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CONTENTS.

A Monograph of Recent Brachiopoda. *By* THOMAS DAVIDSON, *LL.D., F.R.S., F.L.S.*

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Part	I., pp. 1–74,	& Plates	I.–XIII.,	published	October 1886.
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NOTE.—At the request of the late Dr. Davidson, and with the sanction of the Council, the proof-sheets of this Memoir have been laid before Miss Agnes Crane, of Brighton, by whom they have been read on the Author's behalf.

Previous to Dr. Davidson's lamented death, Miss Crane had been studying the Brachiopoda under his guidance, and was conversant with his wishes respecting the publication of this work.

TRANSACTIONS

OF

THE LINNEAN SOCIETY.

I. *A Monograph of Recent Brachiopoda.*—Part I.

By Thomas Davidson, *LL.D., F.R.S., F.L.S., F.G.S., &c.*

Read 5th November, 1885.

(Plates I.-XIII.)

Introductory Remarks.

During the last hundred years the recent Brachiopoda have attracted considerable attention, and a large number of valuable memoirs and papers have been published upon them. Their shells, shell-structure, anatomy, embryology, and affinities have alike been carefully investigated. Observations on the living animals of several genera have also been recorded. The sea-bottoms have been dredged for Brachiopoda in many latitudes and over a wide geographical area, and their habitats and ranges of depth accurately ascertained to a very considerable extent. Four or five incomplete monographs, in which the shells only of a large number of species have been well illustrated and briefly described, have appeared during the present century; but no satisfactory general monograph treating of the shell and animal *conjointly* has yet been published. This omission I have now endeavoured to supply.

In 1843, Küster, in his new edition of Chemnitz's 'Conchylien-Cabinet,' described some twenty-six or thirty species, of which several are now known to be synonyms. These he figured in six quarto plates.

In 1846, G. B. Sowerby, in his 'Thesaurus Conchyliorum,' described and beautifully illustrated forty-seven species, of which number several are synonyms.

In 1859–62, Lovell Reeve, in his 'Conchyliorum Iconica,' described the shells of seventy-five species, of which some were synonyms, accompanied with a series of beautiful illustrations, drawn by G. B. Sowerby.

In 1873, in the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' Mr. W. H. Dall published a catalogue of all the recent species of Brachiopoda known to him up to that date. In this catalogue without figures, about one hundred species are enumerated, some of which are synonymous.

During the last thirty-five or more years, I have devoted much time to the study of the recent forms, in conjunction with that of the fossil species, and have lost no opportunity of making myself acquainted with all that has been done and written upon the subject, as well as in assembling all available material, so as to enable me to bring together in a single monograph the chief results of many independent researches published in a number of scattered papers and works often difficult of access. The literature of the subject is indeed voluminous, as may be realized by a glance at the 'Bibliography of the Brachiopoda,' compiled by Mr. W. H. Dalton and myself, and published in vol. vi. of my 'British Fossil Brachiopoda' (Palæont. Soc., 1886).

I have also, I believe, had advantages which few have possessed in being able to follow out the observations made with respect to the animal and its anatomy, and in having been able to draw a very large number of figures from the types of the best-preserved examples of almost all the known forms, as well as of a large series of individuals of the same species at different stages of development. The study of the adult condition of a species gives insufficient data, and it is requisite to follow out the modifications it has to go through during the different stages of its existence, and to note these differences.

The study of the embryo has also shown that the animal assumes a series of well-defined stages in its development, a fact that was but little known prior to the publication in 1861 of Prof. Lacaze-Duthiers's admirable memoir on *Thecidium mediterraneum*. These observations were subsequently followed by the excellent researches of Fritz Müller, Kowalevsky, E. Morse, H. Friele, M'Crady, Dall, Van Bemmelen, A. E. Shipley, M. A. Schulgin, and one or two more. The results obtained by these authors will be referred to in the sequel. It is very desirable that these important investigations should be continued, as much still remains to be discovered, described, and illustrated.

The shell-structure of the recent Brachiopoda has been admirably worked out by a number of accurate observers, such as Dr. W. B. Carpenter, W. King, Van Bemmelen, Hancock, and many others, and has led to very important results. To Herman Friele, E. Deslongchamps, and one or two others we are indebted for much accurate and important knowledge with respect to the development of the loop, of which but little was known previous to 1852.

The anatomy of the animal has also been admirably investigated and worked out, and it is sufficient to mention the names of Cuvier, Owen, Huxley, Hancock, Vogt, Gratiolet, Lacaze-Duthiers, King, Brooks, Dall, Morse, E. Deslongchamps, Van Bemmelen, Woodward, Shipley, Schulgin *, and others, to show how important and varied have been the additions to our knowledge with respect to this very necessary branch of investigation. In drawing up the description of each species, I have considered it desirable, whenever possible, to reproduce the words and illustrations of the authors, and thus give them all credit for their careful, painstaking researches.

* To these names Dr. Davidson would doubtless have added that of H. G. Beyer, who contributed an important paper on the shell-structure and anatomy of *Lingula* (*Glottidia*) *pyramidata*, Stimpson, to the Studies from the Biological Laboratory of the Johns Hopkins University, Baltimore, vol. iii. no. 5, March 1886.—[A. C.]

The perplexing question of the affinities of the Brachiopoda has given rise to much discussion, and great difference of opinion, especially with regard to their relationship to the group of worms. Now, although I do not admit the Brachiopoda to be worms, they may, as well as the Mollusca and some other groups of invertebrates, have originally diverged from an ancestral vermiform stem, such as the remarkable worm-like mollusk *Neomenia* would denote. In a recent paper on the development of *Argiope* or *Cistella*, Mr. A. E. Shipley observes, and, I think, with justice, that the Brachiopoda and Polyzoa are not so closely united as to form a natural phylum; and he adds, "I should propose to follow Gegenbaur in making a primary class of the Brachiopoda, and though in their development and adult structure they are widely separated from both Vermes and Mollusca, of the two classes I would place them nearer to the former class than to the latter" *. Prof. Huxley † says:—"All known Polyzoa are compound animals, that is to say, the product of every ovum gives rise, by gemmation, to great assemblages of partially independent organisms, or zooids. The Brachiopoda, on the contrary, are all simple, the product of each ovum not giving rise to others by gemmation. All the Brachiopoda possess a bivalve shell—a shell composed of two, more or less horny, or calcified, pieces, which are capable of a certain range of motion on one another, and are very commonly articulated together by teeth and sockets." The shell, the pallial lobes, the intestine, the nerves, and the atrial system, afford characters amply sufficient to define the class.

In this view of Prof. Huxley I entirely concur.

As many species of Brachiopoda live at considerable depths, it is not surprising that so small a number should have been known to early conchologists, and that for many years they should have been such great rarities in conchological collections. The numerous well-conducted dredging expeditions have, however, brought to light a large number of forms that were not previously known, and we may constantly expect to add to the number of species as dredging operations extend to regions not yet explored. It has been ascertained beyond doubt that Brachiopoda are much localized, and that where they occur they are generally abundant. It has also been found that the range in depth of one and the same species is often very variable, that abyssal forms have generally a very thin shell, and that species living at a great depth have a much greater geographical range, and are not nearly so localized as those species that live in shallow waters.

The study of the species brought home by the 'Challenger' Expedition, which I was privileged to examine and describe, has revealed much valuable information with respect to the bathymetrical and geographical distribution of many species. The greatest depth at which a recent species of the class has been found alive was 2900 fathoms. A number of forms inhabit and prefer rocky and stony parts of the bottom, or are attached to corals, and are therefore more difficult to obtain.

It is necessary briefly to refer to the difficult question of classification, upon which many different opinions have been entertained. In company with a larger number of

* "On the Structure and Development of *Argiope*." Mittheilungen aus der zool. Station zu Neapel, Band iv. Heft 4, p. 516 (1883).

† An Introduction to the Classification of Animals, p. 27 (1869).

malacologists and palæontologists, I have considered the interior skeleton that supports the labial appendages as a classificatory character that could be advantageously made use of, and have consequently grouped the recent species into the two great divisions *Arthropomata*, Owen (=*Clistenterata*, King), and *Lyopomata*, Owen (=*Tretenterata*, King), and into six families, as follows :

Arthropomata, Owen=*Clistenterata*, King.

Family	Subfamily	Genus	Species.	Uncertain species.
1st Family TEREBRATULIDÆ.	Subfamily Terebratulinæ	I. Genus *Liothyris*, Douvillé	8	2
		II. Subgenus *Terebratulina*, d'Orbigny	10	5
		III. Genus *Waldheimia*, King	10	1
	Subfamily Terebratellinæ	IV. Genus *Terebratella*, d'Orbigny	9	3
		V. Subgenus *Magasella*, Dall	6	6
	Subfamily Megerlinæ	VI. Genus *Megerlia*, King	2	1
		VII. Subgenus *Laqueus*, Dall	3	
	Subfamily Magasinæ	VIII. Genus *Bouchardia*, Davidson	1	
	Subfamily Kraussininæ	IX. Genus *Kraussina*, Davidson.	5	
		X. Subgenus *Megerlina*, Deslongchamps.	2	
	Subfamily Argiopinæ	XI. Genus *Argiope*, Deslongchamps	1	2?
		XII. Subgenus *Cistella*, Gray	8	1
	Subfamily not yet determined.	XIII. ? *Gwynia*, King	1	
		XIV. Genus *Platydia*, Costa	2	
2nd Family THECIDIIDÆ		XV. Genus *Thecidium*, Defrance	2	
3rd Family RHYNCHONELLIDÆ		XVI. Genus *Rhynchonella*, Fischer	6	
		XVII. Subgenus *Atretia*, Jeffreys	2	

Lyopomata, Owen=*Tretenterata*, King.

Family	Subfamily	Genus	Species.	Uncertain species.
4th Family CRANIIDÆ		XVIII. Genus *Crania*, Retzius	4	1
5th Family DISCINIDÆ		XIX. Genus *Discina*, Lamarck	1	
		XX. Subgenus *Discinisca*, Dall	6	1
6th Family LINGULIDÆ		XXI. Genus *Lingula*, Bruguière	8	3
		XXII. Subgenus *Glottidia*, Dall	3	2

In 1884, M. E. E. Deslongchamps proposed a new scheme of classification for the Terebratulidæ, in which he objected to any arrangement based on either the exterior shape of the shell or of the supports of the labial appendage.

His first group includes the different forms in which the calcified brachial apparatus or loop does not undergo any important modifications from its first origin up to the adult condition. To the characters drawn from the brachial apparatus or loop is added that of the presence of spicula, more or less complicated, which occupy in the mantle all the parts connected with the organs of circulation (arteries, veins or veiny sinuses, &c.), the labial appendages and cirri which accompany them. In this group he places the recent genera *Liothyris*, *Terebratulina*, *Megerlia*, *Kraussina*, and *Platydia*.

In his second group he unites those forms in which the brachial apparatus or loop undergoes numerous transformations from the embryo up to the adult condition, and which have been distinguished by the names of *Platydiform*, *Magadiform*, and *Megerliform* stages. The mantle in this group is not provided with those calcareous spicula which occur so constantly in the first group. The colour also of the dried animal is yellowish, whilst in the first group the hue or tint of the dried arms and of the peripheric portions of the mantle are of a very characteristic dim white. This, I may, however, remark, is not always the case, as I possess specimens of the dried animal of several species of *Terebratulina* that are of a decided yellow colour. The group would, according to M. Deslongchamps, comprise the recent genera *Waldheimia*, *Macandreria*, *Terebratella*, *Laqueus*, and *Magasella*.

While fully appreciating the importance of all characters derived from a study of the animal, I am not convinced that the temporary modifications in the shape of the loop, or the presence or absence of calcareous spicula in the mantle, &c., are indications of sufficient importance or permanence to supersede those derived from the adult shape of the calcareous lamellæ supporting the labial appendages,—characters which are often accessible, and of important assistance in distinguishing the more numerous fossil members of the group. Moreover, Mr. W. H. Dall, in describing the animal of *Waldheimia floridana* (Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 16, 1871), distinctly notes the existence of a few exceedingly delicate spicula in the floor of the great sinuses. It would seem therefore that these spicula occur in a genus which M. E. E. Deslongchamps, in his proposed new classification of the Terebratulidæ, places among those forms characterized by the entire absence of spicula.

After long and searching examinations of the recent forms, I have described in this monograph about one hundred so-termed species, some varieties, and about twenty-eight uncertain ones. Of course the vexed question as to what really constitutes a species remains the same, and is likely to remain so for a long time to come.

It will not be necessary to extend these introductory remarks, as all details have been fully given under each species. In conclusion I would tender my grateful thanks to the many kind friends who have in so zealous a manner supplied me with valuable information and specimens *.

ARTHROPOMATA, Owen=CLISTENTERATA, King.

Family TEREBRATULIDÆ, (Gray) emend. Davidson.

Subfamily TEREBRATULINÆ, Dall, 1870.

During the last few years a strong desire has been manifested by those palæontologists who consider an extreme subdivision of genera desirable, to separate from *Terebratula* proper those forms characterized by a small short loop, of which the principal stems are united anteriorly by a slightly arched lamella, and of which *Liothyris citrea* may be taken as the type.

* The drawings for the Plates were made by myself, on paper; but the state of my health would not allow of my reproducing them on stone.

As there are certainly some differences observable in the two groups, and as none of the recent species would agree in the characters of their loops and in certain other particulars with the forms referred to the genus *Terebratula* of Llhwyd and Klein, it may perhaps be better to adopt Douvillé's generic name *Liothyris* for the species we are about to describe.

In the larger number of the recent species, such as in *Liothyris vitrea*, *L. arctica*, *L. Moseleyi*, *L. uva*, *L. Barlletti*, *L. Wyvillii*, and *L. subquadrata*, the connecting band of the loop is narrow, while in *L. sphænoidea=cubensis* it is larger.

The specific claims of *Liothyris cernica*, and *L.? Dalli* are still uncertain, only a single example of each of them having been hitherto discovered.

Very small, or scarcely any modifications in the shape of the loop have been observed; all the species have their shell minutely perforated by canals, and calcareous spicules are abundant in the mantle.

1. Liothyris vitrea, Born, sp. (Plate I. figs. 1–12.)

Anomia vitrea, Born, Testacea Musei Caes. p. 119, vignette, 1778; Linné, ed. Gmelin, p. 3347, 1788.

Gryphus vitrea, Megerle v. Mühlfeld, Berlin Mus. 1811.

Terebratula vitrea, Lamarck, An. sans Vert. vol. vii. p. 245, 1819; Payraudeau, Cat. p. 83, no. 160, 1826; G. Bronn, Italiens Tertiär-Gebilde, p. 125, 1831; Philippi, Enum. Moll. Siciliæ, vol. i. p. 95, t. 6. figs. 6–8, 1836, vol. ii. p. 66, 1844; A. Scacchi, Cat. Conch. Regni Neapolitani, p. 8, 1836; Küster, Martini & Chemnitz, Conch.-Cab. vol. vii. p. 22, tab. 2. figs. 11–13, 1843; E. Forbes, Report on the Mollusca of the Ægean Sea, Brit. Assoc. Report, p. 141, 1843; D. Galvani, Illustrazione delle Conch. Foss. 1845; G. B. Sowerby, Thes. Conch. vol. i. p. 353, pl. 70. figs. 56–59, 1846; Aradas (pars) Conchiglie fossili di Gravatelli, p. 14, 1851; O. G. Costa, Fauna del regno di Napoli, p. 33, pl. i. figs. 1–3, 1851–52; Davidson, Sketch of a Class. of recent Brachiopoda, Ann. & Mag. Nat. Hist. vol. ix. p. 364, 1852, and Br. Foss. Brach. Pal. Soc. vol. i., Introduction, p. 62, fig. 23, and pl. vi. 1852; S. P. Woodward, Manual of Mollusca, p. 215, 1856; L. Reeve, Conch. Icon. pl. 3. fig. 8, 1860, and Journ. de Conch. vol. ix. p. 124, 1861; Chenu, Man. de Conch. vol. ii. p. 201, 1862; Seguenza, Atti della Soc. Italiana di Scienze Nat. vol. i. p. 17, pl. 1. figs. 1–7, 1865; H. C. Weinkauff, Die Conch. Mittelmeeres, vol. i. p. 284, 1867; Davidson, Italian Tert. Brach., Ann. & Mag. Nat. Hist. vol. vii. pl. xvii. fig. 11, 1870; Jeffreys, Ann. & Mag. Nat. Hist. 5th ser. vol. x. p. 28, 1882.

Liothyris vitrea, Douvillé, Bull. Soc. Géol. de France, 3e sér. vol. vii. 1879; E. Deslongchamps, Note sur la Classification des Térébratules, ou Études critiques sur les Brachiopodes, pp. 106 & 153, pl. xx. figs. 7–11, 1884.

