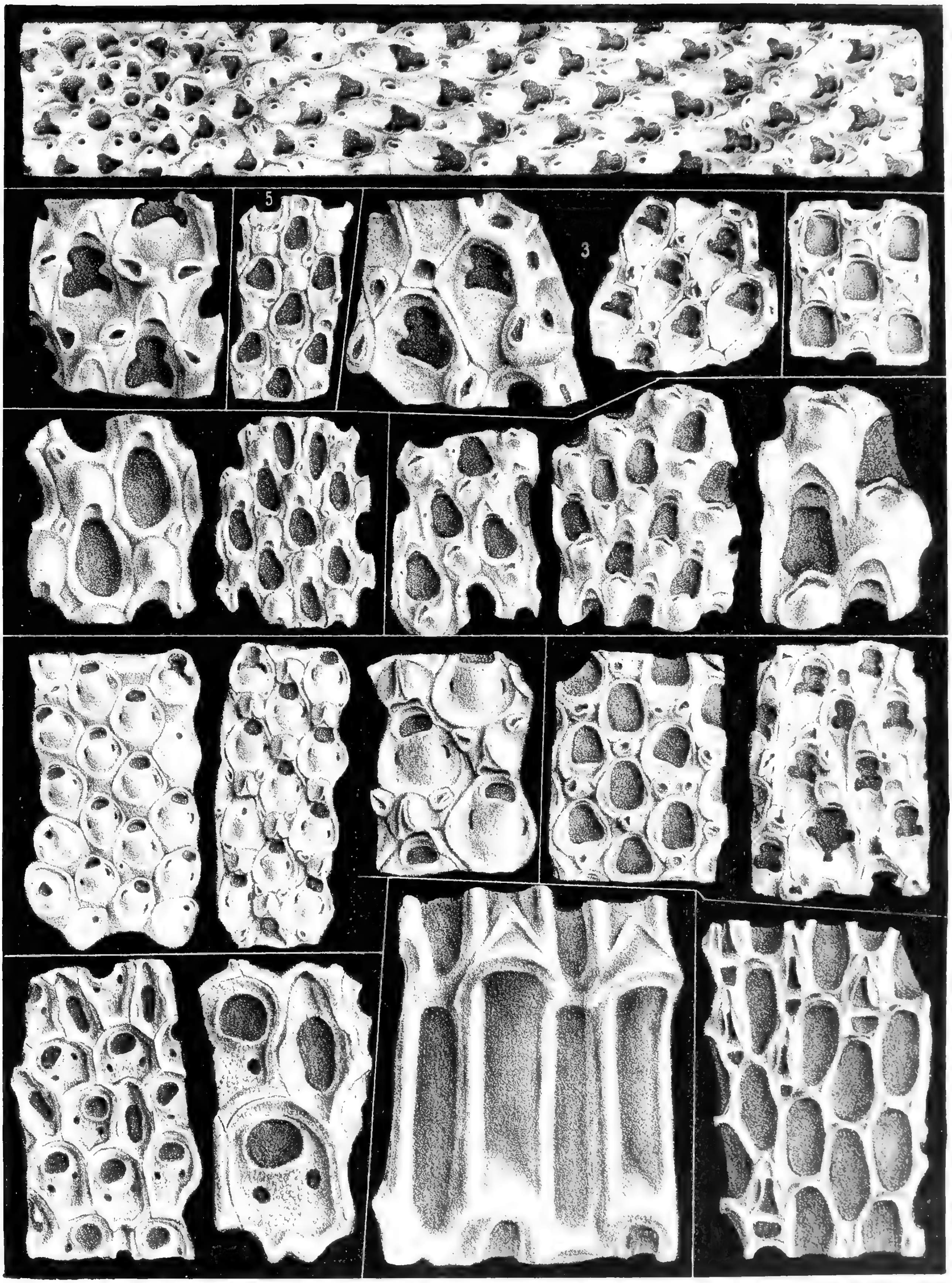

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7. *Eschara cornuta*, p. 67.
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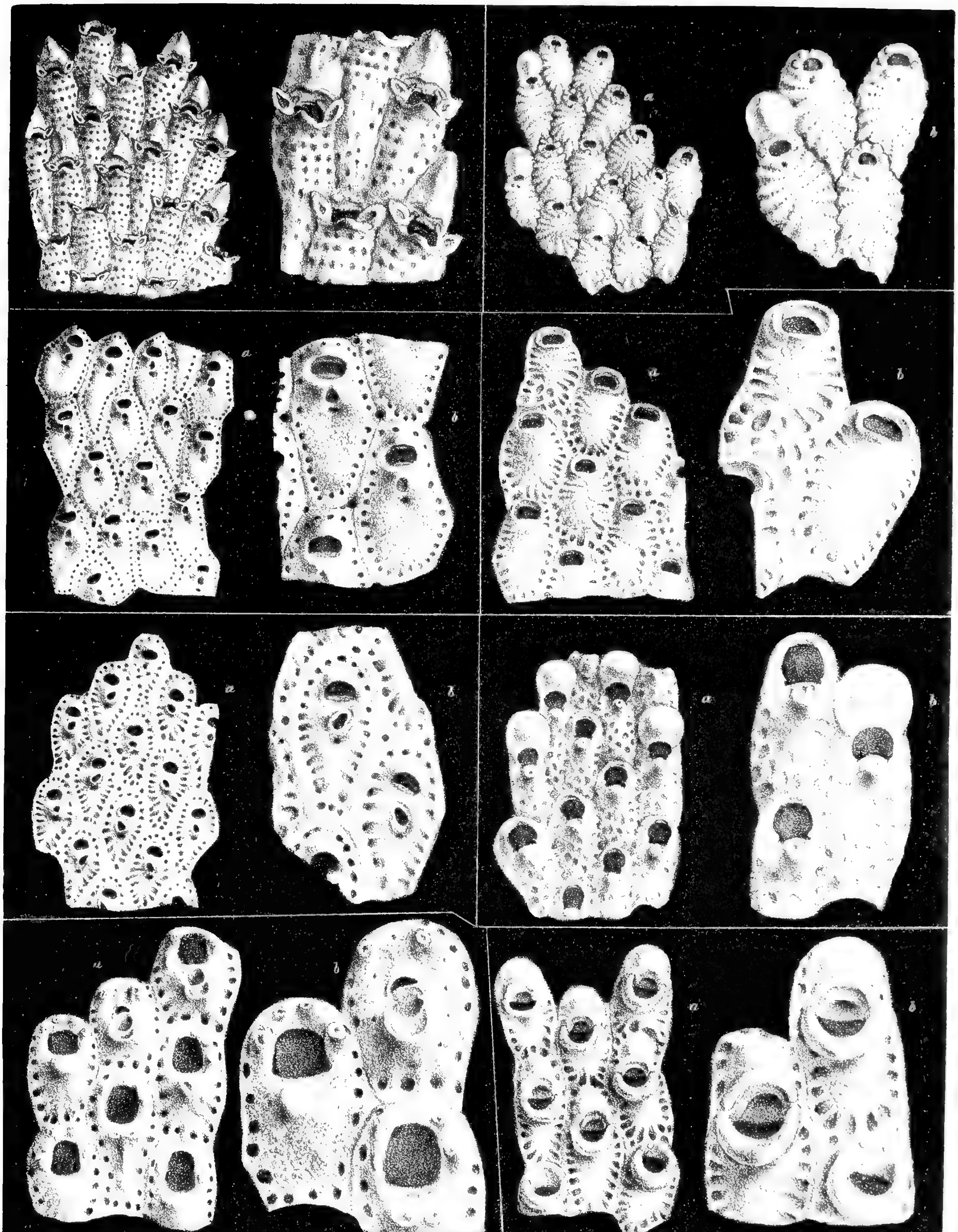