Shell longitudinally oval or ovate, globose, widest about the middle, laterally rounded or more or less pinched in near the front, front margin nearly straight or gently rounded. Colour nearly white, surface smooth, semitransparent, glassy, marked with fine concentric lines of growth and perforated by minute canals. Dorsal valve tumidly convex, longitudinally flattened along the middle, from which the anterior lateral portions slope to the edge. Ventral valve slightly deeper than the dorsal one, longitudinally flattened along the middle; beak incurved, moderately produced and slightly overlying the umbo of the dorsal valve, obliquely truncated by a very small circular foramen with thickened margin and separated from the hinge-line by a small triangular deltidium in two pieces. Loop in the interior of the dorsal valve simple and short, attached by its crura to the hinge-plate and not exceeding a fourth of the length of the valve, the two principal stems becoming soon united anteriorly by a transverse lamella bent upwards in the middle; no mesial septum; cardinal process small and prominent, hinge-plate disunited, four diverging grooves extending from under the cardinal process to about half the length of the valve, the central pair being the longest. In the interior of the ventral valve a similar number of grooves; muscular impressions small, situated at the bottom of the valve under the loop and in the rostral portion of the bottom of the ventral one. Animal attached by a peduncle; labial appendages united to each other by a membrane; brachial disk trilobed; central lobe elongated and spirally convoluted. Very delicate spicula form elegant star-like plates in the mantle. Length 1 inch 8 lines, breadth 1 inch 5 lines, depth 1 inch.

Hab. Abundant in the Mediterranean in depths of from 90 to 250 fathoms. Very numerous in the Bay of Naples at depths of from 100 to 300 metres. Vigo Bay, 40 fathoms (McAndrew). Dredged by Prof. Giglioli, during the Italian Expedition to the Mediterranean in 1881, at a depth of 800 fathoms (see report in the Atti del iii. Congresso Geografico Internazionale). Also for distribution of this and other species, see Jeffreys's papers "On the Mollusca of the 'Lightning' and 'Porcupine' Expeditions," Proc. Zool. Soc. Lond. 1878, 1879, 1881, 1882.

Obs. Liothyris citrea is a beautiful, well-known, and abundant Mediterranean species. It varies considerably in its relative length, breadth, and degree of convexity; some specimens being quite elongated oval, 1 inch 8 lines in length by 1 inch 1 line in breadth, while other examples of the same length would have a breadth of 1 inch and 3 or 4 lines; some are much more pinched in anteriorly than others, and, lastly, some are nearly circular with an equal length and breadth.

Prof. E. Deslongchamps, in his instructive memoir on the classification of the Terebratulidæ, gives us the result of his studies in connection with the embryo of *L. citrea*, as well as of its subsequent stages of development. He states, "I have been able to examine the embryo at two millimètres of size, that is to say from the first moments when the larval condition has ended and the shell has begun to be formed; its shape is then absolutely similar to that of the young of *Terebratulina*; the dorsal valve is rounded, and slightly convex; the ventral one shows a triangular hole, of which the summit, which does not yet show any trace of a notch, will eventually become the beak. No trace of a deltidium is to be seen on the sides of this foramen. On opening this little shell, one is at once struck by the dull white of the internal walls; and, by the aid of a lens, one recognizes granulous parts affecting a certain regularity. The same dull white condition is seen on the fragments of the labial appendages that have remained adhering to them, hiding to some extent the brachial appendages. On examination of these fragmentary labial appendages with an enlargement of 20 to 30 diameters, one immediately observes calcareous spicula, the sharp extremities of which form a most elegant border, encroaching on the brachial membrane. These spicula were formed therefore from the beginning of the formation of the shell and, already very complicated, entirely resemble those seen in the adult individual . . . . The cirri and the channel of the labial appendages are enveloped by a layer of spicula spread out on the interbrachial membrane in a sort of border or festoon . . . . . Having afterwards submitted the minute shell to the action of water, accompanied by a little caustic potash, I was able to isolate the brachial appendages without effecting any fracture. The calcareous appendage, or loop, is formed at this stage of growth by two little short calcareous processes only, which represent the origin of the crura and offer no traces either of the principal stems or of the transverse connecting lamina of the loop. In this first stage, the brachial appendages entirely resemble those of a *Rhynchonella*; and if one limited oneself to a superficial examination one would be more disposed to take the embryo of *Liothyris vitrea* for a minute *Rhynchonella*, the then triangular aspect of the foramen and the pointed beak heightening the illusion . . . . . I next examined different examples of 6 and 7 millimètres in length; the shell then, although still quite young, had completely changed in aspect, its shape being essentially the same as in the adult condition. . . . . . The loop occupies about a fourth of the length of the shell, and is complete in all its parts. I next examined specimens of 10 millimètres in length, in which the only differences, and very slight ones, were limited to the loop being a little broader anteriorly, and it never afterwards assumed any difference. . . . . . Therefore the study of *Liothyris vitrea* offers three facts of great general importance, namely :—

"1. The brachial apparatus or loop follows in its development a regular progression. It is at first as simple as possible, composed of two little branches which unite afterwards so as to form a small apparatus in the shape of a crest.

"2. This apparatus once formed does not undergo any metamorphosis, and does not pass through the complications that one observes in *Terebratella*.

"3. As soon as the labial appendages or arms have developed themselves, and the brachial apparatus or loop has commenced to be formed, the mantle and the arms present in the interior a very complicated system of calcareous spicula, especially destined to protect the channel of circulation, whilst in the *Terebratulæ* with long loops, *Waldheimiæ*, and *Terebratellæ*, one can discover not a trace of similar spicula."

The soft parts of the animal of *Liothyris vitrea* are very similar to those of *Terebratulina caput-serpentis*, to which we allude in the sequel.

It is to be regretted that the anatomy of *L. vitrea* has not yet been published, and still remains a desideratum. The intimate shell-structure of *L. vitrea* has been minutely described and illustrated by Van Bemmelen in his memoir on the anatomy of the Brachiopoda *; the circular perforations, or canals, are widely separated from each other (as may be seen in the figure) although very small on the surface of the shell itself. Malformations in *L. vitrea* are not common. M. E. Deslongchamps has, however, described and illustrated a very remarkable one (Plate I. fig. 10 of this work) in which there exists a large longitudinal septum in both valves, which has been caused by an accident similar to that which caused the formation of the hole in *Terebratula diphya*.

Liothyris vitrea is a common fossil in the Pliocene rocks of Sicily, and occurs at Trapani, Tremonte, Gravitelli, and also at Terreti, near Reggio, in Calabria.

The shell referred to *L. vitrea*, by Chemnitz, in his Neues Conch. Cab. p. 97, tab. 78,

* Over den Bouw der Schelpen van Brachiopoden en Chitonen, 1882.

fig. 707, 1785, cannot surely belong to Born's species, for he figures in it a longitudinal septum, which never occurs in that species.

Several varieties of *L. vitrea* have received distinctive names.

LIOTHYRIS VITREA, var. MINOR, Philippi. (Plate I. fig. 13.)

Terebratula vitrea, var. *minor*, Philippi, Enumeratio Moll. Siciliæ, vol. i. p. 99, pl. vi. fig. 8, 1836; vol. ii. p. 66, 1844.

Terebratula affinis, Calcara, Cenno sui Molluschi viventi e fossili di Sicilia, p. 48, 1845.

Terebratula vitrea (pars), A. Aradas, Descrizione delle conchiglie fossili di Gravatelli presso Messina, p. 14, 1847.

Terebratula minor, E. Suess, Ueber die Wohnsitze der Brachiopoden, 1859; Davidson, On recent Terebratulæ, Ann. & Mag. Nat. Hist. 3rd ser. vol. viii. p. 35, 1861.

Terebratula affinis, G. Seguenza, Notizie succinte intorno etc. pp. 19, 26, 32, 1862; id. Sulla formazione mioc. di Sicilia etc. p. 7, 1862.

Terebratula minor, Davidson, Outline of the Geology of the Maltese Islands by Dr. Leith Adams; and Description of the Brachiopoda by Thos. Davidson, Ann. & Mag. Nat. Hist. 3rd ser. vol. xiv. p. 8, pl. i. fig. 8, 1864; Seguenza, Memorie della Soc. Ital. di Scienze Naturali, vol. i. p. 21, 1865; Kowalevsky, Observations on the Development of the Brachiopoda (in Russian). Nachr. Ges. Mosc. xiv. 1873.

Shell small, ovate, longitudinally oval, longer than wide, about 9 lines in length by 6 in breadth and $5\frac{1}{2}$ in depth. Valves uniformly convex and smooth, no fold or sinus; ventral valve somewhat deeper than the dorsal one; beak moderately incurved, and truncated by a small circular foramen slightly separated from the hinge-line by a narrow deltidium in two pieces; loops short and simple. Colour pale yellowish white.

Hab. Living in the Straits of Messina and off the Eolic Islands in the Mediterranean; off Cape of St. Vincent ('Talisman' Expedition), in 298–818 fathoms.

Obs. Considerable uncertainty has prevailed with respect to this small shell, which Philippi, in 1836, described from fossil Pliocene specimens as a variety of *Terebratula vitrea*. Suess and others declare it to be a distinct species, while others look upon it as a young stage of *Liothyris vitrea*. I have compared species of the fossil shell with species dredged alive by Prof. Seguenza in the bay of Messina, and found them to be identical. I cannot, however, get rid of the idea that *Liothyris minor* is more than a small race or variety of *Liothyris vitrea*; it occurs, associated with the last-named shell, in the same beds and localities in Calabria and in Sicily.

To Kowalevsky's memoir on the development of the Brachiopoda (1873) the reader is referred for observations relative to the embryology of *L. minor*.

LIOTHYRIS VITREA, var. DAVIDSONI, A. Adams. (Plate I. figs. 14–16.)

Terebratula davidsoni, A. Adams, Proc. Zool. Soc. London, p. 314, 1867.

Terebratula minor, Davidson, Proc. Zool. Soc. London, p. 302, pl. xxx. fig. 10, 1871.

Shell ovate, broadest anteriorly, tapering posteriorly, longer than wide, marginally rounded. Valves uniformly convex, no fold or sinus, surface smooth, with faintly marked concentric lines of growth; beak incurved, truncated by a small circular foramen margined laterally by two small deltidial plates; surface of shell finely punctured.

Colour light yellowish white; loop small and simple. Length 10, width 7, depth 6 lines.

Hab. Dredged by A. Adams at Satanomosaki, Japan, in 55 fathoms.

Obs. I am not quite certain that this small species is really a variety of *L. vitrea*. I have seen only two examples of the shell, and they much resemble the typical var. *minor*. One of the specimens bore some resemblance to young examples of *Liothyris uva* from the Gulf of Tehuantepec, but differs from it, according to A. Adams, in its more solid structure and globose form, and in the foramen being smaller and entire. More Japanese examples will have to be examined before the variety can be definitely accepted.

2. LIOTHYRIS ARCTICA, Friele, sp. (Plate I. figs. 17, 18.)

Terebratula arctica, Friele, Særskilt Aftryk af Nyt Magazin for Naturvidenskaberne, pl. i. fig. i., 1877.

Shell small, globose, broadly ovate, rather longer than wide. Valves smooth, glassy, semitransparent, whitish; dorsal valve convex, squarely circular, without fold or sinus; ventral valve very convex and deep; beak unusually short, slightly incurved and truncated by a very small foramen margined anteriorly by rudimentary deltidial plates; loop very small and simple. Length 7, breadth 6, depth 4 lines.

Hab. Dredged by Herman Friele some few miles south-west of Jan Mayen, in 263 fathoms depth. Shell abundant, but so brittle that most of the specimens were broken during the dredging-operation.

Obs. After having carefully compared a specimen of the shell under description, sent to me by Friele, with others of the var. *minor* to which it had been referred by Dr. Jeffreys, I could, as Friele had previously done, discover several differences which, although not very great, have induced me to follow its discoverer in considering it a distinct species. *L. arctica* is much more globose and squarely rounded than *L. minor*, which is more of an elongated oval. As stated by Friele, its form approaches most to *L. minor* of Philippi, but the deviation is shown in the shorter beak and by the position of the foramen, which, in *L. arctica,* is placed directly above the dorsal valve, the deltidium being almost hidden. The loop in *L. arctica* is very much weaker and thinner, and the crura processes are placed further apart than in *L. minor*. It is the first representative of the genus *Liothyris* that has been hitherto found in Arctic seas.

3. LIOTHYRIS UVA, Broderip, sp. (Plate II. figs. 5–7.)

Terebratula uva, Broderip, Trans. Zool. Soc. Lond. vol. i. p. 142, pl. xxii. fig. 2, 1833; Sowerby, Thes. Conch. vol. i. p. 353, pl. lxx. figs. 53–55, 1846; Reeve, Monogr. of the genus *Terebratula,* Conch. Icon. pl. iii. fig. ii., 1860; Dall, Cat. of the recent species of the Class Brachiopoda, Proc. Acad. of Nat. Sciences of Philadelphia, 1873; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 31, pl. ii. figs. 3 & 4, 1880.

Shell oblong-oval, posteriorly compressed on each side, longer than wide, slightly diaphanous, white or of a very light salmon-colour. Dorsal valve convex; marginal line flexuously rounded in front; ventral valve deeper than the dorsal one; beak incurved, moderately produced, obliquely truncated by a large circular foramen separated from the hinge-line by a narrow concave deltidium. Surface smooth, marked by fine concentric lines of growth. Shell finely punctated. Loop short, simple. Length 1 inch 1 line, width 8 lines, depth 6 lines.

Hab. Mr. Broderip states that this species was obtained at Tehuantepec by Capt. Dare, while dredging for *Meleagrinæ margaritiferæ*, attached to a dead sea-worn bivalve, at a depth of 10–12 fathoms, and on a bottom of sandy mud. The type, formerly in Mr. Cuming's collection, is now in the British Museum. The shell was also trawled by the 'Challenger' Expedition off Twofold Bay, in 120 fathoms, and dredged off Buenos Ayres by the same expedition at a depth of 600 fathoms, and again off Heard Island, lat. 52° 4′ S., long. 71 22′ E., at a depth of 150 fathoms.

Obs. Liothyris uva varies much in shape; it is usually longer than wide, and oval, but in some examples the length and depth do not differ materially.

4. LIOTHYRIS MOSELEYI, Davidson. Plate II. figs. 1–4.

Terebratula Moseleyi, Davidson, Proc. of the Royal Society, vol. xxvii. p. 436, 1878; Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 30, pl. ii. figs. 12–14, 1880.

Shell broadly ovate, semiglobose, rather longer than wide, broadest anteriorly, slightly tapering posteriorly, marginally and laterally convex, nearly straight in front, margin sometimes thickened, surface smooth, white. Dorsal valve uniformly convex, without fold or sinus; ventral valve slightly deeper than the dorsal one, uniformly convex; beak moderately produced, slightly incurved and truncated by a circular foramen separated from the hinge-line by a very narrow and small deltidium, beak-ridges not defined. Loop in dorsal valve short and simple, labial appendages occupying about two thirds of the length of the valve, united to each other by a membrane, the central coil making about three turns. Shell-structure perforated by numerous small canals. Colour white. Length 11, breadth 10, depth $7\frac{1}{2}$ lines.

Hab. Dredged by the 'Challenger' Expedition, west of Kerguelen Island, at a depth of 210 fathoms. Types in the British Museum.

Obs. I have reproduced the description I have given in the 'Challenger' Report. Five examples of this shell were obtained, all of about the same dimensions. It seems to be a smaller and more circular species than *L. vitrea* and *L. sphenoidea*. It is less elongated, and not quite so convex as the last-named species, and does not present the flatness and angularity observable in the mesial and lateral portions of the ventral valve of *L. sphenoidea* or in its synonym *L. cubensis*.

I made an examination of the animal of one of the specimens, which did not differ materially from that of *L. vitrea*. The mantle is thin, and not furnished with setæ at its edges. On the dorsal lobe of the mantle I distinctly observed the ramified, bifurcated, fine, thread-like pallial nerves as well as the pallial sinuses, muscles, and brachial or labial appendages, these last occupying a much smaller space in the interior of the shell; and while the labial branches are visibly shorter, the cirri are of considerable length.

5. LIOTHYRIS SPHENOIDEA, Philippi, sp. (Plate II. figs. 17–22.)

Terebratula sphenoidea, Philippi, Enum. Moll. Siciliæ, vol. ii. p. 68, tab. xviii. fig. 6, 1844; G. Seguenza, Pal. Malac. dei Terreni Terziarii del distretto di Messina, Memorie della Soc. Italiana di Scienze Naturali, p. 24, pl. ii. figs. 1–5, 1865; also Studii Paleontologici sui Brachiopodi dell' Italia Meridionale, pl. i. figs. 18–26, Pisa, 1871.

Terebratula cubensis, Pourtales, Contributions to the Fauna of the Gulf Stream at great depths, Bull. Mus. Comp. Zoöl. vol. i. pp. 109 & 124, 1867; Dall, Report on the Brachiopoda obtained by the United States Coast Survey Exp., Bull Mus. Comp. Zoöl. vol. iii. pp.3–9, pl. i. fig. 2, 1871; Davidson, Report on the Brachiopoda, Voy. H.M.S. 'Challenger,' p. 28, pl. ii. figs. 10–11, 1880; Dall, Bull. Mus. Comp. Zoöl. vol. ix. p. 103, 1881.

Terebratula vitrea, var. *sphenoidea,* Jeffreys, On the Mollusca procured during the 'Lightning' and 'Porcupine' Expeditions 1868–70, Proc. Zool. Soc. p. 404, pl. xxii. fig. 6, 1878.