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4. *L. unicornis*, p. 45.
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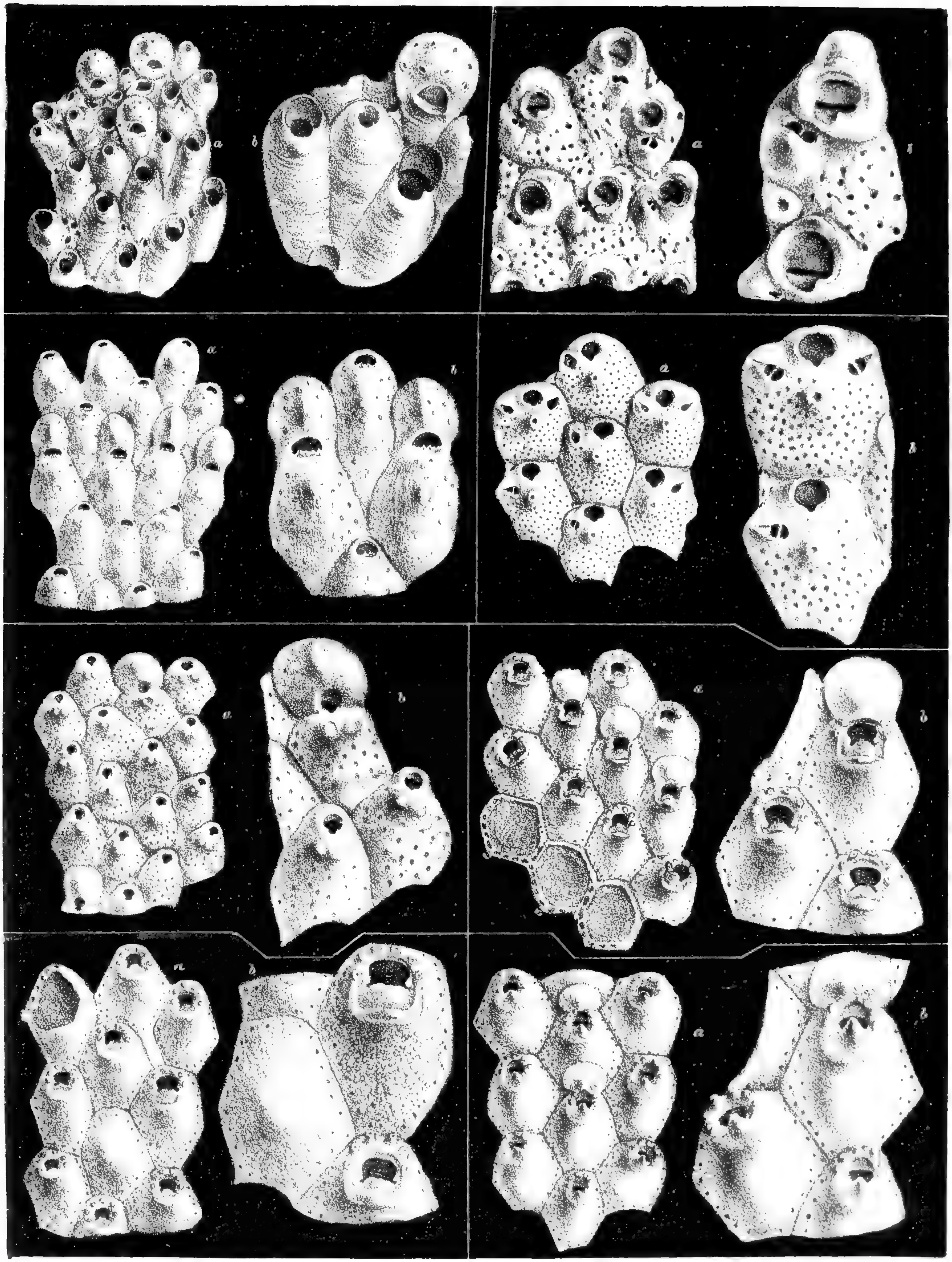

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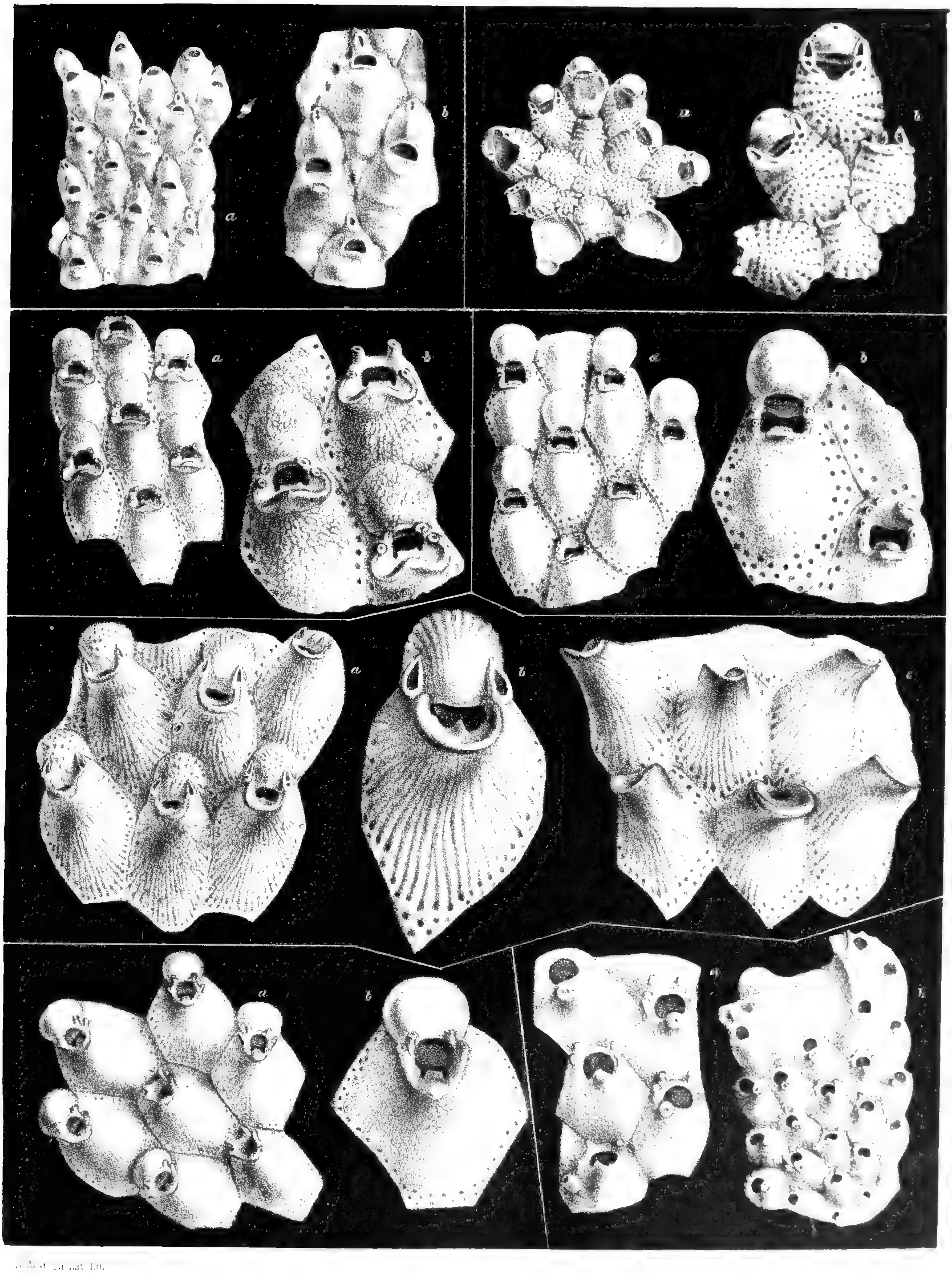

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G West ad nat. lith

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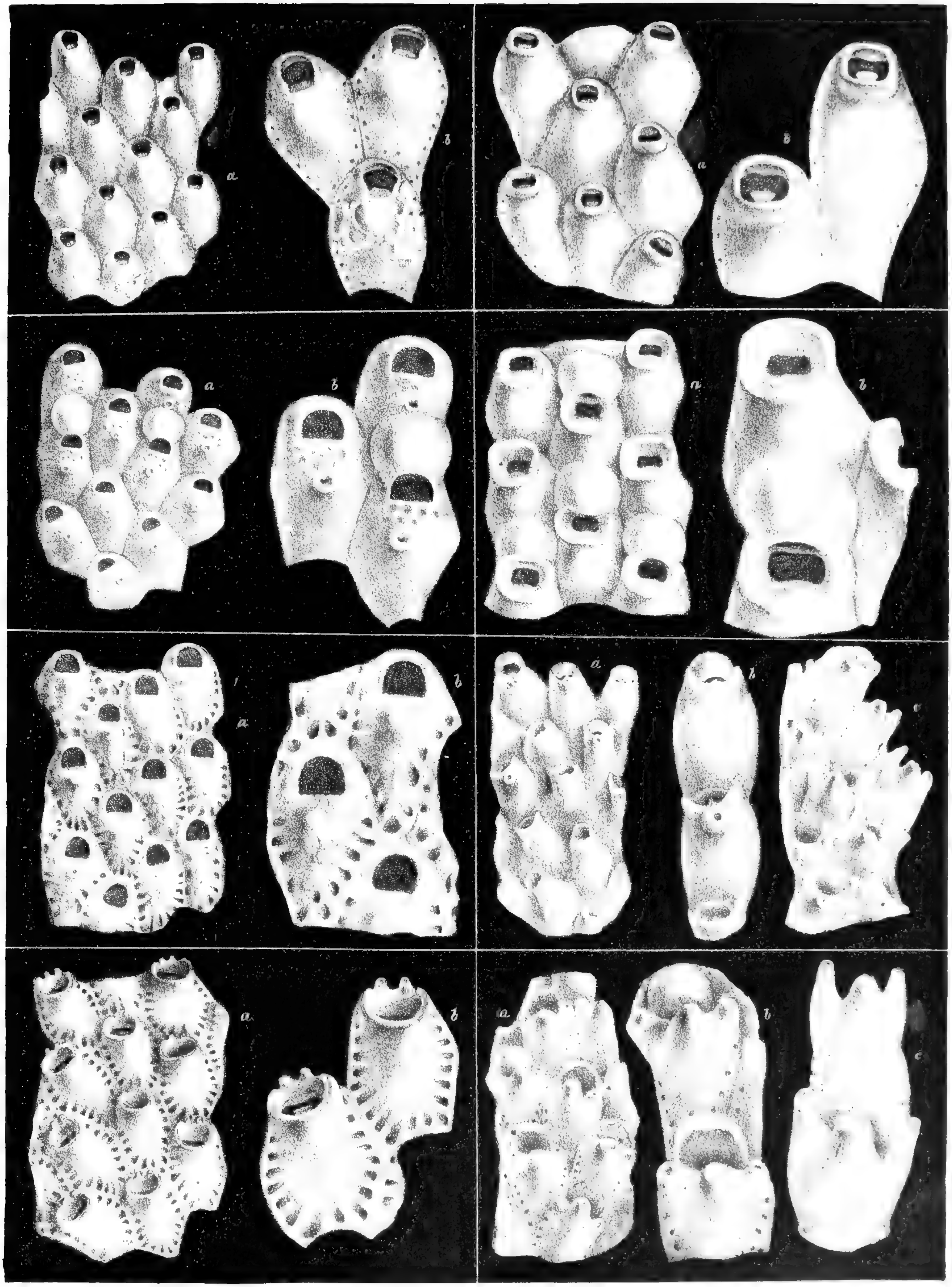