Shell longitudinally more or less trigonal, broadest and rounded anteriorly, tapering posteriorly, lateral marginal line flexuous, that of the dorsal valve forming an outward curve, flexuously varying with age. Dorsal valve uniformly convex, sometimes rather inflated; ventral valve somewhat deeper than the dorsal one, longitudinally broadly flattened, sides of the flattened portion sloping away rather abruptly on either side, giving the valve a somewhat subquadrangular aspect; beak moderately incurved and truncated by a circular foramen separated from the hinge-line by a narrow deltidium. Surface smooth, sometimes marked by fine radiating lines. Loop narrow, small, and simple, bent-up band connecting the principal stems of the loop long and narrow. Colour soiled white. Length 1 inch 3 lines, breadth 11 lines, depth 9 lines.

Hab. Recent. Atlantic (Jeffreys). West-African coast ('Travailleur' and 'Talisman' Expeditions). Gulf of Florida in depths of 100–200 fathoms, rarer towards east end of reefs (Pourtales). Coast of Cuba (Sigsbee), off Havana 270 fathoms. Barbados 100 fathoms, St. Vincent 88 fathoms, Martinique 210 fathoms. Off Ascension 420 fathoms ('Challenger' Expedition). Off Morocco ('Talisman' Expedition) in 298 to 818 fathoms.

Fossil. In Pliocene rocks of Calabria and Sicily (Philippi and Seguenza).

Obs. In 1844, Philippi described and figured, as his *Terebratula sphenoidea,* some fossil Pliocene specimens he had collected in the valley of Lamanto in Calabria. Subsequently Signor Seguenza found the same fossil in Philippi's locality, as well as in rocks of the same age in Sicily. In 1878, Dr. Gwyn Jeffreys described and figured as *Terebratula vitrea,* var. *sphenoidea,* a living specimen which he had dredged during the 'Porcupine' Expedition in 1870, from the Atlantic, at depths of 292, 374, and 994 fathoms, and remarks:—"After a protracted and very careful examination of my specimens, which I had considered the *T. sphenoïdea* of Philippi, and having compared them with fossil specimens sent me by Prof. Seguenza as Philippi's species from the Sicilian Tertiaries, as well as with a series of *T. cubensis* which I received from Count Pourtales and Professor Alexander Agassiz, and also after a close comparison of all these specimens with the description and figures given by Philippi, Seguenza, Pourtales, and Dall, I am convinced the *T. sphenoïdea* and *T. cubensis* are the same, and constitute a well-marked variety of *T. vitrea.* The loop in *T. sphenoïdea* and *T. cubensis* is precisely similar." In this last remark, Dr. Gwyn

Jeffreys is clearly mistaken; for there exists a well-marked difference between the loops of *T. sphenoidea* and *T. cubensis* and that of *L. vitrea*. The loops in the fossil specimens of *Liothyris sphenoidea* and those of the recent *L. cubensis* are exactly the same, as had been clearly illustrated by Philippi in 1844.

As justly remarked by Prof. Dall, *L. sphenoidea* varies much in shape according to age and specimen: some are longer than wide, others almost as wide as long; some taper more than others posteriorly, while much difference is observable in the degree of convexity of their valves.

In his description of *T. cubensis*, Dall enters into minute details, in order to point out the differences which exist between this last-named species and *Liothyris vitrea*. He has also carefully studied the animal of *T. cubensis*, and points out the differences it presents from that of *Waldheimia floridana*. He says, "the mantle is of stouter consistency than in *W. floridana*, and may often be removed from the shell with but little injury if care be exercised. The muscles are similar in disposition to those of the other members of the Terebratulidæ, and present no new features. The peduncle is solid, cup-shaped at its extremity, and has the edge produced in cylindrical horny rootlets, which are attached to foreign bodies. The regular arrangement in layers of the muscles and corium, as well as the axial tube of the peduncle, found in *Lingula*, is less evident or absent in these forms. In this species the peduncle is very short and stout, broadly cordiform at its inner extremity when enveloped by its various tunics.

"The brachia are arranged as in *T. vitrea*, as figured by Woodward; the central coil makes about four turns. The cirrhi are very short behind the mouth, in front of the supra-œsophageal body. A striking feature in its anatomy, which I believe has not yet been noted in any publication on Brachiopods, is the absence of that great series of sinuses in the anterior part of mantle, which was termed by Hancock the 'great pallial sinuses.' So extraordinary did this appear to me, that I could not believe, at first, that I was not deceived by the translucency of the membranes, and it was only after an examination of many specimens that I became convinced that they do not exist in this species. There is in the free lobes of the mantle an extensive and extremely close and fine network of minute channels; or perhaps it might be said that the whole of the mantle-lobes form one great lacune, the upper and lower walls of which are held apart by a profuse number of pillars of tissue, which appear like dark spots under the microscope, and which are situated so close together that the spaces about them are reduced to minute channels. This system occupies the anterior lobes of the mantle, which in some species also contain large branching sinuses, here absent. . . . In the inner lining of the mantle are scattered, everywhere, delicate, branching spiculæ, looking more like briers than like deer-horns, and, while more or less interlocked, and here and there stout and thick, are still much more delicate and slender than those of *Terebratulina caput-serpentis* and *Megerlia truncata*, and do not often exhibit a stellar arrangement. They are much more numerous in some individuals than in others, and when present in abundance are found in almost every part of the epithelium, even to the brachial cirrhi, where the spicules are slender and not branched . . . . The œsophagus is wide and funnel-shaped, narrowest at its junction with the stomach, which it enters at an acute angle. The stomach is small and oval, tapering towards the intestine, which is nearly twice as long as the œsophagus.

"The heart in most specimens was pyriform and of a moderately large size.

"The genitalia . . . are situated in a reticulated series of sinuses, on the surfaces of the sides of the perivisceral tissues.

"Above and behind the mouth, and directly in front of the anterior occlusor (retractor) muscles, the external tissues of the perivisceral membrane are thickened, or a mass of cellular tissue is interposed between the laminæ of the membrane.

"No peculiarities of note were observed in the shell-structure. The perforations appeared to be slightly further apart than in *T. vitrea*, but the difference was not much greater than that which may be observed in the shells of different individuals of the same species."

Mr. Dall then describes what he believes to be the young of *T. cubensis*, dredged off the Samboes, on the Florida reefs, a minute, polished, hyaline shell, 4-100ths of an inch in length, and follows by describing the muscular system, brachia, and organs of digestion.

Liothyris sphenoidea and its synonym *T. cubensis* appear to be very abundant in their especial haunts. I have also been able to examine the animal from one of the specimens dredged by the 'Challenger' Expedition. The mantle in the dorsal valve of one of the specimens showed in a most distinct manner the four principal pallial sinuses, which again branched as they approached the front margin of the shell, and bifurcated again before reaching the margin.

6. Liothyris Bartletti, Dall, sp. (Plate I. figs. 20, 21.)

Terebratula bartletti, Dall, The American Naturalist, vol. xvi. p. 885, Nov. 1882.

Shell ovate, globose, longer than wide, broadest anteriorly, dorsal valve convex, with a wide flattened mesial fold of very small elevation, commencing at about two thirds of the length of the valve and extending to the front. Lateral and frontal margins sinuous, front line of fold nearly straight. Ventral valve slightly deeper and more convex than the dorsal one, with a wide, shallow, flattened, mesial depression or sinus near the front; beak short, much incurved, overlying the umbo of the opposite valve, and truncated by a small, oval-shaped, incomplete foramen. Surface smooth, marked with concentric lines of growth. Colour light yellowish brown. In the interior of the dorsal valve the loop is short and simple. Length $1\frac{1}{2}$ inch, breadth 1 inch 2 lines, depth 1 inch.

Hab. Dredged by the United States Coast Survey. Gulf Stream ('Blake' Expedition) near Vera Cruz, in 218 fathoms.

Obs. I have seen one specimen only of this species, kindly lent to me by Mr. Dall. It approaches much in general shape to some specimens of *Liothyris vitrea*. It differs from *Liothyris sphenoidea* (=*cubensis*) in the shape of its loop, which is similar to that of *L. vitrea*.

7. Liothyris subquadrata, Jeffreys, sp. (Plate II. figs. 15, 16.)

Terebratula subquadrata, Jeffreys, On the Mollusca procured during the 'Lightning' and 'Porcupine' Expeditions in 1868–70, Proc. Zool. Soc. London, 1878, p. 402, pl. xxii. fig. 3.

Shell somewhat subpentagonal or pear-shaped, broadest anteriorly, tapering posteriorly, longer than wide, rounded laterally, slightly indented in front. Dorsal valve moderately and evenly convex, somewhat flattened along the middle. Ventral valve deeper than the dorsal one; beak slightly incurved and moderately produced, obliquely truncated by a rather large circular foramen, separated from the obtusely angular hinge-line by a well-defined triangular area and long, narrow, deltidial plates; beak-margins sharply defined. Surface of valves marked with numerous, wavy, fine, radiating riblets, widely separated and crossed at intervals by concentric lines of growth. Colour ochreous white, cæcal tubuli minute and close-set. Loop small and simple. Length 1 inch 1 line, breadth 1 inch, depth 7 lines.

Hab. Off the coast of Portugal, in 500–600 fathoms; in the Bay of Biscay.

Obs. The only complete specimen of this shell that I have seen is the one described, which I figured for Dr. Jeffreys. It was given to me by Mr. Saville W. Kent, who had dredged it during his cruise in Mr. Hall's yacht 'Norna' off the Setubal coast, near the Tagus in 1870. Since then I have been informed by Dr. Jeffreys that young examples were obtained during the dredgings of the French ship 'Travailleur' in the Bay of Biscay. It seems to be a good and well-marked species.

8. Liothyris Wyvillii, Davidson. (Plate II. figs. 8–14.)

Terebratula Wyvilli, Davidson, Proc. Roy. Soc. vol. xxvii. p. 436, 1878, and *T. wyvillii*, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zoology, vol. i. p. 27, pl. ii. figs. 7, 8, 1880.

Shell somewhat subpentagonal, variable in shape, about as broad as long, sometimes almost square, with rounded angles, with a concave sinus on the dorsal valve and corresponding fold in the ventral one. Shell very thin and exceedingly brittle, almost transparent, smooth, glassy, light-yellowish white. Length 7, breadth 9, depth $4\frac{1}{2}$ lines. Valves in the young slightly and evenly convex; dorsal valve moderately convex, with a depression of greater or less depth commencing close to the umbo, and gradually widening and deepening as it nears the front, front line wide, straight, or presenting an inward curve. Ventral valve deeper and more convex than the opposite one, with a wide *median convex* elevation or fold commencing near the beak, and one extending to the front. Beak very small, slightly incurved, truncated by a small, generally incomplete, circular foramen, laterally margined by deltidial plates. Surface of valves marked at intervals by concentric lines of growth; shell-structure with minute, widely separated perforations or canals. In the interior of the dorsal valve the loop is short and simple; the adductor and other muscular impressions are small and delicate. The labial appendages extend to two thirds of the length of the shell. In the interior of the ventral valve the muscular impressions are small, and occupy a limited area close to the beak.

Hab. This remarkable and very interesting species appears to abound over a wide geographical area, and at depths from 1035 to 2900 fathoms.

It was dredged by the 'Challenger' Expedition at six or seven different stations. In South Australia, in lat. 42° 42′ S., long. 134° 10′ E., depth 2600 fathoms: one example was attached to a manganese nodule. In lat. 12° 8′ S., long. 145° 10′ E., depth 1400 fathoms; bottom-temperature 1°·3 C. In lat. 33° 31′ S., long. 74° 43′ W., depth 2160 fathoms. Off coast of Chili (Valparaiso), along with *Waldheimia Wyvillii* and *Discinisca atlantica*. In lat. 42° 43′ S., long. 82° 11′ W., depth 1450 fathoms. Off coast of Patagonia. One small example from the net-weights, not far from Falkland Islands, at a depth of 1035 fathoms. And, lastly, in lat. 35° 22′ N., long 169° 58′ E., depth 2900 fathoms, the greatest depth at which any Brachiopod was obtained by the 'Challenger' Expedition; bottom-temperature 1°·2 C.; sea-bottom, red clay.

Obs. Liothyris Wyvillii is one of the most interesting species of deep-sea Brachiopoda. The shell is of such extreme thinness that it is almost transparent; indeed the valves, when separated, are really so, and the muscular impressions may be seen through its transparency. I separated the valves of a specimen in order to be able to study the animal and its loop. The latter, which I was much surprised to find short, is exactly similar to that of *Liothyris vitrea*, notwithstanding the outward *Waldheimia*-like appearance of the shell. It bears also much resemblance to several species of the last-named genus occurring in the Jurassic and Cretaceous formations. We meet with but few recent species with such a thin shell; but among others may be named the widespread *Discinisca atlantica*, King, *Atretia gnomon*, Jeffreys, *Waldheimia* or *Macandrevia tenera*, Jeffreys, *Rhynchonella lucida*, Gould, and one or two others.

In external shape and character of loop, *Liothyris Wyvillii* also strongly resembles the *Terebratula nucleata* of Schlotheim. Zittel's figure 544, on page 700 of his 'Handbuch der Paläontologie,' 1880, seems as if drawn from a specimen of the recent *L. Wyvillii*. For *T. nucleata* Douvillé proposes a genus *Glossothyris*; but this I am unable to admit or adopt.

Uncertain Species.

9. Liothyris cernica, Crosse, sp. (Plate I. fig. 19.)

Terebratula cernica, Crosse, Journal de Conchyliologie, vol. xxi. p. 285, and vol.xxii. p. 75, pl. i. fig. 3, 1873.

Shell longitudinally oval, somewhat pear-shaped, longer than wide, broadest anteriorly, tapering posteriorly. Valves uniformly convex and globose, lateral margins rounded and flexuous. Surface smooth, white, semitransparent and somewhat vitreous. Beak not much produced, incurved and truncated by a small circular foramen, separated from the hinge-line by a deltidium in two pieces. Loop not known, in all probability short and simple, as in *L. vitrea*. Length 1 inch 4 lines, breadth 1 inch 1 line.

Hab. Off Mauritius Island (Liénard).

Obs. Mr. Crosse, in his description, says that *T. cernica*, from the lateral compression of its dorsal valve, possesses affinities with *T. uva*, Broderip, but that it is less elongated and more globose, and approaches *T. vitrea* and, even more closely, *T. cubensis* of Pourtales. I have never seen the single example of the shell under description; but from inquiries I made in the Island of Mauritius, Mr. V. Robillard has informed me that it has not been dredged, but was found in the stomach of a fish taken at 80 fathoms depth, that it is the only specimen existing, and that there is but little chance of finding it again. He adds that he does not know of any other species of Brachiopod from the waters of

Mauritius, although he has been studying conchology there for the last forty-five years.

10. LIOTHYRIS? vel TEREBRATULINA DALLI, Davidson. (Plate II. fig. 23.)

Terebratula? Dalli, Davidson, Proc. Roy. Soc. vol. xxvii. p. 437, 1878; and Report on the Brachiopoda. Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 38, pl. ii. figs. 15, 15 *a*, *b*, 1880.

Shell small, thin, longitudinally oval, globose, glassy, semitransparent. Dorsal valve moderately convex, slightly depressed anteriorly. Ventral valve uniformly convex, a little deeper than the dorsal one. Beak small, slightly incurved, and truncated by an incomplete foramen, laterally margined by small deltidial plates. Surface of valves covered with fine, radiating, raised striæ, with shorter ones here and there, interpolated between the longer ones. Loop short and simple. Length 3, width 2 lines.

Hab. One example only, without the animal, was dredged by the 'Challenger' Expedition near Yeddo, off Japan, lat. 34° 37′ N., long. 140° 32′ E., depth 1875 fathoms.

Obs. I am not quite certain whether this small shell is a *Liothyris* or a *Terebratulina*. Its generic claims must be considered uncertain.

Subgenus TEREBRATULINA, d'Orbigny, 1847.

The subgenus *Terebratulina* is closely allied to *Liothyris*. When young, and up to a certain stage of its development, the loop is similar to that of *Liothyris*; but with age the crural processes become united and form a shelly band, which is never the case in *Liothyris*. Apart from the last-named peculiarity of the ring-shaped loop, the subgenus *Terebratulina* well defines a small group of shells distinguished and characterized by the presence of ear-shaped expansions on each side of the umbo, and by the fine radiating striæ that cover the surface of their valves.

11. TEREBRATULINA CAPUT-SERPENTIS, Linné, sp. (Plate III. fig. 12; Plate IV. figs. 1–11; Plate V. figs. 32–34.) [Figs. 35–37, var. *emarginata*, Risso=var. *mediterranea*, Jeffreys. See footnote, p. 25.]

Anomia caput-serpentis, Linné, Syst. Nat. ed. duodecima reformata, vol. i. p. 1153, Holmiæ, 1767.

Anomia pubescens, id. ibid. p. 1153.

Anomia retusa, id. ibid. p. 1151.

Animal Anomiæ nondum antea depictum, Ad. Murray, Fundamenta Testaceologiæ, Upsala, p. 43, pl. ii. fig. 23, 1771.

Anomia caput-serpentis, Pennant, (Linné) Nova Acta Regiæ Societatis Upsaliensis, vol. i. p. 38, tab. v. fig. 4, 1773.

Terebratula caput-serpentis (animal), Grundler, Naturforscher, Bd. i. p. 81, tab. iii. figs. 1–6, 1774; Beschreibung und Abbildung zweier natürlichen Terebrateln, Naturf. Bd. ii. p. 80, 1774; Born, Musei Cæsarei Vindobonensis, p. 119, 1780.

Anomia caput-serpentis, Chemnitz, Conchylien-Cabinet, vol. viii. p. 103, tab. 78. fig. 712, 1785.

Terebratula pubescens, Retzius, Nov. Gen. xv., 1788.

Terebratula caput-serpentis, Dillwyn, Cat. Recent Shells, 1817; Lamarck, An. sans Vert. p. 247, 1819.

Terebratula aurita, Fleming, Phil. of Zool. ii. p. 498, tab. iv. fig. 5, 1822, and History of British Animals, vol. i. p. 369, 1828.

Terebratula costata, Lowe, Zool. Journal, vol. ii. p. 105, 1825.

Terebratula emarginata, Risso, Hist. Nat. de l'Europe Méridionale, vol. iv. p. 388, pl. xii. fig. 175, 1826.

Terebratula quadrata, Risso, ibid. p. 389, pl. iv. fig. 176, 1826.

Delthyris spatula, Menke, Synopsis Methodica Molluscorum, 2nd ed. p. 96, 1828–30.

Terebratula caput-serpentis, Philippi, Enum. Moll. Siciliæ, vol. i. p. 84, tab. vi. fig. 5, 1836; Anton, Verzeichniss der Conchylien, p. 23, 1836.

Terebratula Gervillei, S. V. Wood, Ann. & Mag. Nat. Hist. 1st ser. vol. vi. p. 253, 1840.

Terebratula Chemnitzii, Küster, Martini & Chemnitz, Conchylien-Cabinet, vol. vii. p. 37, pl. 2 *b*. figs. 19 and 20, 1843.

Terebratula caput-serpentis, G. B. Sowerby, Thes. Conch. vol. i. p. 343, pl. lxviii. figs. 1–4, and pl. lxxii. fig. 116, 1846.

Terebratulina caput-serpentis, d'Orbigny, Ann. des Sci. Nat. vol. viii. p. 67, pl. vii. figs. 7 & 8, 1848.

Terebratulina cornea, d'Orbigny, 1848.

Terebratula caput-serpentis, Forbes and Hanley, Brit. Moll. pl. lvi. figs. 1–4, 1849.

Terebratulina caput-serpentis, Davidson, Sketch of a Classification of Recent Brachiopoda, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 365, 1852; Davidson, Br. Tert. Brach., Pal. Soc. vol. i. p. 12, pl. i. figs. 3–6, 1852.

Terebratula striata, Leach, Br. Moll. 1852.

Terebratulina striata, S. P. Woodward, Manual of the Mollusca, p. 215, 1854; Hancock, Phil. Trans. vol. cxlviii., 1858.

Terebratula striata, L. Reeve, Conch. Icon. pl. iv. fig. 15, 1860.

Terebratulina striata, E. Deslongchamps, Recherches sur l'Organisation du Manteau chez les Brachiopodes articulés, 1864; Brusina, Moll. Dalmati, Verh. zool.-bot. Ges. Wien, Bd. xvi., 1866; Dall, Proc. Acad. Nat. Sciences of Philadelphia, p. 179, 1873; Kowalevsky, On the Development of the Brach., 1874; G. O. Sars, Bidrag til Kundskaben om Norges Arktiske Fauna, Mollusca Regionis Arcticæ Norvegiæ, tab. i. fig. 5, 1878; Jeffreys, Brit. Conch. vol. ii. p. 14, and vol. v. pl. xix. fig. 2, 1873–79; E. Deslongchamps, Études critiques sur des Brachiopodes nouveaux ou peu connus, 1884*.

Shell ovate, somewhat pentagonal, longer than wide, broadest about the middle, slightly rounded or indented anteriorly; dorsal valve more or less uniformly convex, but with sometimes a mesial longitudinal depression, marginally flexuous on the sides; lateral sides of the umbo auricular; ventral valve convex, rather deeper than the dorsal one, anteriorly mesially depressed; beak rather short, gently incurved and obliquely truncated by an incomplete foramen, posteriorly margined by the substance of the beak, anteriorly by the extremity of the umbo, laterally by two small deltidial plates, no distinct cardinal area or beak-ridges; surface of shell densely covered with fine radiating striæ, few in number, coarse and simple when young, but rapidly increasing in number with age, by means of bifurcation, and by the interpolation of smaller and shorter ribs; both valves are also crossed by numerous concentric raised lines of growth, more prominent in the young, finer and closer as the shell increases in size. Loop short and simple in the young, with age becoming annular through the union of the oral processes. Colour whitish, with a tinge of yellow, sometimes rust-stained. Dimensions variable; a large example measured 1 inch 3 lines, breadth 1 inch, depth $\frac{1}{2}$ inch.

* In addition to the above references, the species has been alluded to by many other conchologists and palæontologists, such as by Gualtieri, in his Index Conch. tab. 96. fig. 3, 1742; by Davila, Cat. i. pl. xx.; Favanne, Conch. pl. 41. fig. A², 1780, and by many others.

Hab. Spitzbergen and Davis Straits; north-east European seas; Oban and off Cumbrae Islands, Loch Torridon, Scotland; off Belfast; Finisterre and Croix de Gavie; Morbihan; Cape Breton; Adventure Bank; off Guetaria, Spain; north-east coast of Jamaica; Corea and Sagami Bay, Japan, &c.

Fossil. In the Upper Tertiaries of Sicily; Coralline Crag of England, Belgium, south of Spain, Azores, &c., &c.

Obs. No species of Brachiopoda has been more thoroughly or more carefully studied than the *Anomia caput-serpentis* of Linné. It is a very common and well-known species, abounding in the localities where it is found, and has since 1767 attracted the attention of a large number of malacologists.

The shell varies somewhat in shape and especially, according to age, in the number of its ribs. These modifications have been often described by myself and others, and most recently, in 1884, by M. E. Deslongchamps *. In the youngest condition the shell tapers posteriorly, and is widest anteriorly; the hinge-line is then almost straight, the auricular expansions comparatively larger, the foramen triangular or elongated oval. In a specimen, less than a line in length, forwarded for my examination by the Marquis de Folin, the posterior half of the valves was smooth, while on the anterior half some seven, scarcely developed, rounded radiating ribs were present. At one and a half line the surface of each valve was ornamented with about ten simple rounded ribs with interspaces of about equal breadth, concentrically crossed by equidistant projecting ridges, most prominent on the surface of the ribs. As the shell grows larger, the auricular expansions become smaller, the hinge-line obliquely or obtusely angular, the ribs more numerous and finer, the lines of growth less prominent, and the greatest breadth at about half the shell's length. Similar important modifications take place also in the interior of the valves. In the interior of the dorsal valve, when quite young, and up to a certain age, the crura are widely separated; but as the shell grows, the pointed extremities facing each other extend nearer and nearer towards each other until they become united and form a well-defined band, giving the loop an annelliform shape and character.

The intimate shell-structure of *T. caput-serpentis* has been described and figured by Dr. W. B. Carpenter, Oscar Schmidt, Prof. W. King, E. Deslongchamps, and others. Dr. Carpenter says that it is in *T. caput-serpentis* "that the canals are of smallest dimensions, their largest diameter being about $\frac{1}{5000}$ of an inch, whilst their average distance from each other is about the same as in the preceding case [*Waldheimia flavescens*, $\frac{1}{400}$ inch]—their regular arrangement, however, being so modified, that the external orifices are principally seen upon the elevated parts of the plications, ... whilst they open internally in similar rows."

When alluding to the shell-structure of *T. caput-serpentis*, in his valuable memoir on the histology of the test of the Palliobranchiata (Trans. Roy. Irish Acad. vol. xxiv. p. 448, 1869), Prof. W. King says:—" The species just mentioned, which is longitudinally ribbed, has two kinds of perforations: those lying in the furrows are simple; while those

* 'Etudes critiques sur des Brachiopodes nouveaux ou peu connus:' Caen, 1884.

belonging to the ribs are antler-shaped, that is, twice, thrice, or oftener subdivided. Occasionally the perforations are confined to the ribs, which causes them to lie in bands. It is only by the most careful examination, while grinding down the ribs to the level of the intermediate furrows, that the true forms of the perforations can be determined. As the modification in question is a very important one in many respects, I have given two representations of it taken from a section prepared by Dr. Rowney. Fig. 10 shows a band of antler-shaped perforations in the simplest state, magnified 60 diameters: it would have been difficult to have represented them under the complex form they sometimes assume. Fig. 11 shows a portion of one of the perforations, magnified 210 diameters, having each termination of its branches furnished with a brush-like bundle, which in this species, as in *Terebratula vitrea*, is smaller than usual." [See woodcut, fig. 1 A & B.]

Fig. 1.

After W. King.

The shell-structure of *T. caput-serpentis* being so very remarkable, I asked my friend Mr. John Young, of the Hunterian Museum, Glasgow, to carefully examine the shell-structure of this species. He writes me on the 20th of April, 1885:—"The shell-structure of this species is of great beauty. The numerous canals incline from the lower margin of the shell upwards towards the beak, but on the ribs of the shell they radiate from the centre of each rib to either side, there being a central row of tubes or canals that point nearly straight upwards, while the other rows diverge. It is this bending inwards of the tubes on each side of the ribs towards the interior of the shell that caused Dr. Carpenter, in the introduction to your monograph, to state that they open internally in rows. Dr. Carpenter is, however, wrong when he states that the pores or canals are principally seen *on the elevated parts of the plications* (in this species), my etched specimens show that they open quite as numerously in the hollows between the ribs. It is only internally that the perforations gather together into rows with bare spaces between. On the exterior surface of the valves the pores are more evenly distributed, owing to the divergence of the tubes on the ribs. The perforations are not so well seen on this species, previous to etching. The tubes on their passage through the shell-surface often have a wave outward and upwards."

The embryology of *Terebratulina caput-serpentis* and of *T. septentrionalis* has been admirably investigated by Prof. E. Morse * and Prof. Kowalevsky †. Prof. E. Morse says:— "In the first stage the embryo becomes widened at one end. The segments are barely indicated, the posterior end is the widest, the anterior portion is ornamented with a conspicuous tuft of long cilia, so peculiar to the embryos of many worms. The embryo is also clothed with vibratile cilia, and in this condition slowly moves along the bottom of the dish without rising from it, or remains quiet. In the second well-marked stage the embryo is divided into two prominent segments; these expand and contract upon each other slightly, and the cephalic segment has the power of partially bending from side to side. In this stage the embryo is most active, swimming rapidly in every direction and turning

* "Embryology of *Terebratulina*," Mem. Boston Soc. Nat. Hist. vol. ii. pp. 251–264, 1873; and "The Systematic Position of the Brachiopoda," Proc. Boston Soc. Nat. Hist. vol. xv. pp. 315–372, 1873.

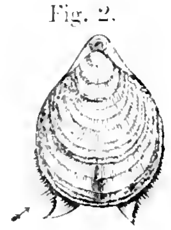
† 'Untersuchungen über die Embryologie der Brachiopoden:' Moskau, 1874.

abruptly about. The œsophagus also becomes dimly defined. In the third stage the peduncular segment is developed and projects from the posterior portion of what can now be called the thoracic segment. At this stage the embryo either remains immovable upon the bottom of the dish or slowly moves about. In two cases delicately barbed setæ to the number of thirty-five projected directly backward from the peduncular segment. The embryo is still clothed with cilia, though the long pencil of cilia has disappeared. The head is closely drawn to the thoracic segment, which becomes wider in transverse diameter, so as nearly to hide the peduncle. In the fifth stage the thoracic ring commences to fold, or turn upward upon opposite surfaces of its circumference, so as to gradually enclose the head; one fold being made slightly in advance of the other represents the larger or ventral valve. In this stage appear clusters of barbed and deciduous setæ upon the anterior margin, and in a later portion of this stage the first hardened areas of the dorsal and ventral plates make their appearance, and the cirri appear as blunted papillæ about the mouth. In the sixth stage the shell becomes rounded, the peculiar sealed structure makes its appearance, and the formation of tubules perforating the shell and of permanent setæ takes place." The author adds, further on, "that the eggs not only fill the large pallial sinuses, but hang in clusters from the genital band; from these parts they escape by dehiscence, and float freely in the perivisceral cavity . . . . . The eggs are not uniform either in shape or size." Prof. Morse then describes in detail each of the stages; but space will not allow me to proceed further with his elaborate investigations, as they would demand numerous illustrations. (See Plate V. figs. 1–31.)

Dr. Gwyn Jeffreys states, in vol. ii. p. 7 of his 'British Conchology,' that in the fry-stage the little creature can creep and swim; but, "After quitting the embryonic state, they become invariably and permanently fixed to other substances, being incapable of any other motion than making a half turn round the peduncle or pivot."

Mr. Lucas Barrett, who had an opportunity of examining *T. caput-serpentis* in life, says *:—"This species shows more of itself than any other, and protrudes its cirri further; it was met with everywhere [near the coast of Norway], in small numbers, in 30 to 150 fathoms, often attached to *Oculina*. The cirri on the reflected part of the arms are shorter than those on the first part, as shown in the woodcut. The cirri were almost constantly in motion, and often observed to convey small particles to the channel at their base. When placed in a small glass of sea-water, the valves gradually opened. Individuals remaining attached to other objects manifested a remarkable power and disposition to move on their pedicles. Detached specimens could be moved about without causing the animal to close its valves. If any of the protruded cirri were touched, the cirri were retracted and the valves closed with a snap, but soon after opened again. When the oral arms are retracted the cirri are bent up, but are gradually uncoiled and straightened when the shell is opened, before which the animal has often been observed to protrude

Fig. 2.



T. caput-serpentis, after L. Barrett.

* Ann. & Mag. Nat. Hist. 2nd ser. vol. xvi. p. 257. 1855.

a few of its cirri and move them about, as if to ascertain if any danger threatened. Only on one occasion a current was observed to set in on one side between the two rows of cirri. I had been attempting to ascertain the existence of currents, by introducing small quantities of indigo into the water surrounding the animal with a camel's-hair brush; three times the water was forcibly drawn in, and the particles of indigo were seen to glide along the groove at the base of the cirri in the direction of the mouth." See likewise a paper by Hérouard "Sur les courants de nutrition des Brachiopodes," Journ. de Conchyl. vol. xxv. p. 229, 1877.

Hancock * says:—"The pallial lobes extend forward, but do not project beyond the side of the body, where they become united, the junction being marked by a groove, bordered by a ridge on each side. They are very delicate and transparent, so that the great pallial sinuses can be distinctly traced, even to their terminal ramifications" (p. 793). "The arms of *W.* [*Waldheimia*] *cranium* and *T. caput-serpentis* are disposed in the same manner as in *W. australis*; and in the former the calcareous loop is precisely similar to that of the latter; but in *T. caput-serpentis* it is very much reduced, the extended lateral portions having almost entirely disappeared, little more than the transverse portion existing; and this, together with the crural processes, which are united below across the median line, forms a collar upon which the bases of the arms rest. In this species, therefore, the expanded lateral portions of the arms are without any apophysary support, and accordingly other means are provided for sustaining them. The two produced lobules of the dorsal pallial lobe reach to the ends of these portions of the arms as in *W. australis*; and are stiffened with numerous, imbedded, calcareous spicula, to such an extent, that when the soft tissues are removed by maceration the form of the parts remains unaltered. The spicula extend also over the surface of the inner lamina of the pallial lobe, and pervade likewise the walls of the canal, and even the cirri; so that the brachial apparatus becomes firmly fixed, and in this way a substitute is found for the usual apophysary support." (*Loc. cit.* p. 808.)

It is, however, to Oscar Schmidt, so far as I am aware, that we are indebted for the first notice of these remarkable spicula †, and in the Annals & Mag. of Nat. Hist. 2nd ser. vol. xvi. p. 439, pl. x., I gave a translation, with figures, of Schmidt's observations. The author remarks "that the mantle, oral arms, and cirri in *Terebratulina caput-serpentis* contain an innumerable number of calcareous plates, generally flattened, dilated and irregularly denticulated, situated in close vicinity to each other...... It is easily conceived [he adds] that these calcareous masses stiffen the parts which contain them, and seem particularly to serve this function in the hollow cirri, thus preventing their sides from sinking down."

We are also indebted to Prof. E. Deslongchamps for an admirable memoir 'Recherches sur l'Organisation du Manteau chez les Brachiopodes articulés' (Caen, 1864), in which

* Phil. Trans. vol. cxlviii., 1858.