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PLATE X

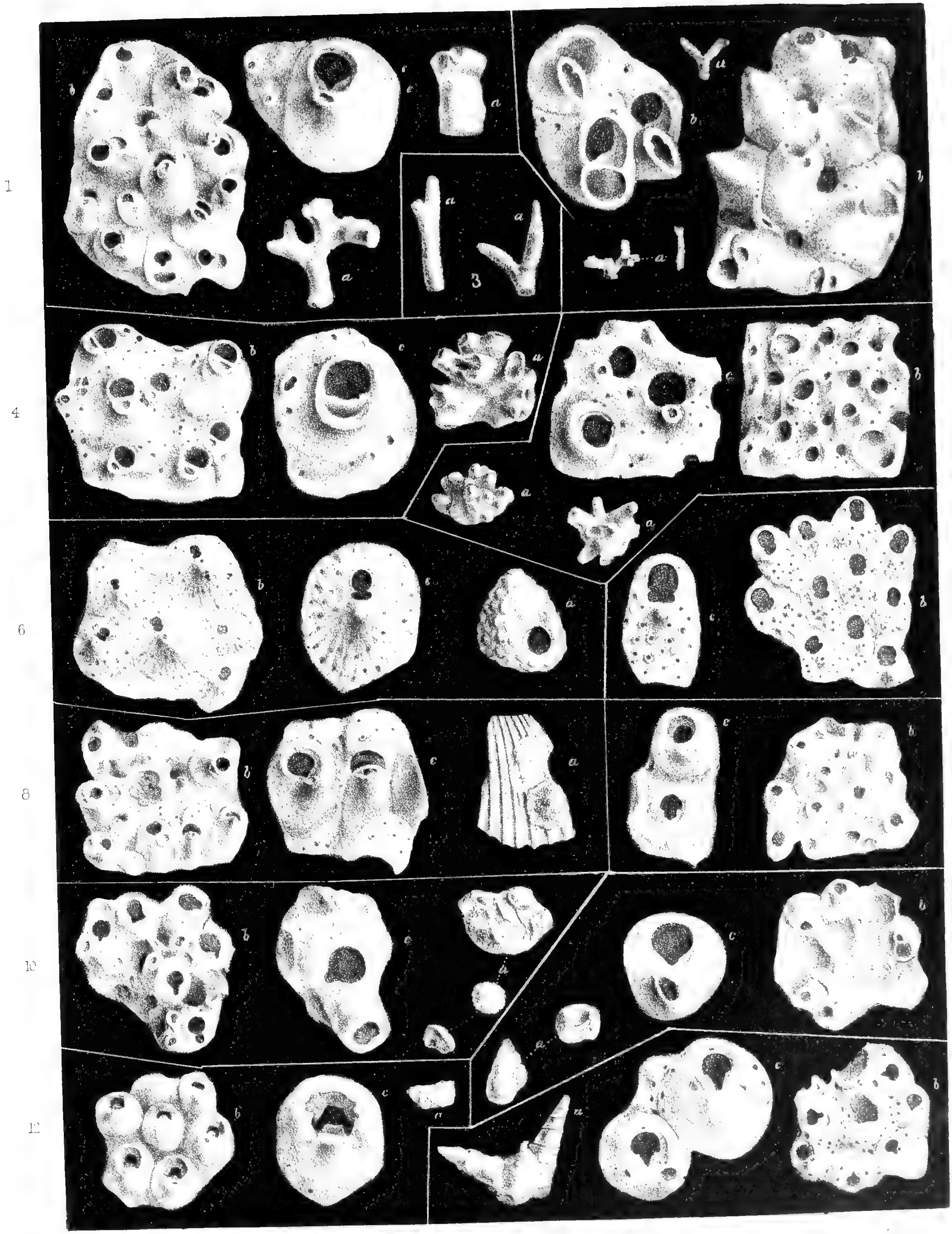

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PLATE X

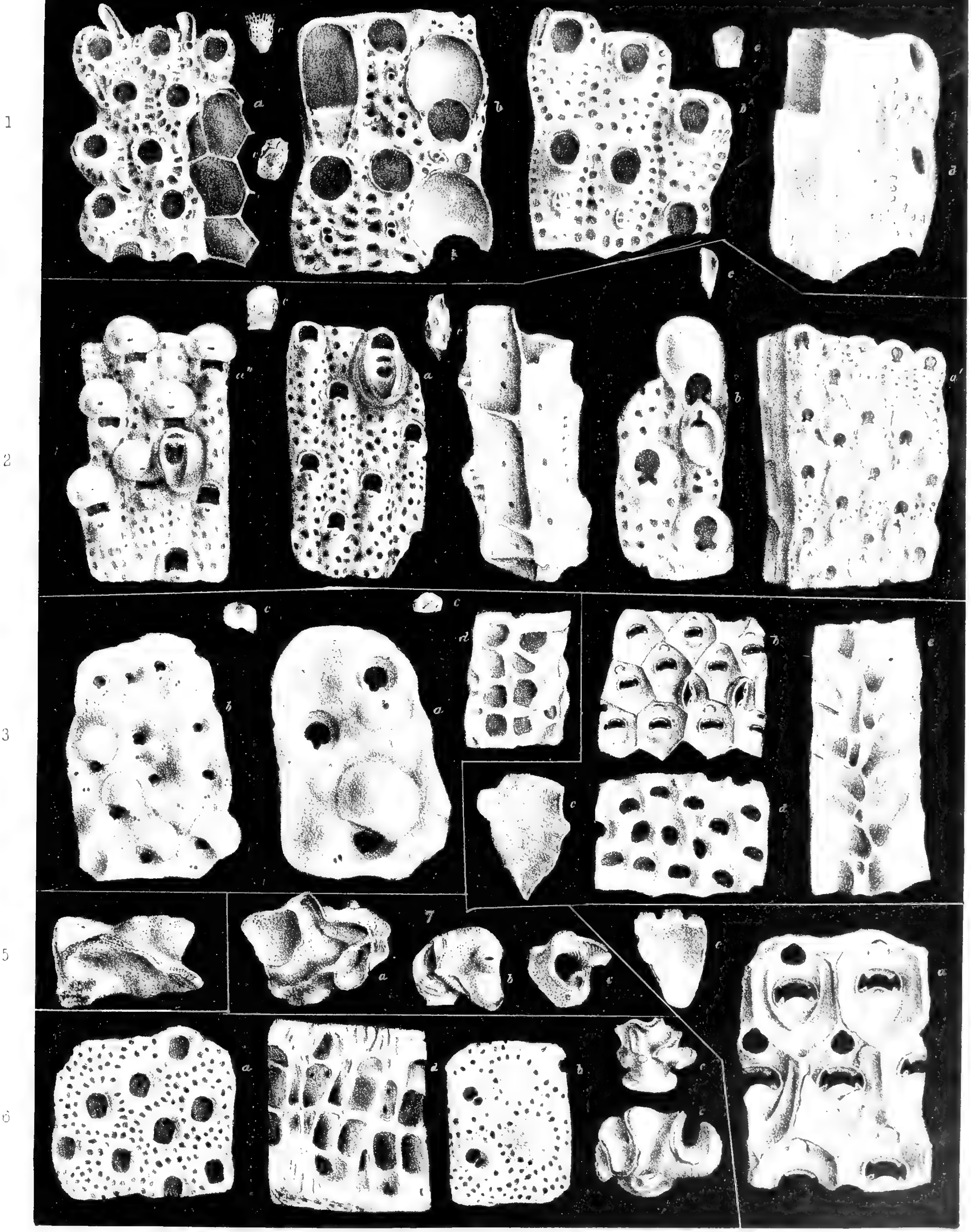

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PLATE XI.

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1. *Eschara monilifera,* p. 68.

 a, a, a, a, a, a, a, a, a. Various forms, natural size.

 a′, a′. Portions, magnified 6 diameters.

 b, c, d. In different conditions, magnified 25 diameters.

2. *E. monilifera.*

 a. Portion, showing one of the fertile (?) cells, closed with a cribriform plate.

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3. *E. monilifera.*

 a. Portion of surface nearly smooth.

 b. Transverse section.

 c. Longitudinal section.

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 b, c, d, e. Various aspects at different ages, magnified 25 diameters.

 f. Section, magnified 25 diameters.