† "Die neusten Untersuchungen über die Brachiopoden von Owen, Carpenter und Davidson, mit einigen Zusätzen," Zeitsch. f. gesammten Naturwissenschaften, p. 325, 1854. In 1856, Dr. S. P. Woodward exhibited, at a meeting of the Zoological Society, the spicula in the pallial lobe of *T. caput-serpentis* (Proc. Zool. Soc. p. 268, 1856).

he minutely describes and illustrates the arrangement of the spicula in *Terebratulina caput-serpentis* as well as in other genera in which they occur (see Pl. IV. figs. 10, 11). He tells us that each of the lobes of the mantle in this species has four vascular sinuses, of which the lateral ones are more developed than the median two, which last contain in their interior the organs of reproduction. The spicula cover these sinuses, and afterwards line the walls of the visceral cavity, producing two large convex surfaces, which become united and thus completely close this cavity. In the dorsal valve the mantle reflects itself on the brachial apparatus, formed here of calcareous laminæ bent in the shape of a ring, and spread themselves on the labial appendages, of which they line the interior of the great canal, as well as the cirri; the cirri, he adds, which I have also carefully examined in many specimens, are stated by Hancock to be large, much-branched, colourless, glass-like, and pellucid, somewhat like the antlers of a deer, only the branches are all on the same plane and are flattened and depressed a little; that they are, however, frequently much complicated, forming a central network with irregular radiating branches; in others, again, the branches pass from a single network centre. The spicula lie in the outer layer of the inner lamina, and are crowded to such a degree that the edges of the branches are almost in contact, thus forming an extensive though incomplete network of calcareous matter over the trunks of the great pallial sinuses; elsewhere they are sparingly distributed towards the margin of the lobes, where they are rather numerous. The brachial disk is trilobed, the central lobe elongated and spirally convoluted.

In 1771, in the 'Fundamenta Testaceologiæ' it is represented as the animal of *Terebratulina caput-serpentis* without its shell. In 1773, Pennant describes the same species, and gives a figure of its labial appendages. Grundler, again, in 1774, devotes a whole plate to enlarged figures of the same appendages, and in two of them points out the position of the loop. Since that period they have also been described and illustrated by several malacologists, and more particularly by Albany Hancock, in his classical memoir 'On the Organization of the Brachiopoda' (1858). Mr. Hancock informs us, at p. 793 of his work, that, "To facilitate the examination of the soft parts, it is necessary to reduce the valves by dissolving them in dilute acid. When the calcareous matter has entirely disappeared, and the calcified shell-membrane has been removed, the transparent tegumentary envelope of the animal is exposed to view; and this, when placed in water, assumes the form of the shell. . . . . . Towards the posterior or umbonal region the enlarged extremities of the shell-muscles are always apparent, clustered together on each side of the antero-posterior line, forming reddish-coloured patches."

The muscles naturally divide themselves into two groups, the valvular and those for adjusting the shell to the peduncle. As the arrangement of the muscles is stated by Hancock to be essentially the same in all the articulated Brachiopoda, and they have been described further on in *Waldheimia flavescens*, it will not be necessary here to refer further to those details, although it may be added that Hancock mentions an important modification as occurring in *T. caput-serpentis*, which consists in the large and powerful dorsal adjustor muscles not being attached to the hinge-plate, as in *W. flavescens*, but having their insertions in the valve itself. The posterior extremities of these muscles are seen on the surface of the animal, on each side of the median line, elongated in the antero-posterior direction, and extending between the occlusors, almost as far forward as their anterior margins. They are of irregular form, and enlarged posteriorly in *T. caput-serpentis.*

In Pl. IV. figs. 8 & 9, we give Hancock's two enlarged figures showing the dorsal and ventral views of *Terebratulina caput-serpentis* deprived of the shell, and exhibiting the respective positions of the various muscles above described.

While alluding to the digestive organs, Hancock states (*l. c.* p. 814) that "In *T. caput-serpentis* there appears to be only two hepatic ducts, and both in it and in *W.* [*Waldheimia*] *cranium* the intestine is very short, terminating in a blind sac before it reaches the ventral wall of the perivisceral chamber. It tapers gradually to a point which is rounded, and suspended in its place by the mesentery." The genitalia exhibit a somewhat different arrangement in *T. caput-serpentis* to what prevails in *W. flavescens*; "they are placed in large sinuses situated in the pallial lobes, one at each side. These sinuses are, however, nothing more than the enlarged trunks of the so-called pallial vessels or great pallial sinuses. They are four in number, two in each lobe, and the genital band, which is placed within them, forms a thick convolute layer, with small spaces between the folds."

"In *T. caput-serpentis* the heart is more decidedly pyriform than in the other species, and it is placed a little further back, the branchio-systemic vein passing for some distance down the stomach beyond the central gastro-parietal band . . . The setæ in *T. caput-serpentis* are placed rather far apart from each other, and issue from the mantle at the points corresponding to the marginal crenulations of the shell; these crenulations give to the pallial membrane a scalloped appearance. The setæ are rather robust; the marginal fold is deep, and the follicules are of considerable length and rather wide, with their bases surrounded with glandular matter, forming a roundish, red-coloured spot at the end of each seta" (*l. c.* p. 829). The blood-system of the brachial apparatus has likewise been well investigated by Hancock. He says:—"This is beautifully developed, and presents considerable variety in the character of the several plexuses of which it is composed. The walls of the great canal, the ridge supporting the cirri, the membranes that unite the upper and lower members of the loop, that which connects the spirals, and those which form the small canal or channel at the base of the cirri, as well as that forming the sheath of the apophysary support,—all have their system of lacunes which intercommunicate and compose the brachial system" (*l. c.* p. 831).

Dr. Van Bemmelen questions the lacunary system as described by Hancock. He concurs in the statement that in *T. caput-serpentis* and *T. septentrionalis* the sexes are separate *.

While treating of the perivisceral chamber, Hancock observes that in *T. caput-serpentis* the four trunks may be recognized. "Here the trunks are fused so as to form on each lobe two large, lateral, semilunar sinuses, in which the genitalia are placed. The external margins of these sinuses give off numerous, rather delicate branches, which dividing dichotomously run to the pallial margin; the branches next the middle line, which

* "On the Structure of the Shells of Brachiopods and Chitons," Ann. & Mag. Nat. Hist. 5th ser. vol. xi. p. 379.

correspond to the inner sinuses, pass off from their internal margins, and divide once or twice" (*l. c.* p. 840).

TEREBRATULINA CAPUT-SERPENTIS, var. UNGUICULATA. (Plate V. figs. 38–40.)

Terebratula unguicula, P. Carpenter, Proc. Zool. Soc. 1865, p. 201, figs. 1–4; Cooper, Geogr. Cat. California. Moll. p. 3, 1866; Dall, Amer. Journ. of Conch. vol. vi. p. 102, 1870, and Report on Brachiop. of Alaska, 1877; S. T. Whiteaves, On Some Marine Invertebrata from the West Coast of North America, Canadian Naturalist, n.s. vol. viii. p. 164, 1878.

Shell ovate, longer than wide; valves almost equally convex, rounded laterally and in front; lateral sides of the umbo strongly auricular, especially in young and middle-aged specimens. Ventral valve evenly convex, but sometimes very slightly depressed anteriorly; beak short, obliquely truncated by a rather large incomplete foramen, margined anteriorly by the umbo of the dorsal valve and by two small lateral deltidia. Surface of valves marked with numerous radiating delicate riblets, simple and stronger at their origin, but rapidly augmenting in number from bifurcation and by the interpolation of shorter riblets between the longer ones. Valves crossed with concentric raised striæ. Loop short and simple, the crura disunited in the young, annelliform in the more advanced age. Colour light yellowish white. Length 13, breadth 10, depth 5 lines.

Hab. San Diego, Cal., to the Aleutian Islands, San Pedro, Cal. (Cooper); Neeah Bay (W. T. Swan); Victoria (V. W. Lord, J. Richardson); Port Etches; Shumargin Islands; Unalaska (Dall). Range: low water to 100 fathoms, those from deep water, the largest, adhering to shells and stones (Dall). At Race Island lighthouse, and Victoria Harbour, in 30 to 70 fathoms; end of Texada Island, in 40 to 70 fathoms, mud (Richardson).

Obs. Mr. Dall states, in the paper already referred to, that this species is readily separated from *Terebratulina caput-serpentis*, *T. japonica*, and other species, which strongly resemble it externally, by the broad loop, which is usually open, instead of being closed, as the genus requires. However, it finally becomes closed in fully adult specimens, which reach the size of *T. caput-serpentis*. I have also had the advantage of being able to examine a large number of young and adult examples of Carpenter's species, which were kindly lent to me by Mr. Whiteaves, as well as others which I purchased from Mr. G. B. Sowerby, who had obtained them direct from Vancouver Island. After having minutely compared their exterior and interior with a large number of European specimens of *T. caput-serpentis*, I arrived at the conclusion that *T. unguicula* is no more than a variety of Linné's species. Carpenter's specimens, as he himself admits, were all of small size, and consequently the crura of the loop were disunited. The specimens of *T. unguicula* I was able to open had not the broad loop described by Dall, but agreed well with the European specimens of *T. caput-serpentis* which I had previously opened and examined. In these specimens of *T. unguicula*, the front line was rounded, and not indented; but this is also the case with very many examples of *T. caput-serpentis*.

In a letter dated December 1884, Mr. Dall writes me that he would not wish to be quoted as believing *T. unguicula* distinct from *T. caput-serpentis* *, and would be only

* [Dr. Davidson has given three excellent figures (see Pl. V. figs. 35, 36, & 37) of the well-marked variety of *Terebratulina caput-serpentis* from the Mediterranean Sea, to which Dr. Gwyn Jeffreys gave the varietal designation of *mediterranea*. He described it as longer and more slender than *T. caput-serpentis*, "more compressed or flatter than

willing to assert that the specimens he has seen seem distinguishable, and that as the distribution of the two forms is absolutely separate, their identity would seem to require proof.

12. Terebratulina Cailleti, Crosse. (Plate V. figs. 41, 42.)

Terebratulina Cailleti, Crosse, Journ. de Conch. vol. xiii. p. 27, pl. 1. figs. 1–3, 1865; Pourtales, Bull. Mus. Comp. Zoöl. (Harv.) vol. i. p. 109, 1867; Dall, Am. Journ. Conch. vi. p. 106, 1870, and Bull. Mus. Comp. Zoöl. (Harv.) vol. iii., 1871; Davidson, Report on the Brachiopoda, Voyage of H.M.S. Challenger,' Zool. vol. i. p. 37, pl. 2. fig. 2, 1880; Dall, Bull. Mus. Comp. Zoöl. (Harv.) vol. ix. p. 103, 1881.

Shell ovate, longer than wide, broadest about the middle, rounded or slightly indented in front; dorsal valve evenly convex, no defined mesial fold, lateral sides of the umbo auricular; ventral valve moderately convex, with a strongly marked longitudinal depression or sinus, commencing at the beak and extending to the front; front raised into a rounded wave; beak short, and obliquely truncated by a moderate-sized incomplete foramen and two small disunited deltidial plates; surface of valves marked with about forty small radiating riblets, the larger number being shorter ones interpolated at various distances between the larger ones; surface marked also with fine concentric raised lines. Loop short, crura disunited in the young, annelliform in the adult. Colour of a slightly greyish white. Length 5, breadth 4, depth 2 lines; but Mr. Dall mentions having taken specimens 1 inch in length.

Hab. *T. Cailleti* was obtained by M. de Pourtales off Chorrera, Cuba, in 270 fathoms; near Cojima in 450 fms. Off Double-headed Shot Key in 471 fms., and near Tennessee Reef in 115 fms. Off West Florida 30 fms., St. Vincent 88 fms. (Pourtales and Dall). At Guadaloupe in 200 fms., by an Italian party who were searching for beds of coral. Mr. A. Agassiz sent me a specimen dredged by the Hunter Expedition off Barbados, taken at a depth of 100 fms., and I have also two young examples dredged by L. Barrett off Jamaica, and by Sigsbee off Havanna, in from 80 to 150 fms. I am likewise indebted to Mr. R. Rathbun for several young specimens obtained in 70 fms. in lat. 21° 48′ S. and long. 40° 3′ W. of Greenwich, which had been dredged by the Captain of the English Atlantic steamer 'Norseman.' A single example was obtained by the 'Challenger' Expedition, west of Pernambuco, in 350 fathoms.

Obs. This species has been minutely described by Mr. H. Crosse and by Mr. W. Dall. Crosse says that it is easily distinguishable from *T. caput-serpentis* by its stronger radiating riblets, these last being more separated from each other than in Linné's species. When quite young, and measuring 1 line in length, it has only from nine to ten simple ribs; at 2 lines already two or three short interpolated riblets have made their appearance close to the margin; at 3 lines in length the interpolated riblets become more numerous, and the whole surface is concentrically crossed by strongly marked, slightly projecting, equidistant, concentric ridges. The ridges become very much less marked as the shell approaches and attains the adult condition; but this feature is common to several species of the subgenus.

usual, and more or less cloven in front" ("Mollusca of the 'Lightning' and 'Porcupine' Expeditions," Proc. Zool. Soc. 1878, p. 401). From a MS. note attached to the types in the Davidson Collection, it is evident that Dr. Davidson considered this to be "a good variety of *T. caput-serpentis*," but identical with the shell named *Terebratula emarginata* by Risso in 1826, "of which the *Terebratula quadrata*, Risso, is probably a synonym." The variety *mediterranea* should therefore be henceforth known as *T. caput-serpentis*, var. *emarginata*, Risso.—A. C.]

Mr. Dall, in his paper in the Bull. Mus. Comp. Zoöl. already referred to, enters into many details to show that it is a distinct species. He has since then written me that, although *T. Cailleti* may be a southern form of *T. caput-serpentis*, he has seen probably nineteen twentieths of all the existing specimens, and that it seems to him to be as well distinguishable as any of the fossil forms, and that he considers it at any rate fully entitled to a varietal name, as it is well distinguished by its granulated ribs, and varies much in form.

Dall says (*l. c.* p. 10) "That the smallest specimens of this species which I was able to find among those sent by M. de Pourtales were nearly ·1 inch in length. That the characteristic sculpture was developed upon them to the very apex of the shell. . . . . The various muscles were already well developed. The mouth was as described in the young of the *T. cubensis*. The intestine was short, cylindrical, and straight. The lower portion was embraced by a few hepatic digitations. These lobes were very dark brown, the muscles of a deep reddish brown, and the brachia of a flesh-colour. The latter were in the shape of a horseshoe, with no trace of a median lobe. They were close set and marked with transverse lines as in *T. cubensis*. The membrane which covered the viscera was covered internally with irregular hyaline spots with well-marked boundaries, which no doubt are the limits of the lacunar channels of circulation. The mantle was quite transparent, with a brownish edge, and in each of the internal channels, corresponding to the ribs of the outside of the shell, was a single bristle, composed of longitudinal fibres of chitine, without any of the transverse markings which are seen in the setæ of the adult. The extreme tip of the bristle alone protruded from the mantle, and its inner extremity was slightly bulbous. It was of a glistening yellow color throughout. In those adults which I examined there were only five or six of these setæ in each mantle lobe. These specimens were obtained off Havana, in two hundred and seventy fathoms water. The very extraordinary manner in which all the soft parts were crowded and crammed with masses of calcareous spiculæ defied my best efforts to obtain any very satisfactory results from the two or three alcoholic specimens at my command. A flocculent mass of white matter resisted the action of acid, and filled all the interstices of the membranes so as to render them quite opaque. . . . . The intestine was cylindrical, and ended much as it does in *T. caput-serpentis*. The mouth was surrounded by a dark-brown line. There were no structures above and behind the mouth, such as are described as existing in *T. cubensis*. The attached extremities of the muscles were of a very bright red-brown. . . . The peduncle is white, slender, and exceedingly long, the exposed portion sometimes equalling in length one third of the shell. A brownish tinge pervaded all the tissues of the adult. Transverse markings were noticed in the brachia, as described in other species by Hancock. One specimen, growing on a rock which had become covered with sponge, afforded an interesting observation. The peduncle was exceedingly long, and on cleaning off the sponge it was seen that the creature, on the growth of the sponge towards it, had apparently lengthened its peduncle to get out of the way; and while the original attachment still remained, ... somewhat further on, nearer the shell, a second attachment of the peduncle had taken place by the outgrowth, from the underside, of a bunch of cylindrical rootlets, exactly resembling the attachment of an ivy to a stone."

13. TEREBRATULINA SEPTENTRIONALIS, Couthouy. (Plate V. figs. 1–31 & 43–52.)

Terebratulina septentrionalis, Couthouy, Boston Journ. Nat. Hist. vol. ii. p. 65, pl. iii. fig. 18, 1838.

Terebratula septentrionalis, G. B. Sowerby, Thes. Conch. p. 342, pl. xviii. figs. 5 & 6, 1846; Stimpson, Test. Moll. New England, p. 75, 1851.

Terebratula caput-serpentis, L. Reeve, Monogr. of Terebratula, Conch. Icon. 1861.

Terebratulina septentrionalis, E. Morse (On the early Stages of), Mem. Boston Soc. Nat. Hist. vol. ii. (read Oct. 1869); Gould, Invert. Mass., Binney's 2nd ed. p. 208, fig. 500, 1870.

Terebratulina septentrionalis, Dall, Cat. of Recent Brach., Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 180; Sars, Fauna Moll. Regionis Arcticæ Norvegiæ, p. 10, tab. i. fig. 4, 1878.

Terebratulina caput-serpentis, var. *septentrionalis*, Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zoology, vol i. p. 33, pl. i. figs. 3–9, 1880.