PLATE XI

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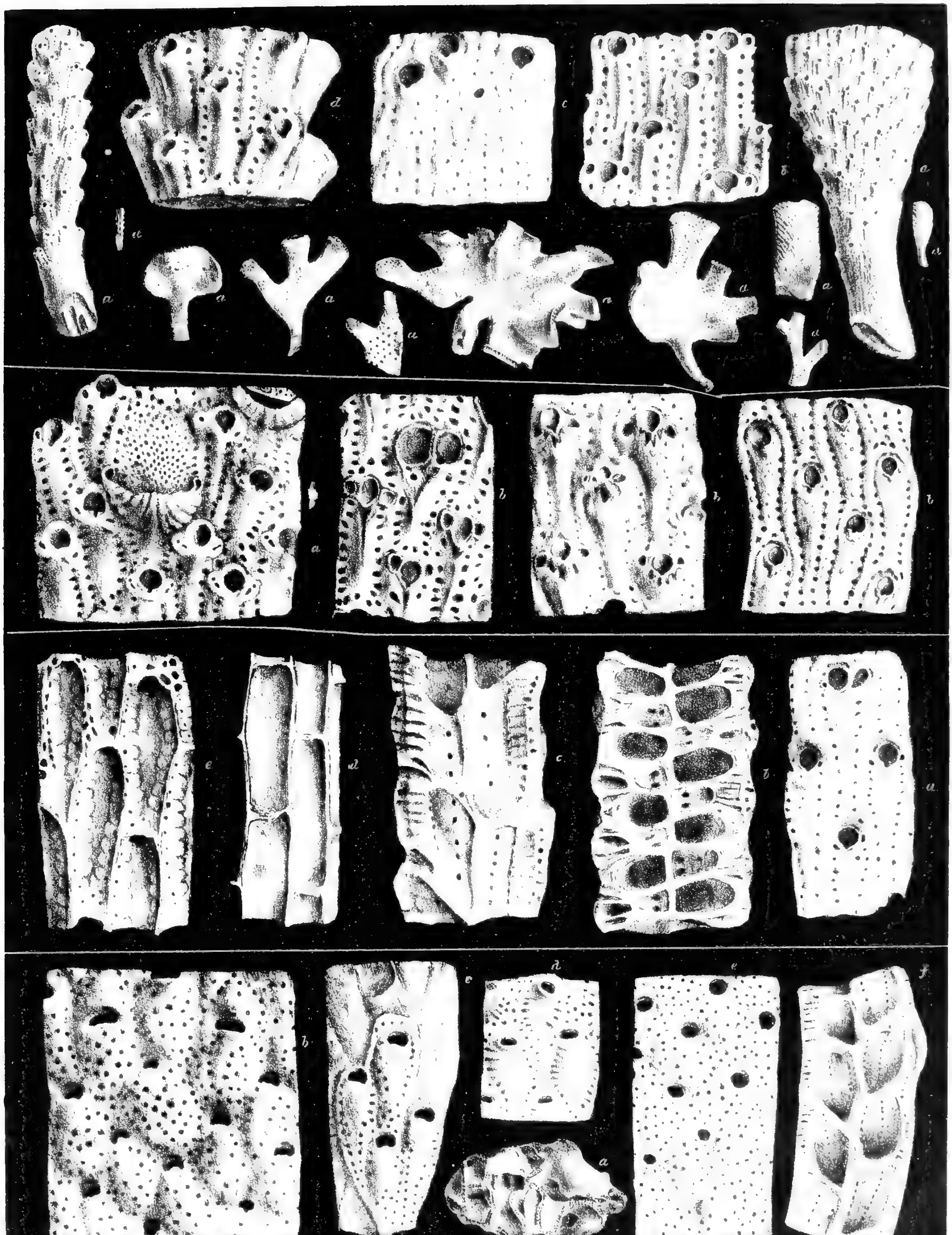

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PLATE XII.

Fig.

1. *Retepora cellulosa*, p. 74.

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b. Anterior surface, magnified 50 diameters.

b'. Posterior surface, magnified 25 diameters.

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b. Anterior surface, magnified 50 diameters.

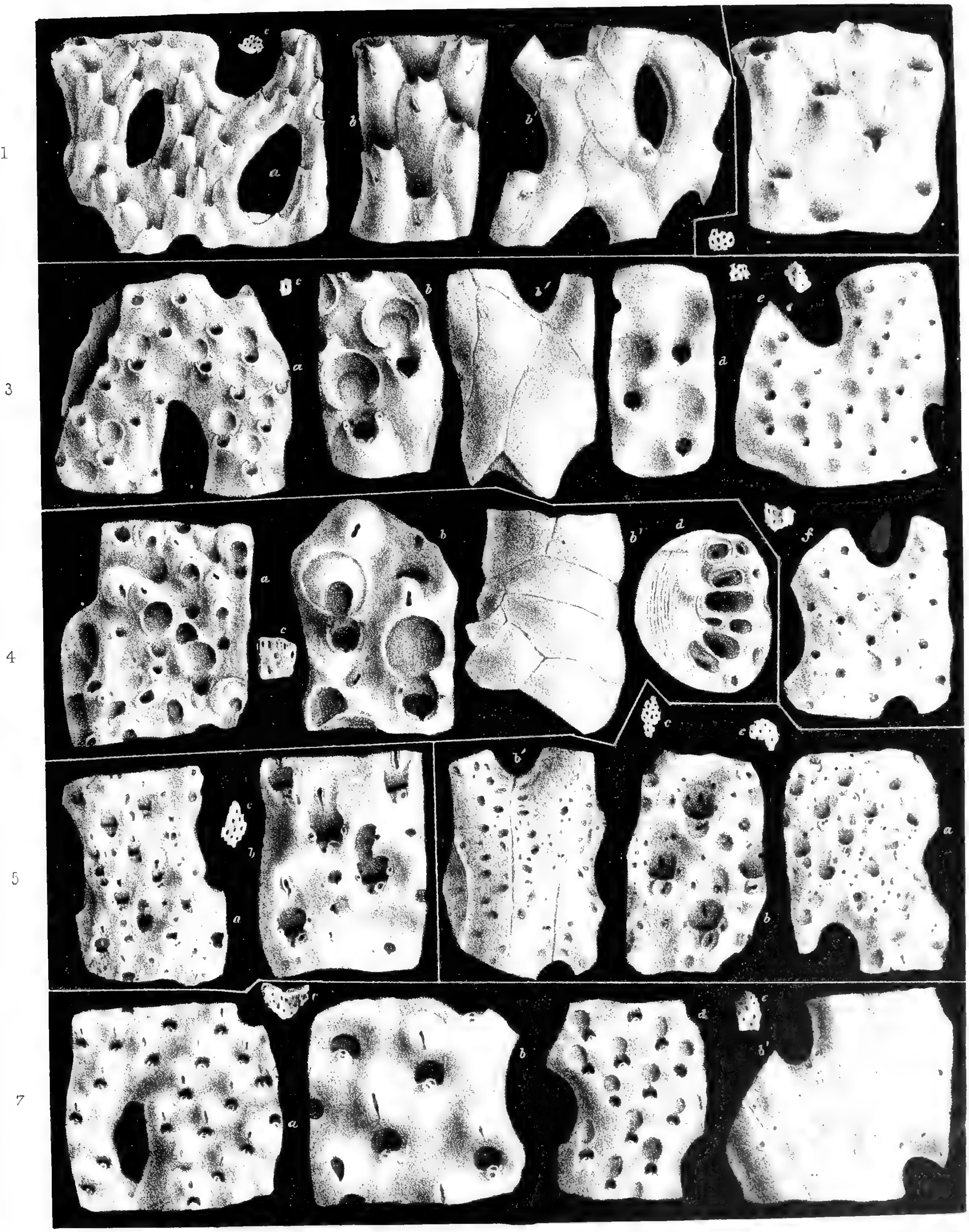
b'. Posterior surface, magnified 50 diameters.

c. Fragment (natural size).

d. Section, magnified 25 diameters.

5, 6, 7. *R. Beaniana*.

PLATE XII



G. West ad nat. lith

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   (Letters as above.)
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   - *c.* Anterior surface, very much worn, magnified 25 diameters.
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   - *c.* Posterior surface, magnified 25 diameters.
   - *d.* Fragments of larger specimens.
   - *e.* Section, magnified 25 diameters.
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PLATE XIII