Terebratulina caput-serpentis, W. F. Ganong, The Invertebrate Zool. of Passamaquoddy Bay, Nat. Hist. Soc. of New Brunswick, Bull. No. 4, p. 91, 1884.

Shell rather thin, longitudinally broadly ovate, pear-shaped or somewhat subpentagonal, narrow and tapering posteriorly, abruptly widening below the beak, broadest anteriorly; front line nearly straight, slightly indented or rounded; colour yellowish white, nearly diaphanous; dorsal valve gently convex, especially towards the middle, slightly depressed towards the front, eared at the umbo; ventral valve feebly convex, or slightly deeper than the dorsal one, somewhat depressed towards the front; beak short, attenuated, slightly incurved and truncated by a moderately large and incomplete semielliptical foramen, completed below by the umbo of the ventral valve, and laterally margined by small deltidial plates; surface of both valves covered with a variable number of fine rounded radiating raised striæ or riblets (240 in some specimens when counted at the margin), these increase in number at variable distances from the beaks by the interpolation of shorter riblets; shell-structure perforated by numerous small canals. In the interior of the dorsal valve the loop is short and simple, rendered annular, with age, by the union of the oral processes. The brachial appendages are united to each other by a membrane, cirrated and developed from each side of the mouth, divided into three lobes, the two lateral ones extending to a little more than two thirds of the length of the valve, the central one not exceeding half the length of the valve, and spiral at its extremities. Proportions variable. Length 15, breadth 11, depth 6 lines.

Hab. The geographical range of *T. septentrionalis* seems to be very extended. The 'Challenger' Expedition dredged it abundantly off the New-York coast at depths of 51 fathoms, also, at a depth of 83 fathoms, off Halifax. Again, according to the officers of the expedition, off the Cape of Good Hope (but I should like to have this last statement confirmed), at latitude 46° 40′ S., long. 37° 50′ E., at a depth of 150 fathoms. Mr. Couthouy, in his description of *T. septentrionalis*, says that it has been found at Lubec Bay by Dr. C. T. Jackson during his geological survey of the State of Maine, and that it is probably an inhabitant of deep water on the whole New-England coast. Dr. Gould mentions having found it in considerable numbers in the stomach of fishes, and occasionally on the sea-beach, and that its usual habitat is in the Laminarian or deep Coral zones of northern seas. At Eastport, at low water, it is common off the

Isle of Shoals, 20 fathoms; Grand Manan, common (Packard, Stimpson); Halifax harbour (Willis); Trias Cove, Passamaquoddy Bay, in 12 fathoms, where they occur clinging together in bunches, large and small together, and seem to prefer the clear fresh water on pebbly bottoms (W. F. Ganong).

Obs. The above description is the one I published in my 'Challenger' Report. Some difference of opinion has prevailed with respect to the specific claims of the species under description. Certain malacologists consider it a distinct species, others as only a simple variety of *T. caput-serpentis*. Gould, in 1838, believed it to be distinct; but in the 'Report on the Invertebrates of Massachusetts' (2nd ed. by W. H. Binney, 1870) we find stated at p. 208:—"An examination of the descriptions of *T. caput-serpentis* given by Linnæus, Müller, and Chemnitz, and a comparison of them with our shell, has well satisfied me of their correspondence. The downy epidermis is a character too rare and singular to be overlooked. This, however, is rubbed off very easily. The shell is much thinner, in general more elongated, and the striæ nearly twice as numerous, being about thirty to forty in the European, and fifty to sixty in the American specimens. No account of the internal bony processes is given in any description except that of Mr. Couthouy. These would afford the best possible specific character, were it not that they are usually more or less broken. But I have been relieved from all further speculation by the receipt of specimens from Dr. Lovén, which settle the identity of our species with the European *caput-serpentis*." Mr. W. H. Binney seems to be of a different opinion, for he adds, after Gould's observations just recorded:—"I have retained the above remarks from the former edition, because our shell is so generally still regarded as identical with the European species. But further examination of numerous specimens has led me to coincide with Dr. Stimpson, who has dredged extensively, both in the British and American seas, in his opinion that the species differs from the European *caput-serpentis*, sufficiently in both shell and animal."

G. B. Sowerby, on p. 344 of his 'Thesaurus Conchyliorum' (1846), observes that *T. septentrionalis* is distinguished from *T. caput-serpentis* by its much finer radiating striæ, its larger and less oblique foramen, and by its rather more extended and somewhat differently formed internal appendage.

Since publishing my description of this shell in the reports of the 'Challenger' Expedition, I feel more disposed to leave *T. septentrionalis* and *T. caput-serpentis* as separate species, the first being evidently more regularly oval and rounded in front than in Linné's species; and even in the young stage the riblets are more numerous than in *T. caput-serpentis*. I have been able to examine specimens from less than 1 line in length up to that of 1 inch and 3 lines. Up to about 3 lines, and sometimes even more, the ribs are very few in number, prominent and radiate from the extremity of the beak to the margin, and are crossed by strongly indented concentric lines, which give to the riblets the so-termed tuberculated appearance that has been so often described in the species of this subgenus. As the shell grows the ribs become more delicate and more numerous from repeated interpolations of shorter ribs, and the concentric ones become more and more faintly marked.

It is, however, to Prof. E. Morse that science is most indebted for the knowledge we at present possess of the embryology, or early stages, of *Terebratulina septentrionalis* *. This distinguished zoologist having dredged in 15 fathoms of water in the harbour of Eastport, Maine, in 1869, individuals of all ages, has minutely and elaborately described all the stages of its development, which he illustrates in the most complete and admirable manner. The details and illustrations he communicates are so numerous that we feel ourselves obliged to refer the reader to the author's memoir, and to limit ourselves to the reproduction of the following selected observations and illustrations; he says:—"The species occur in great numbers, at various depths, and have also been collected at low-tide mark, by Dr. Stimpson and Prof. Verrill. The specimens were found attached to stones brought up in the dredge, and also adhering to the lower valve of adult individuals, generally near the peduncle †. . . . . The eggs were generally kidney-shaped, though very irregular as to form and size [see Plate V. figs. 1–4]; they were spermaceti-white in color, and opaque, though having a central area, translucent, and apparently depressed. . . . . This form recalled the general proportions of *Argiope* and *Megerlia*, in being transversely oval, in having the hinge margin wide and straight, and in the presence of a proportionately wide foramen. This stage was exceedingly minute, ... the shell showed nothing of the scale-like structure so characteristic in later stages. Between this stage and the next, the shell rapidly elongates, while the hinge margin remains nearly the same in width; this is also shown in the concentric lines of growth seen faintly on the surface, indicating a rapid increase in the length of the shell, while no corresponding increase takes place in the widening of the hinge margin. The peduncle is longer than the shell, having distinct walls apparently enclosing a clear interspace, the end slightly dilating and forming a pear-shaped adhering disk. The structure of the shell . . . . showed clearly the scale-like structure, with the cæcal tubules of the pallial lobes perforating it. The anterior margin of the pallial lobes gave rise to seven setæ of variable lengths, all of them projecting forward [Plate V. fig. 21]. . . . The future position of the calcareous loop was indicated by a strongly arched process midway the length of the shell, from which sprang six short and stout cirri, all of them curving towards the mouth, which occupied the centre of the base from which the cirri sprang. The digestive sac hung from the mouth, and was twice as long as broad, having a strong constriction in the centre, forming two chambers, the lowermost one being globular in shape, and having its walls colored a light reddish-brown, this colored portion evidently indicating hepatic cells. The cavity next the mouth indicates the stomach, whilst the lowermost cavity indicates the future intestine or cul-de-sac. The cirri moved frequently, and in various directions, though generally performing a grasping motion, as if securing some bit of food. . . . . In this stage, and several succeeding stages, the outline of the shell is remarkably like that of *Lingula*, and this resemblance is more striking from the proportionally long peduncle. [Plate V. fig. 31.]

"In another stage, the numerous irregular shaped calcareous spiculæ lined the outer

* "On the Early Stages of *Terebratulina septentrionalis*," Memoirs of the Boston Society of Natural History, vol. ii. p. 29, 1871; and "Embryology of *Terebratulina*," ibid. p. 249.

† On an adult specimen of *T. septentrionalis*, dredged by the 'Challenger' expedition, I counted no less than twenty-eight young shells of the species attached to the surface of both valves, and more especially to its peduncle.—T. D.

margin of the cirri, while the future position of the calcareous loop, or crura, was indicated by a row of irregular-shaped spiculæ. . . . In these slightly advanced stages, the peduncle becomes much shorter in proportion to the length of the shell. . . . . In all these stages the peduncle has very slight adhesion to the rock or whatever substance it may be attached to, in this respect differing greatly from the adult, which often requires at this age great force to detach it. . . . . I was fortunate in observing an individual [slightly larger] in motion. The animal whirled quickly on its peduncle; when at rest the shells were always closed, and rested on the rock; from this position it turned slowly more than half way round, raising the body at the same time almost erect; this movement being completed, the valves would very slowly open, and the cirri expand as if to perform a grasping motion; in no case, however, were they projected beyond the margin of the valves. The cilia lining the cirri produced gentle currents in the water. In this position, with the valves widely open and the cirri expanded, the animal would remain motionless for twenty or thirty seconds, and then, with an abrupt closing of the valves, suddenly assume its first position. . . . . In watching these motions for a long time, one could not help being impressed with the fact that great caution was evidently indicated in the slow and careful movements made in elevating and opening the shell, while the prompt closing of the valves, and the alert manner in which the animal regained its first position, seemed to show that food had been secured, and further caution was unnecessary."

Prof. Morse then goes on to describe how in successive stages a fold on each side of the stomach was first noticed, these folds being the first appearance of the liver, then the upper portion of the digestive sac and that portion which answers to the œsophagus and stomach in the contracted state, while the lower portion is widely expanded. In a still more advanced stage, he says:—"The shell is now becoming proportionally broader and the cirri increase in number, though still forming a simple circle around the mouth. The crura have also begun to form. At a considerably more advanced stage "The cirri are more numerous, numbering thirty-one: two of them are seen encroaching upon the circular lophophore, and at this stage the lophophore has begun to assume its hippocrepian character.

"The crura are plainly seen supporting the crown of cirri, and the liver already shows the first indications of its differentiations under the peculiar cæcal ramifications which become so numerous in the adult. . . . . The divaricators are completely formed, and between these two muscles is seen the lengthened intestine, the blind extremity of which is held firmly to the shell by a membrane, called by Hancock the ventral mesentery." At this stage "Radiating ribs, to the number of fifteen, ornament the shell."

Successive stages are then described. At p. 35 of his admirable memoir, Prof. Morse enters into long details in connexion with the structure of the shell; he says:—"In the youngest stages of the shell the scale-like structure may be studied to the best advantage. The scales are few in number, but slightly overlapping, and form a layer quite distinct from the outer layer, which appears to be homogeneous, save the concentric lines of growth appearing like rows of oblong and flattened nodules. The terminal portions of the pallial cæca within or upon this outer layer, are brown in colour and distinctly granulated. . . . the tubules radiate from the largest diameter of the cæca, and not from the periphery of the granulated disk, and this is in accordance with the admirable observations made by King *. The scales do not appear to encroach upon the walls of the cæca."

Then follow many very important details on the growth of the shell, as well as the gradual development of the crura and loop. The crura of the calcareous loop, although not connected by a calcareous shelly layer in the young animal at all stages, have portions nevertheless connected by a membrane charged with spicula. The peduncular opening also, with age, becomes more circular, while the cardinal process, which does not appear in the earlier stages, is latterly present.

In Prof. Morse's memoir in question a vast number of important details are given, to which we have only briefly alluded.

I have myself examined specimens at all stages of growth, brought home by the 'Challenger' Expedition, and I am able to confirm Prof. Morse's accurate observations. When half a line in length the dorsal valve is elongate semicircular, the hinge-line straight, and nearly as long as the breadth of the shell, only eight or nine rounded ribs ornamenting the surface of each of its valves; by degrees the hinge-line becomes shorter and obtusely angular, and the ribs that ornament the surface of the valves become more numerous.

14. TEREBRATULINA WYVILLII, Davidson. (Plate III. figs. 1–3.)

Terebratulina Wyvilli, Davidson, Proc. Roy. Soc. vol. xxvii. p. 436, 1878, and (*T. wyvilii*) Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zoology, vol. i. p. 32, pl. i. figs. 1–2, 1880.

Shell large, trigonal, longer than wide, broadest anteriorly, light yellowish; dorsal valve triangular, anterior angles rounded; hinge-line obtusely angular, moderately convex, somewhat flattened along the middle, and abruptly bent inwards close to the margin; lateral sides of the umbo auricular; ventral valve convex, deeper than the opposite one, flattened anteriorly, abruptly bent inwards close to the margin; beak incurved, truncated by a large oval-shaped foramen, separated from the hinge-line by a triangular concave depression sharply defined laterally; surface of shell nearly smooth to the naked eye, but marked by very fine radiating raised lines; perforations rather large. In the interior of the dorsal valve the loop is short and simple, rendered annular by the union of the oral processes. Length $2\frac{1}{2}$ inches, breadth 2 inches, depth 1 inch 4 lines.

Hab. A single specimen of this fine species was dredged on the 25th of March, 1873, by the 'Challenger' Expedition off Culebra Island, to the north-west of St. Thomas, in the West Indies, depth 390 fathoms. It was also obtained in some abundance by the French expeditions of the 'Travailleur' and 'Talisman' in 1882 and 1883, near the western coast of Africa. It is alluded to by Prof. A. Milne-Edwards in the 'Comptes Rendus de l'Académie des Sciences,' tom. xciii. Nov. 1881, and has also, according to Dr. P. Fischer, been dredged off the coast of Spain.

* "On the Histology of the Test of the Class Palliobranchiata," Trans. Royal Irish Academy, vol. xxiv.

Obs. This is the largest species of *Terebratulina* with which I am acquainted, either in the recent or fossil condition.

15. TEREBRATULINA CROSSII, Davidson. (Plate III. figs. 4–6.)

Terebratulina Crossei, Davidson, Journal de Conchyliologie, vol. xxx. p. 106, pl. vii. fig. 1, 1882.

Shell large, elongated oval, longer than wide; valves almost equally convex, mesial fold and sinus scarcely indicated; dorsal valve feebly auriculated; beak of ventral valve slightly incurved, obliquely truncated by a rather large foramen, margined in part by the umbo and by two small lateral deltidial plates; surface of valves covered with numerous fine radiating striæ, at times almost obsolete, and crossed by concentric lines of growth. Colour light yellowish or light salmon. Loop short, not quite a third or fourth of the length of the valve. Length 2 inches 1 line, width 1 inch 8 lines, depth 1 inch.

Hab. This magnificent species occurs in Sagami Bay, Japan, where it was dredged by Dr. L. Döderlein. The locality is situated in the neighbourhood of station No. 232 of the 'Challenger' Expedition, only a little nearer the coast, and in about 100 to 250 fathoms. Dr. Döderlein, who kindly lent me the fine series of Brachiopoda procured by himself in that locality, tells me that the sea-bottom is covered with mud, stones, and fragments of volcanic origin, with abundant animal life of astonishing variety, and that there is no better locality for dredging-purposes in Japanese waters.

Obs. I became first acquainted with this fine species in 1882, M. H. Crosse having kindly forwarded a specimen he had received from Japan, which I subsequently described and figured in his valuable 'Journal de Conchyliologie.' Soon after I was able to purchase from Mr. G. B. Sowerby another good specimen of the same shell, and subsequently two other fine examples were lent to me by Dr. Döderlein. I have given figures of three of the specimens. It does not appear to be a very rare species in the locality where it is found.

I may also mention that no single locality has hitherto afforded a larger or more varied assemblage of specific forms of Brachiopoda than the waters that surround the Japanese islands, Corea, and the neighbouring coast of China. I have been able from those seas to examine and describe the following species:—

1. *Terebratula* or *Terebratulina Dalli*, Davidson.
2. —— *Davidsoni*, Adams.
3. *Terebratulina Crossii*, Davidson.
4. —— *caput-serpentis*, Linné.
5. —— *japonica*, G. B. Sowerby.
6. —— *Cumingi*, Davidson.
7. —— *radiata*, Reeve.
8. *Waldheimia Raphaelis*, Dall.
9. —— *Grayi*, Davidson.
10. *Terebratella spitzbergensis*, Davidson.
11. —— *Blanfordi*, Dunker.
12. —— *coreanica*, Reeve.
13. —— *Mariæ*, Adams.
14. *Terebratella frontalis*, Middendorff.
15. *Magasella Adamsi*, Davidson.
16. —— *Gouldi*, Dall.
17. *Megerlia* or *Ismenia sanguinea*, Chemnitz.
18. —— *Reevei*, Davidson.
19. —— *pulchella*, G. B. Sowerby.
20. *Laqueus picta*, Chemnitz.
21. —— *rubella*, G. B. Sowerby.
22. *Platydia anomioides*, Scacchi.
23. *Rhynchonella psittacea*, var. *Woodwardi*, Adams.
24. —— *lucida*, Gould.
25. —— *Döderleini*, Davidson (a species covered with spines).

26. *Crania japonica*, Adams.
27. *Discinisca stella*, Gould.
28. *Lingula anatina*, Lamarck.
29. —— *Adamsi*, Dall.
30. *Lingula jaspidea*, Adams.
31. —— *smaragdina*, Adams.
32. —— *lepidula*, Adams.