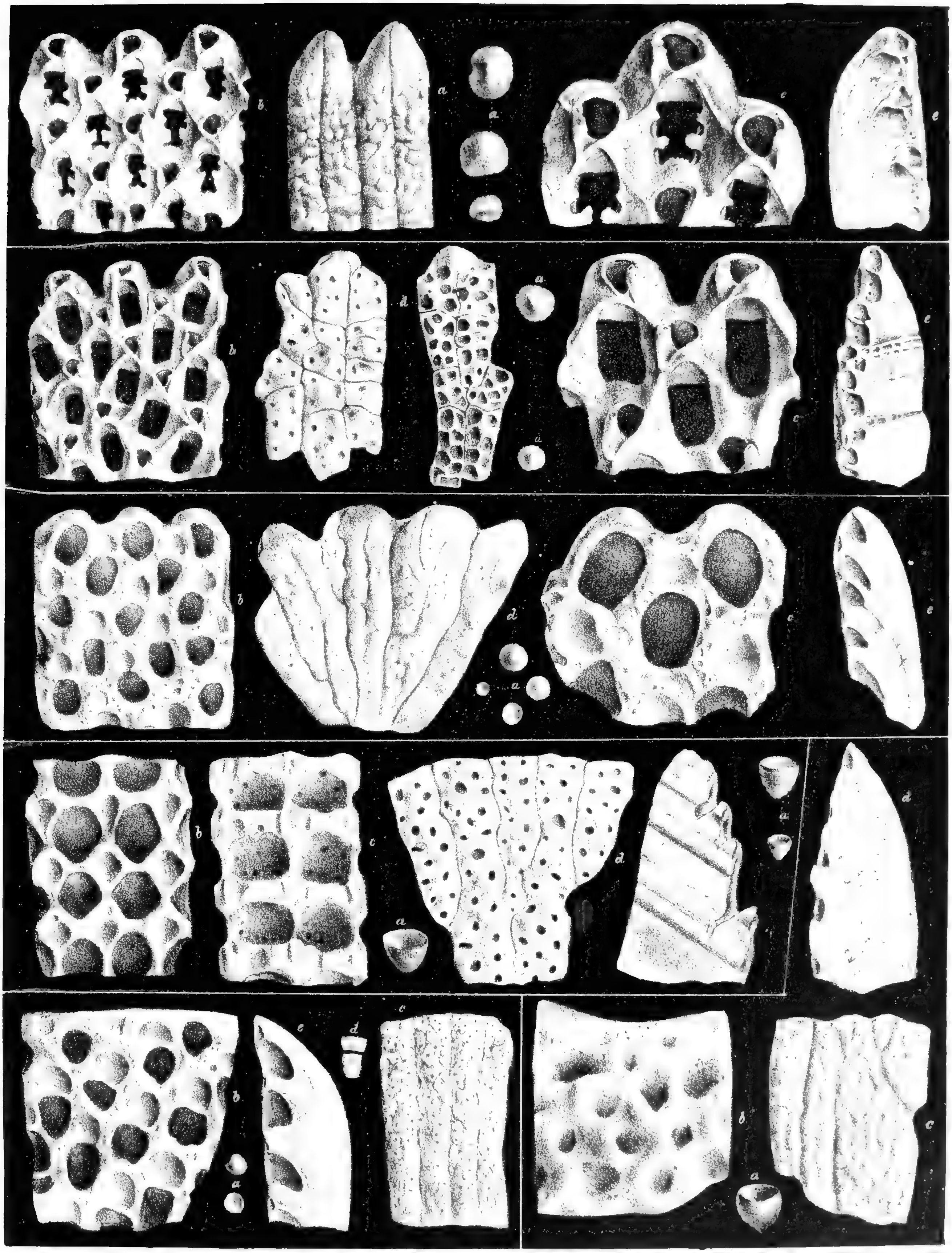

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PLATE XIV.

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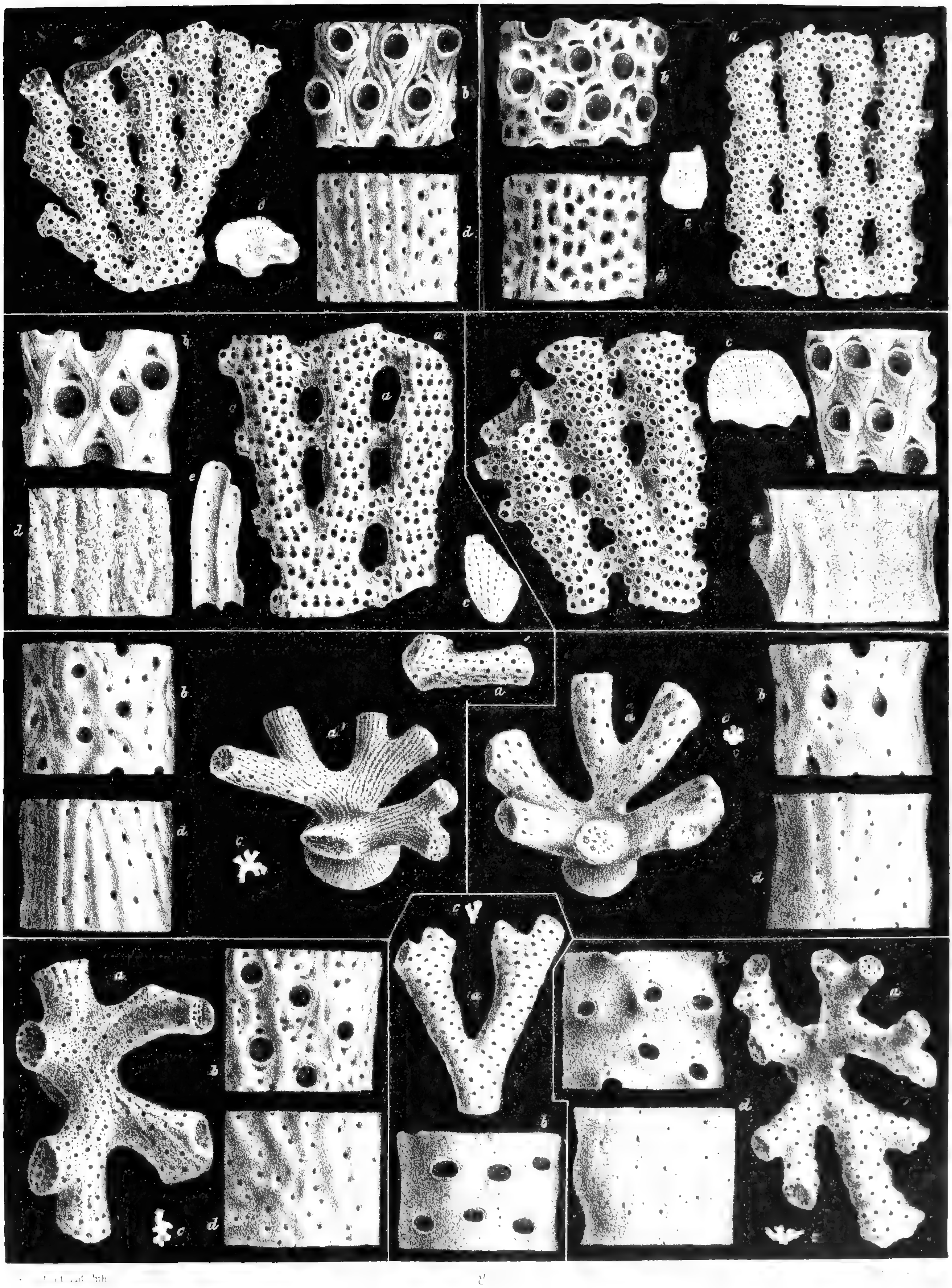
7. „ *pertusa*, p. 101.
8, 9. „ *hippolyta*, p. 101.

PLATE XIV.



1 3 4 5 7 8

PLATE XV.

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3. ,, *striata*, p. 103.

4. ,, *rhomboidalis*, p. 103.

5. *Idmonea punctata*, p. 104.

6. ,, *fenestrata*, p. 105.

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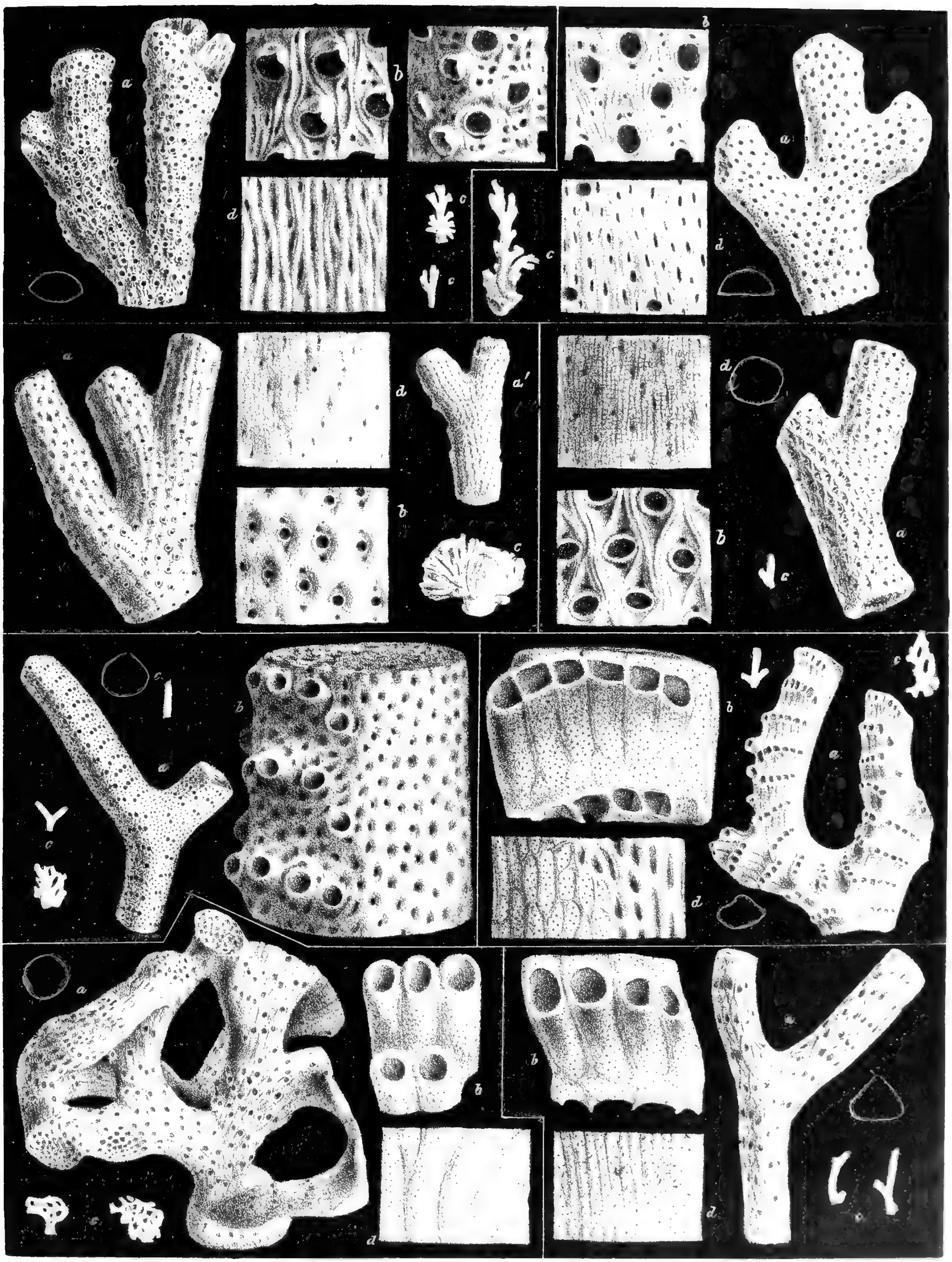

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Fig.

1. *Hornera rhomboidalis*, p. 103.

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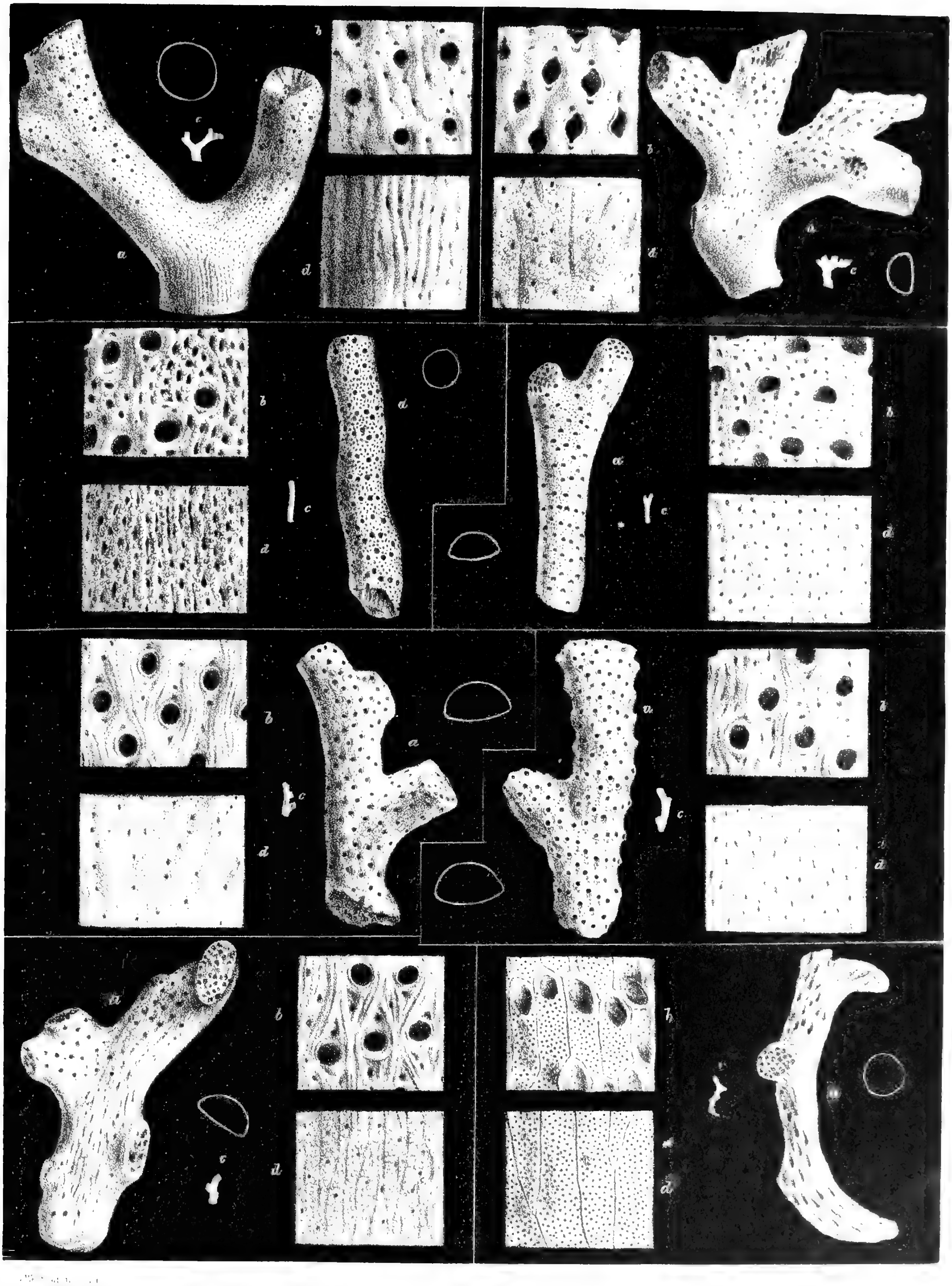

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6. *Fungella infundibulata*, p. 120.

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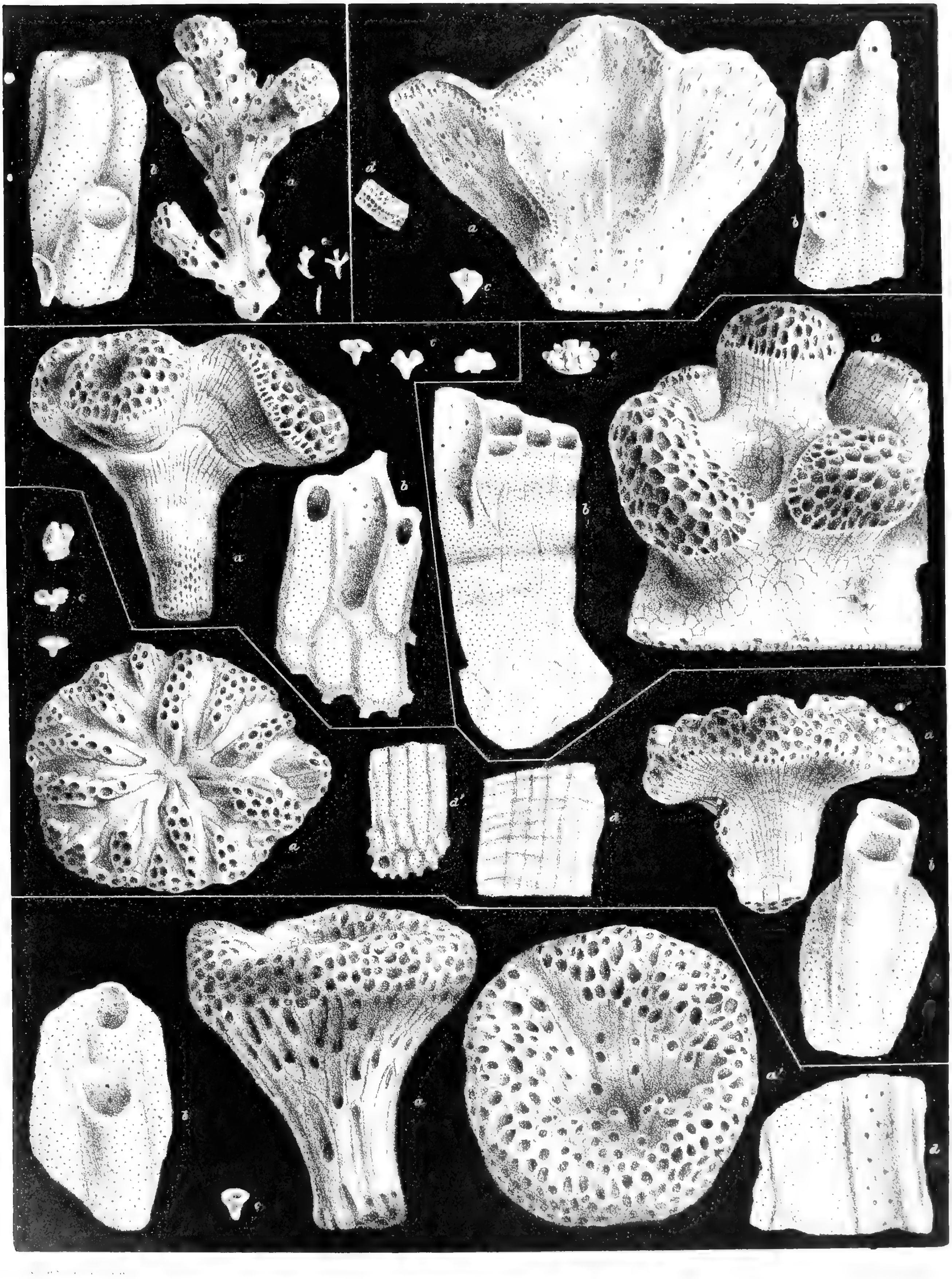