16. TEREBRATULINA JAPONICA, Sowerby, sp. (Plate III. figs. 7–11.)

Terebratula japonica, Sowerby, Proc. Zool. Soc. 1846, p. 91; Thes. Conch. vol. i. p. 344, pl. lxviii. figs. 7–8, 1846; Adams & Reeve, Voyage of the 'Samarang,' Mollusca, p. 71, pl. xxi. fig. 1, 1848.

Terebratula angusta, Adams & Reeve, Voyage of the 'Samarang,' Mollusca, p. 71, pl. xxi. fig. 2, 1848.

Terebratulina japonica, L. Reeve, Conch. Icon., Monogr. of *Terebratula*, pl. iv. fig. 16, 1860; A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 98, 1863.

Terebratulina caput-serpentis, var. *japonica*, Davidson, Proc. Zool. Soc. 1871, p. 303, pl. xxx. fig. 8.

Terebratulina japonica, Dall, Cat. of the Recent Species of the Class Brach., Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 180.

Terebratulina caput-serpentis, var. *japonica*, G. Dunker, Index Moll. maris Japonici, p. 251, 1882.

Shell oblong, ovate, almond-shaped, widest about the middle, rounded in front, valves nearly equally and uniformly convex, no defined fold or sinus; beak slightly incurved and obliquely truncated by an incomplete circular foramen; deltidial plates rudimentary. Auricles in dorsal valve very small, marginal line nearly straight, inclining to the sides near the hinge. Surface of valves longitudinally striated, striæ numerous and radiating, augmenting in number at intervals through the bifurcation of some of the ribs and by the interpolation of shorter ones of variable thickness. Valves crossed by concentric lines of growth. Colour light salmon or nearly white. In the interior of the dorsal valve the loop is small and ring-shaped. Length 1 inch 4 lines, breadth 1 inch, depth 7 lines.

Hab. Gotto, 48 fathoms; Tsusalei, 55 fathoms (Adams); Sagami Bay, Japan (Döderlein).

Obs. This species is remarkable on account of its spindle-like shape; it is nearest related to *T. Crossii*, and easily distinguished from the other recent species of the genus. Lovell Reeve says, in his Monograph of *Terebratula*, that " *T. japonica* is very closely allied to *T. caput-serpentis* and is without doubt its representative in the Corean and Japanese waters." I must, however, differ from Mr. Reeve in this matter, although in 1871 I expressed a similar opinion. Dr. Döderlein, it is true, dredged in Sagami Bay a specimen which I could not distinguish from Linné's *T. caput-serpentis*, but it differs in many respects from *T. japonica*, which occurs in the same locality. I am, however, quite prepared to concur with Mr. Reeve's statement that *T. angusta*, Adams & Reeve, is only a smaller form of *T. japonica*. Dall places *T. abyssicola*, Reeve, *T. angusta*, Reeve, and *T. Cumingi*, Davidson, among his synonyms of *T. japonica*. Reeve's figures of *T. abyssicola* would hardly lead me to consider it a synonym of the above-named species, and a similar doubt may be entertained with respect to *T. Cumingi*.

17. TEREBRATULINA RADIATA, Reeve. (Plate VI. figs. 9–14.)

Terebratula (*Terebratulina*) *radiata*, L. Reeve, Conch. Icon. pl. iii. figs. 7 *a–b*, 1860, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 173, 1861.

Terebratulina radiata, Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 180, 1873.

Shell subpentagonal or ovate, longer than wide, indented in front, flexuously waved towards the margin. Dorsal valve convex, anterior half biplicated, a median concave depression commencing at about half the length of the valve, separating the two rounded ribs. Ventral valve convex, somewhat flattened along the middle and divided on the anterior half by a median rounded rib, with concave groove on either side. Beak short, obliquely truncated by a rather large foramen, completed by a part of the umbo of the opposite valve and by two small lateral deltidial plates. Surface of valves densely covered with very fine radiating striæ of unequal width, and increasing in number through bifurcation and the interpolation of shorter riblets. Colour dirty white, sometimes rayed with broad pencils of black. Loop short and simple, incomplete when young, but with age becoming annular through the union of the crural processes. Length 11 lines, by 9 in breadth and 6 in depth.

Hab. L. Reeve says "Mr. Cuming possesses two or three specimens, all exactly alike, procured, he fancies, from the dredgings of Sir E. Belcher in the Strait of Corea." I have seen and possess a number of specimens of this shell, which Mr. Sowerby assures me were obtained near the Cape of Good Hope, its probable habitat.

Obs. Mr. Lovell Reeve considers this to be a good and well-marked species, and in this statement I feel disposed to concur. I have seen a great many specimens of the shell, some as wide as long, others longer than wide, and all presenting a more or less well-marked biplication. In some exceptional examples there existed also an additional rib on the lateral portions of the dorsal valve. *T. radiata* is remarkable, as observed by Mr. Reeve, on account of being very often sparingly rayed with black. It is a smaller shell than *T. cancellata*, its nearest ally. In some specimens the foramen becomes complete by the union of the deltidial plates, but this appears to be the exception and not the rule.

18. TEREBRATULINA CANCELLATA, Koch, sp. (Plate VI. figs. 1–8.)

Terebratula cancellata, Koch, in Küster, Conch.-Cab. vol. vii. p. 35, pl. 2*b*. figs. 11–13, 1843.
Terebratula, species quædam ignota, Menke, Moll. Nov. Holland. specim. p. 35, no. 192.
Terebratula cancellata, Sowerby, Thes. Conchyl. p. 358, pl. lxxi. figs. 93–95, 1846.
Terebratula (*Terebratulina*) *cancellata*, Reeve, Conch. Icon. pl. iv. fig. 13, 1860.
Terebratulina cancellata, Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 179, 1873; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 37, pl. i. figs. 11–16, 1880.

Shell rather large, elongated oval, livid brown or light yellowish with darker concentric bands, widest about the middle, nearly straight in front. Dorsal valve very convex, flattened longitudinally along the middle, from which the lateral portions slope away at a strong angle. Ventral valve convex, rather less deep than the opposite one and sometimes flattened towards the front; beak incurved, tapering, moderately produced and truncated by a rather large foramen, which is very slightly separated from the hinge-line by a very narrow deltidium, the beak often slightly overlying the umbo of the dorsal valve. Surface of both valves ornamented with a great number of delicate raised striæ or riblets, increasing in number at various distances from the beaks by the interpolations of shorter riblets. The surface is also crossed at intervals by fine concentric lines of growth. In the interior of the dorsal valve the loop is simple and short, and rendered annular in the adult by the union of the crural processes. Shell-structure perforated by canals. Brachial appendages united by a membrane and divided into three lobes, the central shorter one spirally coiled. Length 1 inch 7 lines, breadth 1 inch, depth 10 lines.

Hab. Küster informs us that his types were derived from Western Australia. His figures are not good, and he colours them dark brown; some specimens, it is true, are of livid brown, but those brought back by the 'Challenger' Expedition were of a yellowish colour. It was dredged abundantly by the 'Challenger' Expedition in 1874 off Moncœur Island, Bass's Strait, in a depth of 35 to 40 fathoms, sea-bottom mud; many of the specimens being attached by their peduncle to *Pecten*, *Cardium*, *Arca*, spines of *Cidaris*, stones, &c. A dwarfed form was also dredged for the first time by Mr. John Brazier of Sydney, at Old Man's Hat Point, Inner North Head, off Port Jackson, N.S.W., near the rocks, in 7 fathoms, bottom of dead broken shells with coarse sand and stones; also at Sow and Pigs Reef, eastern side, Port Jackson, near the rocks, in 3 fathoms bottom. One example was found adhering to a valve of *Trigonia Lamarckii*, Gray, and is the only specimen Mr. Brazier ever found on *Trigonia*.

Obs. When young *T. cancellata* is often longitudinally spindle-shaped and oval, but with age shows more of a straight front. Some of the 'Challenger' specimens have also much exceeded in size those figured by Küster, G. B. Sowerby, and L. Reeve. There exists likewise in some exceptional specimens a median depression on the anterior portion of the dorsal valve, commencing at about the middle of the shell and extending to the front.

19. TEREBRATULINA (AGULHASIA) DAVIDSONI, King. (Plate VII. figs. 1–5.)

Agulhasia Davidsoni, King, Annals & Mag. of Nat. Hist. 4th ser. vol. vii. p. 111, pl. xi. figs. 1–7, 1871.
Terebratulina Davidsoni, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 180.

Shell very small, elongated triangular, much longer than wide. Dorsal valve about as wide as long, broadest and slightly rounded anteriorly, more tapering posteriorly, uniformly and moderately convex without fold, lateral sides of umbo gently auriculated. Ventral valve pyramidal, rather deeper or more convex than the dorsal one and with a slight mesial depression near the front, beak solid, nearly one third of the length of the valve, tapering to a small incurved point, area in form of an acute isosceles triangle; deltidium long and narrow, closed except at the cardinal termination by the internal plate, foramen incomplete and notch-shaped, lying close to the umbo of the opposite valve. Surface of valves radiately striated with about twenty small ribs, of which about half the number are shorter ones interpolated between the longer ribs. Loop in dorsal valve short and simple, furnished with long crural spurs. Colour white. Length 3 lines, by 2 in breadth and 1 in depth.

Hab. Agulhas bank, South Africa, and obtained from a depth of 45 to 60 fathoms.

Obs. In 1870 several specimens of this elegant lyre-shaped shell were placed in my hands by Mr. G. B. Sowerby, and having sent them to my distinguished friend Prof. W. King, he kindly offered to publish a description of the shell under the name of *Agulhasia Davidsoni*. Although possessing characters bearing relation to *Terebratulina*, Prof. King arrived at the opinion that it could be generically distinguished. The chief differences are to be found in the shape and character of the beak. "The long narrow form of the deltidium," writes Prof. King, "causes the area to appear as if divided longitudinally by a linear groove; which part is at once striking and unique. The foramen, which appears like a notch in the centre of the cardinal edge of the large valve, is made entire by the juxtaposition of the cardinal edge of the small valve. The area is well defined laterally by each of the sutures which separate it from the inflexed sides of the beak. The loop agrees very closely in form and relative size with that of *Terebratula vitrea*; perhaps its crural spurs are more produced. The tubuli appear to run in rows, and to be most numerous in the ribs, from which they branch off laterally towards the furrows." Mr. Dall believes the specimens described by Prof. King to be the young of some species of *Terebratulina*, but the specimens I have in my possession would lead me to consider them the adult condition of a very remarkable small species.

Uncertain Species.

20. TEREBRATULINA CUMINGI, Davidson. (Plate V. fig. 53.)

Terebratulina Cumingii, Davidson, Proc. Zool. Soc. 1852, p. 79, pl. xiv. figs. 17–19; Reeve, Conch. Icon., Monogr. of Terebratula, pl. iv. fig. 12, 1860.

Shell small, squarely ovate, somewhat pentagonal, nearly as wide as long; valves almost equally convex; beak small, obliquely truncated by a large incomplete foramen, deltidial plates disunited, a small portion of the aperture completed by the umbo; auricular expansions on either side of the umbo, very small; valves rather gibbously convex. Surface ornamented by a great number of minute radiating striæ, augmenting rapidly by the interpolation of smaller riblets at variable distances from the beaks; front margin in ventral valve forming a convex curve, and slightly depressed near the front. Loop small, annelliform. Colour opaque white. Length $3\frac{1}{2}$, width 3, depth 2 lines.

Hab. Chinese Seas.

Obs. Mr. L. Reeve says that this is "An extremely characteristic well-defined species. The radiating ridges do not all diverge together from the beak; a new ridge commences between each former ridge as the space enlarges to receive it." *T. Cumingi* seems to be distinguished from other species of the subgenus by its size and relative width and length, being much more convex and globular. In 1871 (Proc. Zool. Soc.) I thought that *T. Cumingi* might perhaps be a variety of *T. caput-serpentis*, but am now not of that opinion, for having seen a number of specimens of the little Chinese shell, I found them all to be possessed of the same shape and character.

In his "Catalogue of the Recent Species of the Class Brachiopoda' (Proc. Acad. Nat. Sci. Philadelphia, 1873), Mr. Dall places *T. Cumingi* among his synonyms of *T. japonica*, but I cannot agree with him in this particular.

21. TEREBRATULINA ABYSSICOLA, Adams & Reeve, sp. (Plate V. fig. 54.)

Terebratula abyssicola, Adams & Reeve, Moll. Voyage of the 'Samarang,' p. 72, pl. xxi. fig. 5, 1850; L. Reeve, Conch. Icon. pl. iv. fig. 14, 1860.

"Shell triangularly pear-shaped, orange flesh-colour, radiately obsoletely ridged, ridges distant, with numerous bifurcated striæ coming between them, beak obtusely produced, foramen rather large, incomplete, deltidium obsolete; loop short" (Reeve). Length 5, breadth $4\frac{1}{2}$, depth $2\frac{1}{2}$ lines.

Hab. Cape of Good Hope (dredged at a depth of 120 fathoms by Sir E. Belcher).

Obs. I have seen three examples only of this species (?), one of which was attached to a specimen of *Kraussina rubra*. In the type figured by Reeve there is evidence of a longitudinal depression along the middle of the dorsal valve, and in an authenticated example in my possession the riblets seem somewhat fasciculated.

Dall, at page 180 of his "Catalogue of the Recent Species of the Class Brachiopoda" (Proc. Acad. Nat. Sci. Philadelphia, 1873), places *T. abyssicola* among his synonyms of *T. japonica*; but I fear I cannot concur with my friend in this identification. The Cape-of-Good-Hope form is evidently more nearly related to *T. caput-serpentis* than to *T. japonica*. More specimens will have to be examined before a positive conclusion can be arrived at with respect to its specific claims.

22. TEREBRATULINA ? INCERTA, Davidson. (Plate VI. figs. 23–25.)

Megerlia (?) *incerta*, Davidson, Proc. Royal Soc. vol. xxvii. p. 438, 1878; and Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zoology, vol. i. p. 19, 1880.

Shell small, nearly circular, somewhat broader than long, widest towards the middle. Hinge-line long, nearly straight or very obtusely angular, rather exceeding two thirds of the breadth of the shell, with obtuse cardinal angles. Dorsal valve somewhat semicircular, very slightly convex, most so at the umbo, lateral sides of the umbo auricular, no fold or sinus. Ventral valve a little deeper or more convex than the opposite one, slightly longitudinally depressed along the middle; beak short and truncated by an incomplete circular foramen margined by the umbo of the dorsal valve and by two lateral deltidial plates; beak-margins sharply defined, leaving between them and the hinge-line a narrow area. Surface of both valves marked by numerous fine rounded radiating riblets with concave interspaces, some of the ribs bifurcating near the front, other shorter ones intervening between the longer ones at variable distances from the beaks. Valves crossed by numerous irregular concentric lines of growth. Shell perforated by minute canals. Colour yellowish white. In the interior of the dorsal valve the cardinal process is long and narrow; the loop short and simple. Length 5, breadth $5\frac{1}{2}$, depth $2\frac{1}{4}$ lines.

Hab. One young example attached to *Limopsis aurita* (?), Brocchi, and two or three more were dredged by the 'Challenger' Expedition between Sierra Leone (Africa) and Fernando de Noronha (South Atlantic) in 1850 fathoms, associated with *Discinisca atlantica*.

Obs. In 1880, when describing this shell for my 'Challenger' Report, I felt very uncertain with respect to the genus to which it should be referred, especially as I was unacquainted with the shape and character of its loop, and did not like to run the risk of opening the shell and separating its valves. Since then a number of specimens having been obtained during the 'Blake' Expedition, Mr. Dall was able to examine the loop, which he found to be simple and short, as in *Terebratula* or *Terebratulina*; the lateral portions of the umbo are decidedly auricular, and the character of the radiating riblets would, he thinks, warrant us in classing the shell in the last-named subgenus. It appears to be a good species.

23. TEREBRATULINA MURRAYI, Davidson. (Plate VI. figs. 15–17.)

Terebratula Murrayi, Davidson, Proc. Roy. Soc. vol. xxvii. p. 437, 1878; and (*Terebratulina murrayi*) Report of the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zoology, vol. i. p. 39, pl. i., 1880.

Shell small, obscurely trigonal, about as broad as long, widest anteriorly, tapering posteriorly, white; surface of valves marked with about seventeen rounded ribs, of which, in some specimens, a few are due to the interpolation of smaller and shorter ribs between the longer ones, the whole surface crossed also by fine concentric lines of growth. Hinge-line obtusely angular. Ventral valve a little deeper than the dorsal one, beak very slightly incurved, foramen rather large and incomplete, margined laterally by small deltidial plates. In the interior of the dorsal valve the loop is simple. Length 2, breadth 2 lines.

Hab. Dredged by the 'Challenger' Expedition in 1874, lat. 38° 35′ S., long. 177° 50′ W., near Kermadoc Island, south of Fiji Islands, in a depth of 600 fathoms.