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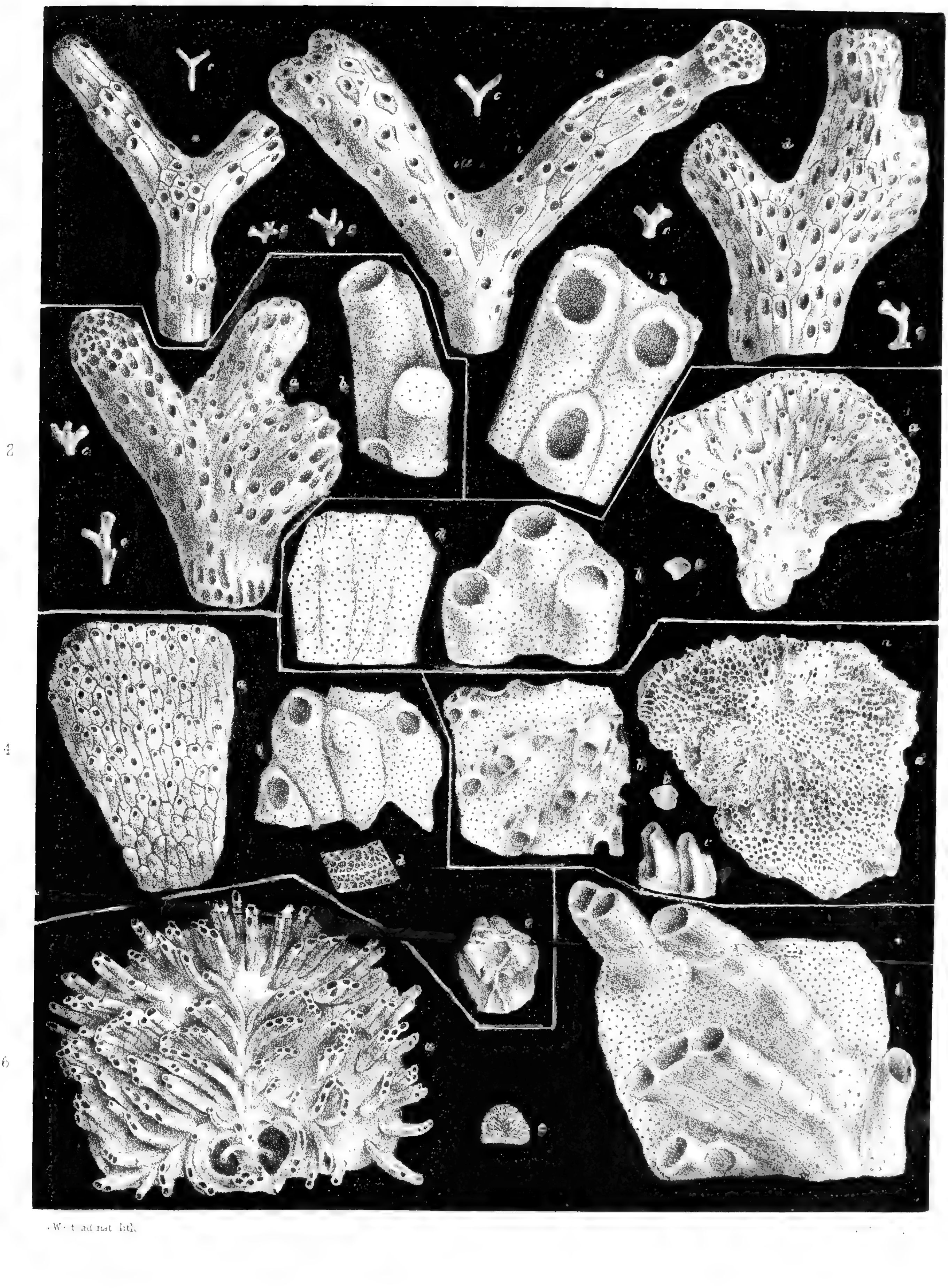

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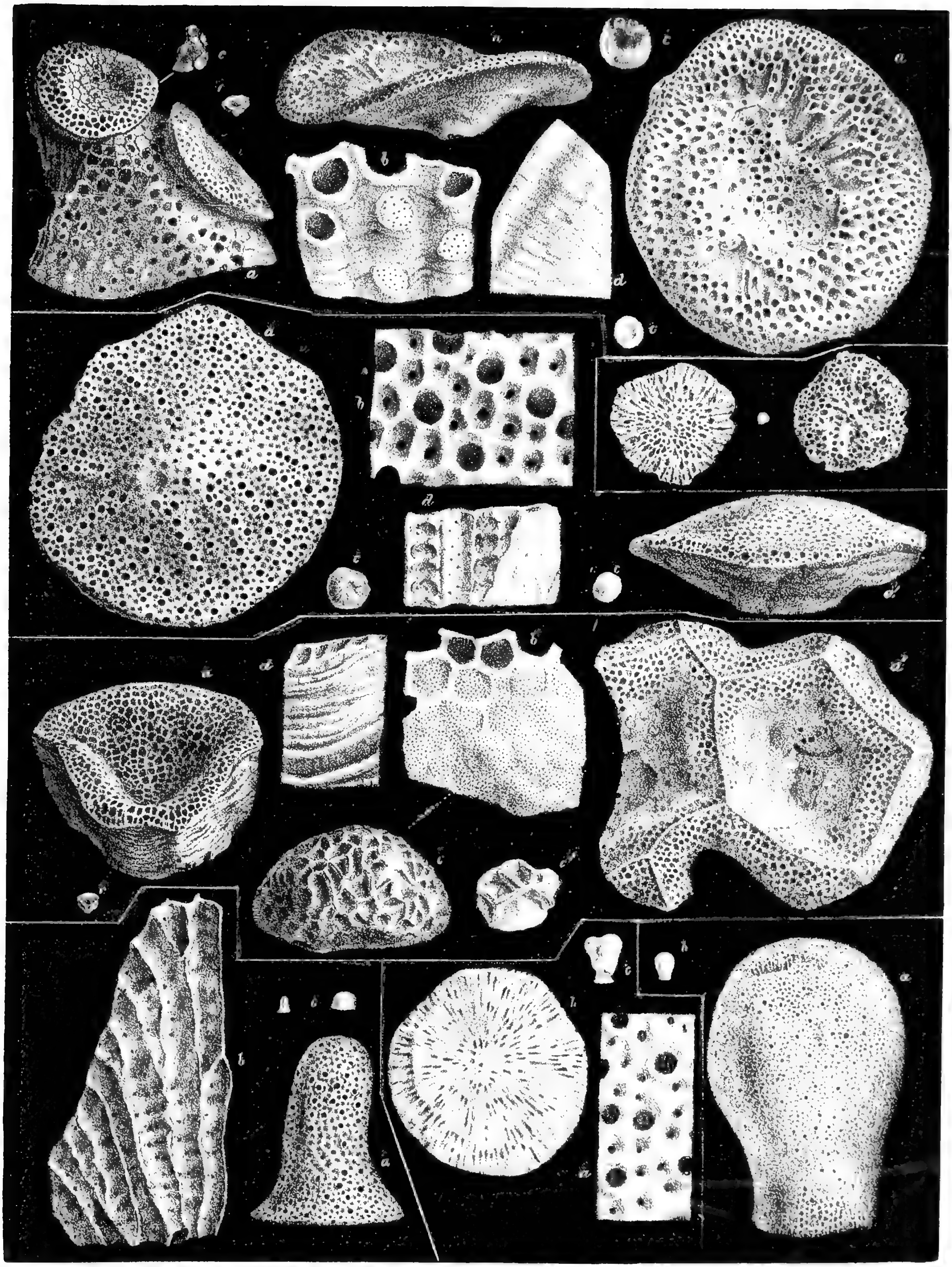

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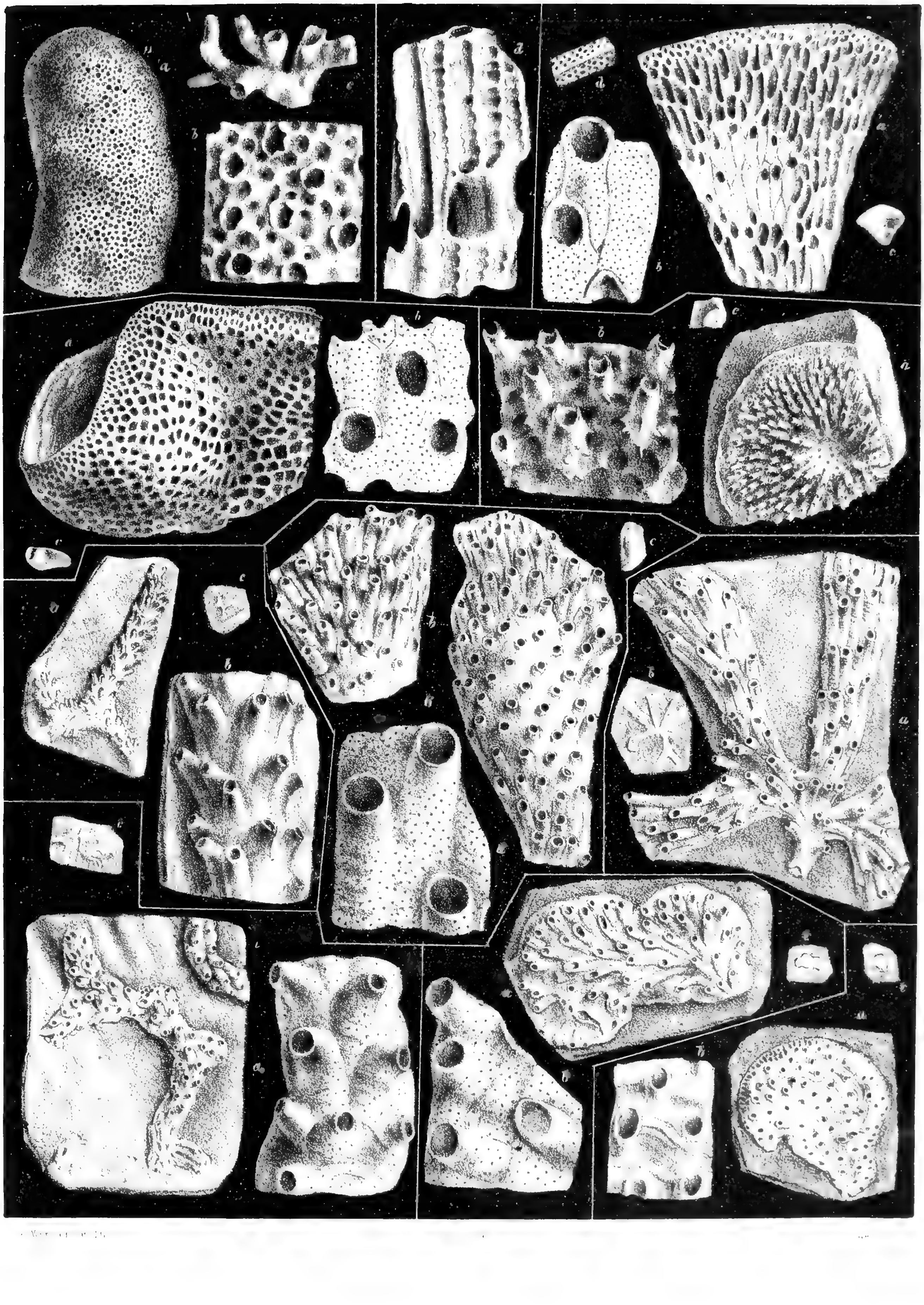

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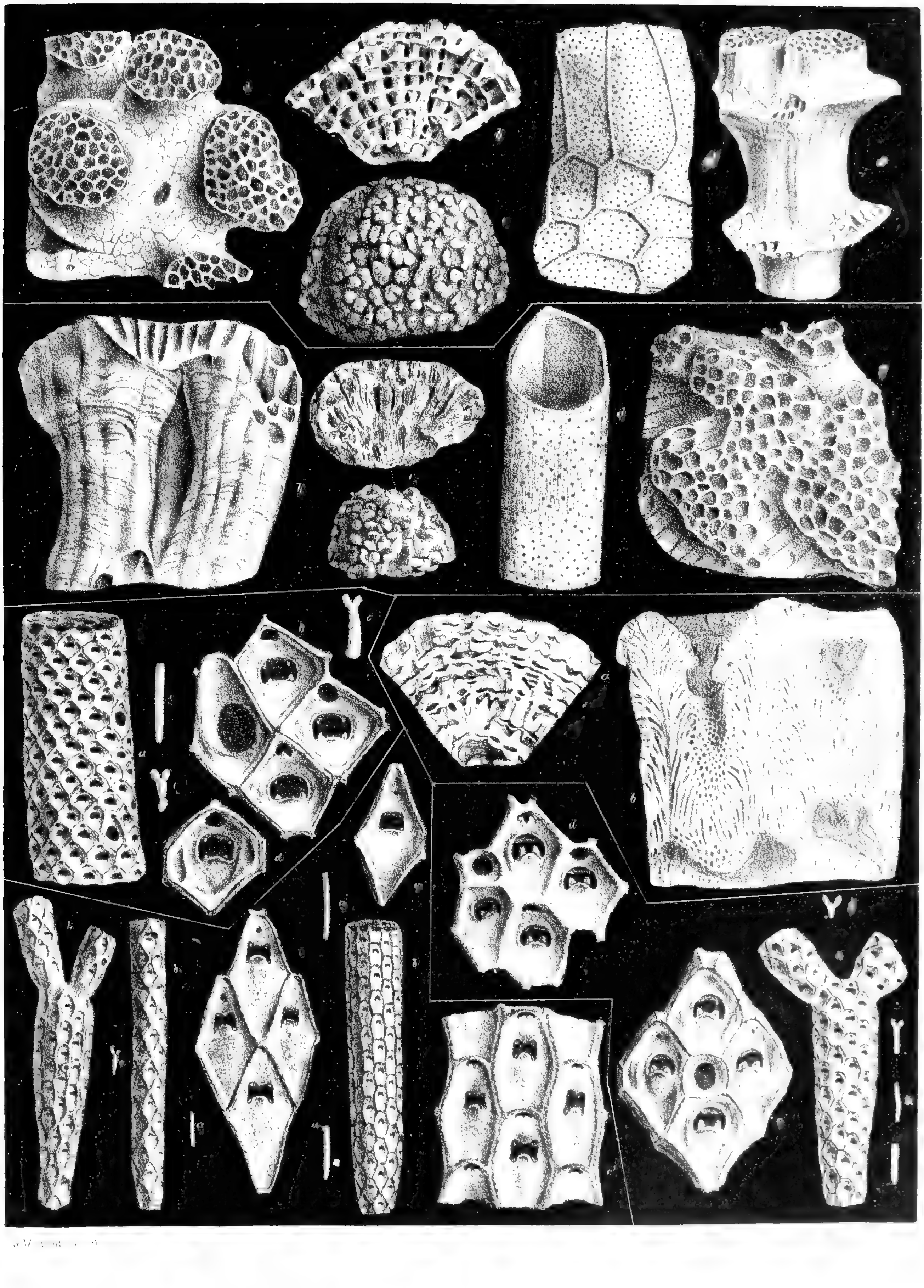

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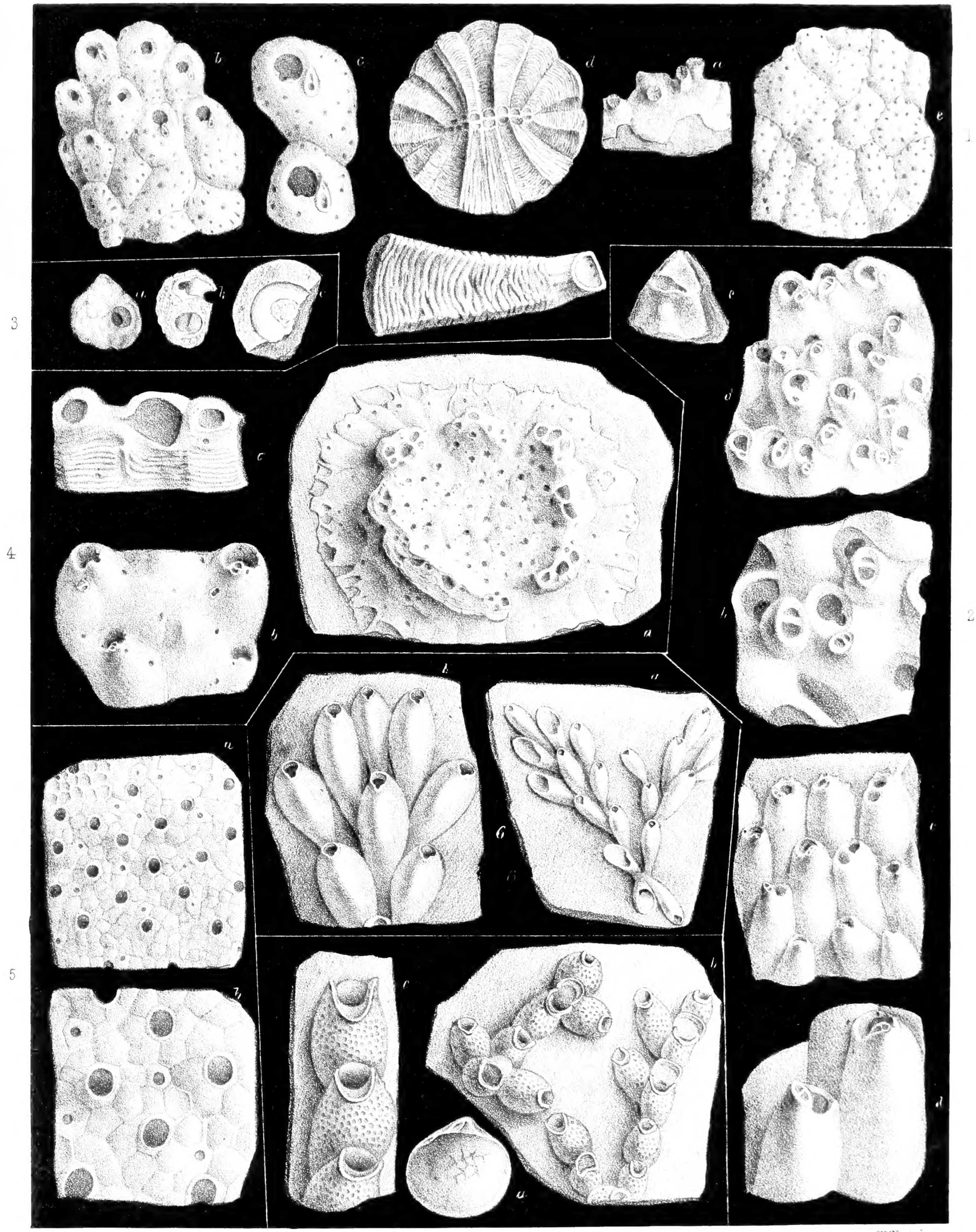
PLATE XXII.



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