Obs. Some eleven examples of this small shell were dredged by the 'Challenger' Expedition, and none exceeded the dimensions above given. It varied a good deal with respect to the character of its ribs; in some they were all simple, while in others smaller and shorter ribs were interpolated here and there between the longer ones. The crura likewise in some examples in the younger individuals were disunited. In 1879 I sent a specimen to Mr. Dall for examination, and he wrote me, saying that "by devoting about half an hour to this little shell, I have cleared away all the animal matter, leaving the loop perfect. You will see at once that it is a young *Terebratulina*. I suspected this before I could see the loop, from the character of the punctuations, which, you will recollect, is peculiar to the group." I had also previously ascertained that the loop is simple, and that the mantle rises from the bottom of the shell near the loop and adheres to its sides, as was so well illustrated by E. Deslongchamps in *Terebratulina caput-serpentis*.

24. TEREBRATULINA TUBERATA, Jeffreys, sp. (Plate VI. figs. 18–20.)

Terebratula tuberata, Jeffreys, Mollusca of the 'Lightning' and 'Porcupine' Expeditions, 1868–70, Proc. Zool. Soc. 1878, p. 401, pl. xxii. fig. 2.

Shell somewhat triangular, broadest and rounded anteriorly, tapering posteriorly, longer than wide. Dorsal valve semicircular; hinge-line nearly straight, shorter than the width of the shell; valve moderately convex and somewhat compressed, lateral sides of umbo auricular. Ventral valve rather deeper than the dorsal one; beak pointed, very little incurved; area triangular; foramen oval-shaped and incomplete, margined anteriorly by the umbo of the ventral valve, laterally by small deltidial plates. Surface of valves traversed by about twenty radiating ribs, of which some are shorter and interpolated between the longer ones. Valves crossed likewise by numerous equidistant concentric raised lines, sometimes slightly projecting and prickly in the young. In the dorsal valve the crural processes are separated in the young, arched in the adult. Colour dirty white. Length 4, breadth 3, depth 2 lines.

Obs. This small shell was discovered by Dr. J. Gwyn Jeffreys, who described it as a small or young specimen of *Terebratula*, which he had obtained during the 'Porcupine' Expedition in 1870, at a depth of 795 fathoms; and he adds that Prof. Lovén had lent him a perfect example from the Josephine Bank off the Straits of Gibraltar, dredged in 340 to 430 fathoms. Since then several larger and more adult examples were also obtained by the French dredging expeditions in 1882 and 1883, off the western coast of Africa, at a depth of about 4787 metres, and off Morocco and Sahara ('Talisman' Expedition), in 300 to 1261 fathoms.

25. TEREBRATULINA TRIGONA, Jeffreys, sp. (Plate VI. figs. 21, 22.)

Terebratula trigona, Jeffreys, Mollusca of the 'Lightning' and 'Porcupine' Expeditions, 1868–70, Proc. Zool. Soc. 1878, p. 402, pl. xxii. fig. 3.

Shell small, ovate, broadly rounded anteriorly, tapering posteriorly, moderately convex, semitransparent between the ribs and glossy; beak short, foramen rather large, incomplete, lateral deltidial plates small; hinge-line obtusely angular. Surface of the valves marked by about eleven simple rounded ribs, of which the three central ones are the largest. Cæcal tubuli numerous. Margins gently curved and scalloped in front. Surface of valves marked with numerous equidistant raised lines. Loop short, simple, and semicircular. Colour clear white. Length scarcely 2 lines, breadth $1\frac{1}{2}$.

Obs. We know so very little about this so-called species that its specific claims cannot be substantiated. I have only seen a single living specimen, that dredged by Mr. Saville Kent in Marshall Hall's yacht 'Norna' off the coast of Portugal, in about 500 fathoms. Dr. J. Gwyn Jeffreys, who described the shell in 1878, says:—"It may perhaps be immature; but I cannot identify it with the young of any other species." In this I feel disposed to agree with Mr. Jeffreys, as I examined the specimen with great attention while drawing the figures for his paper.

Genus WALDHEIMIA, King, 1850*.

This excellent genus was founded in 1850 by Prof. W. King for those *Terebratulæ* in which the dorsal valve was provided with a long deeply reflected loop, having its crura attached to the hinge-plate, as is seen in the recent type *Terebratula flavescens*, Lamarck. In the same year Prof. King proposed a genus *Macandrevia* for a shell with a similar loop, in which the umbonal cavity of the ventral valve is furnished with two dental plates, passing somewhat perpendicularly from the dental prominences to the surface of the valve, the umbonal cavity in the dorsal valve being also furnished with

* In 1846, four years prior to the publication of King's name *Waldheimia* for a Brachiopod, the same name had been given by Brullé to an insect; and both Prof. J. Hall and E. Deslongchamps question whether it can consequently be retained for a Brachiopod

similarly directed plates, and for this genus he selected the recent *Terebratula cranium*, Müller, as his type.

In 1880 M. Douvillé proposed a genus *Neothyris* for another recent species with a similar long loop, of which the *Terebratula lenticularis*, Deshayes, would constitute the type.

I cannot, however, but consider these so-termed genera to be very nearly connected and as mere modifications of *Waldheimia*, and not sufficiently important to warrant their separation into distinct genera.

After a long examination and much thought, I determined to retain the following ten species and one uncertain one:—

1. *Waldheimia flavescens*, Lamarck.
2. —— *kerguelenensis*, Davidson.
3. —— *Grayi*, Davidson.
4. —— *septigera*, Lovén.
5. —— *Raphaelis*, Dall.
6. *Waldheimia floridana*, Pourtales.
7. —— *venosa*, Solander.
8. —— *lenticularis*, Deshayes.
9. —— (*Macandreria*) *cranium*, Müller.
10. —— (——) *tenera*, Jeffreys.

Uncertain: *Waldheimia Wyrillii*, Davidson.

The characters of both *Waldheimia* and *Macandreria* will be found fully recorded in our descriptions of *W. flavescens* and *W. cranium*.

Calcareous spicula are absent or almost so in the species above named. Numerous metamorphoses or changes take place in the shape or development of the loop during the different stages of its growth, as will be fully described in the sequel.

26. Waldheimia flavescens, Lamarck, sp. (Plate VII. figs. 6–19.)

Terebratula flavescens, Valenciennes apud Lamarck, An. sans Vert. vol. vi. p. 246, 1819.

Terebratula australis, Quoy & Gaimard, Voyage de l'Astrolabe, Zool. p. 551, pl. lxxxv. figs. 1–5, 1834.

Terebratula incurva, Quoy & Gaimard, loc. cit. p. 554, pl. lxxxv. figs. 11 & 12, 1834.

Terebratula australis, G. B. Sowerby, Thes. Conch. p. 349, pl. lxix. figs. 25–33, 1846.

Waldheimia australis, King, English Permian Fossils, Pal. Soc. p. 145, pl. xx. figs. 10–12, 1849.

Terebratula australis, Davidson, Classification of Recent Brachiopoda, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 365, 1852.

Waldheimia flavescens, Davidson, Brit. Foss. Brach. vol. i. p. 64, figs. 6 & 7, 1853; R. Owen, Davidson's Mon. Pal. Soc. vol. i. chapter 1, 1853.

Waldheimia australis, S. Woodward, A Manual of the Mollusca, p. 216, figs. 113 & 114, 1854; Gratiolet, Etudes Anatomiques sur la *Terebratula australis*, Journal de Conchyliologie, 1857; A. Hancock, On the Organization of the Brachiopoda, Phil. Trans. Royal Soc. vol. 148, p. 791, 1858.

Waldheimia flavescens, H. & A. Adams, The Genera of Recent Mollusca, vol. ii. p. 575, vol. iii. pl. cxxx. fig. 3, 1858.

Terebratula (*Waldheimia*) *flavescens*, L. Reeve, Monogr. of *Terebratula*, Conch. Icon. pls. 1 & 2, fig. 1 *a*, *b*, 1860.

Waldheimia australis, Huxley, An Introduction to the Classif. of Animals, p. 28, fig. 10, 1869.

Waldheimia flavescens, Dall, Amer. Journ. of Conch. vol. vi. p. 108, 1870, and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 181; Tenison Woods, Proc. Roy. Soc. of Tasmania, 1877, p. 57; Douvillé, Bull. Soc. Géol. de France, 3e sér. pl. vii., 1879; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 41, pl. iii. figs. 10–12, 1880; Zittel, Handbuch der Paläontologie, pp. 645

& 702, 1880; E. Deslongchamps, Études critiques sur les Brachiopodes, pp. 172 & 177, 1884; Davidson, Pal. Soc. Brit. Foss. Brach. vol. v. p. 323, 1884.

Shell longer than wide, ovate or subpentagonal, broadest about the middle, straight in front, yellowish or light brown. Dorsal valve convex, sometimes flattened from about the middle of the valve to the front; ventral valve rather deeper and more convex than the opposite one, with a slightly raised longitudinal flattened elevation or fold along the middle. Beak moderately incurved, truncated by a circular foramen, somewhat separated from the hinge-line by a deltidium; beak-ridges sharply defined. Surface of both valves from the beaks generally smooth up to a certain age, then radiating and irregularly plaited, some ribs being shorter than others, the central one straight, those on the lateral portions of the valves somewhat curved. Shell-structure perforated by canals. In the interior of the dorsal valve the loop is long and simple; after being attached to the hinge-plate and its crural processes given off, the principal stems are outwardly

Fig. 3.

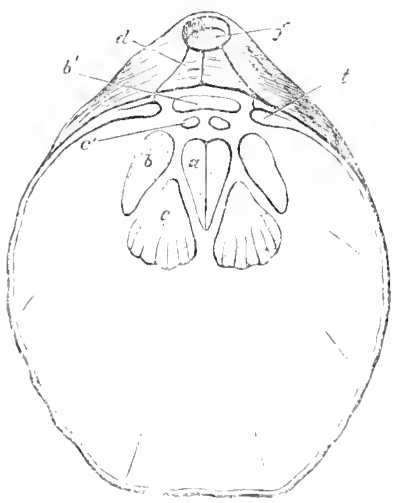
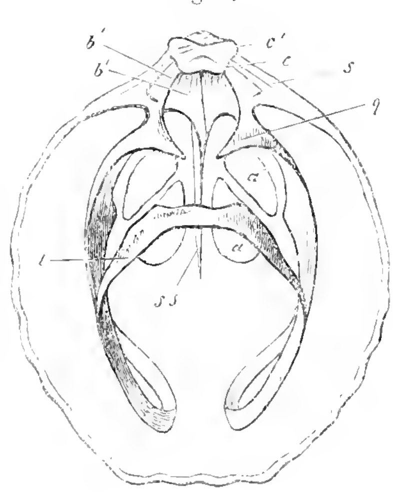


Fig. 4.



Waldheimia flavescens. Interior of both Valves, enlarged.

Fig. 3. Interior of the ventral valve: *f*, foramen; *d*, deltidium; *t*, teeth; *a*, adductor impressions (= occlusors of Hancock); *c*, divaricators (= cardinal muscles of King = muscles diducteurs principaux of Gratiolet); *c'*, accessory divaricators (= muscles diducteurs of Gratiolet); *b*, ventral adjustors (= ventral peduncular muscles, or muscles du pédoncule, paire supérieure, Gratiolet); *b'*, peduncular muscle.

Fig. 4. Interior of the dorsal valve: *c*, *c'*, cardinal process; *b*, *b'*, hinge-plate; *s*, dental sockets; *l*, loop; *q*, crura; *a*, *a*, adductor impressions; *ss*, septum.

curved, and on reaching to about three fourths of the length of the valve become reflected. The median septum extends along the bottom of the shell from under the hinge-plate to a little beyond one third of the length of the valve. Brachial or labial appendages largely developed and united to each other by a membrane. The principal lateral branches commence on either side of the mouth, curving outward and facing the bottom of the smaller valve, extend to within a short distance of the front; then becoming suddenly bent back upon themselves to within a short distance of the mouth, are by an elegant semicircular curve directed towards the centre of the larger valve, and form the commencement of the shorter spiral central lobe. Dimensions very variable, a large well-shaped example measured—length 1 inch 7 lines, breadth 1 inch 4 lines, depth 1 inch.

Hab. Waldheimia flavescens (=*australis*) was picked up in great numbers by the 'Challenger' Expedition on the 3rd of June, 1874, at Port Jackson, N. S. W., on the shore, and in from two to ten feet depth of water. Mr. John Brazier, who has dredged extensively in the seas adjoining New South Wales, has kindly sent me specimens from Point Piper, Port Jackson, found under stones in clusters like grapes during low spring-tides, also on *Ostrea glomerata*, Gould, with a specimen of *Kraussina Lamarckiana* on the inside; a young or smooth variety on a piece of shell with *Ismenia* or *Megerlia pulchella*, from the inner north head of Port Jackson, at 10 fathoms, on a bottom of sand and broken shells; likewise from Bottle and Glass Rocks, Port Jackson; and also from off Shark Point, Port Jackson, at a depth of 14 fathoms. Quoy and Gaimard found this species, in 1834, in immense numbers at Port Western, Bass Strait. They observe that hundreds were brought up at each haul of the dredge, either grouped among themselves, or attached to other shells; also at Port Jackson, in four feet of water. Prof. Beete Jukes collected any number while boating in South Australia, among the reefs at Port Jackson; indeed this is one of the commonest species in the locality. The Rev. Tenison Woods observes, in his 'Census of the Marine Shells of Tasmania,' that *Waldheimia flavescens* is found off all South Australia, but only on the north coast of Tasmania.

Obs. I have nothing much to add to my description of this well-known species given in the 'Challenger' Report. The shell has received four or five different specific names, but the best known are those of *flavescens*, Lamarck, and *australis*, Quoy. In 1819, Lamarck having become blind, Valenciennes described for Lamarck the species in question, under the names of *Terebratula flavescens* and *T. dentata*; but he gives no figures of his species, and upon inquiring from Valenciennes, in 1882, I found that it was to a specimen from Port Jackson that he gave the name of *flavescens*. The larger number of malacologists have preferred the name of *australis*, given to it in 1834 by Quoy and Gaimard, who gave a number of good illustrations of the shell, including that of the loop *. Quoy's *T. recurva* is no more than a short variation in form of a specimen in which the beak is much incurved; and the same may be said of Lamarck's *T. dentata*.

Waldheimia flavescens is very variable in shape and ribbing. In some examples the beak is longer or more produced than in others, and the foramen much more distant from the hinge-line in some individuals than in others. Some specimens are also more or less subpentagonal, others elongated oval, some lozenge-shaped and circular. The valves in some examples are quite smooth in the young, and very often up to an advanced stage of growth. In other specimens the ribs are simple or bifurcating, and of different size and strength on the same individual, and begin to rise close to, or at some distance from, the extremity of the beak and umbo. In Pl. VII. some of these modifications in shape and character have been illustrated.

* Voyage de l'Astrolabe, Atlas, pl. 85 (1834).

The loop passes likewise through a series of metamorphoses from the very young state up to the period when it assumes the simple adult *Waldheimia*-character, as has been so elaborately described and illustrated by Herman Friele in the case of *Waldheimia septigera* and *Waldheimia* (or *Macandrevia*) *cranium*.

The intimate shell-structure of *Waldheimia flavescens* has been minutely described and admirably illustrated by Dr. W. B. Carpenter, in his chapter "On the Intimate Structure of the Shells of the Brachiopoda," which he kindly prepared in 1853 for vol. i. of my 'Monograph on British Fossil Brachiopoda,' and to which the reader is referred. But we may here mention that he found the perforations in *W. flavescens* to average a diameter of about $\frac{1}{800}$ inch, and the distance of their centres about $\frac{1}{400}$. Three of his illustrations have been given in Pl. VII. figs. 17–19.

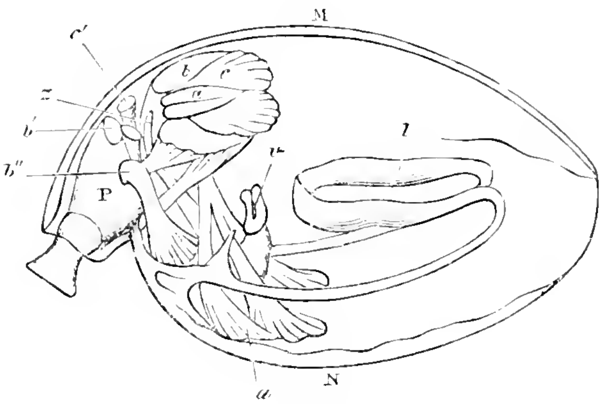
In 1869, in vol. xxiv. of the Transactions of the Royal Irish Academy, Prof. W. King gave an excellent description of the shell-structure of the species under description, in which he observes that Quekett, in 1850, discovered that the extremity of the cæcal appendages, as they are now generally called, is more or less flattened or disk-shaped, and encircled with a fringe of exceedingly minute radiating lines or membranous filaments. Prof. King adds, "In position and arrangement the *filaments* belonging to the terminations of the cæcal appendages so completely agree with the *radiating lines* which intersect the apertural rims of the perforations, as to leave no doubt on my mind that the latter are *tubular* and enclose the former." The shell of *W. flavescens* and its intimate shell-structure is also described by Gratiolet, in his admirable memoir "Études anatomiques sur la Térébratule australe," Journal de Conchyliologie, 1857. He says, at p. 214 of his memoir, that the shell, when divested of the foreign objects that generally cover its surface, is of a tolerable transparency. One notices in it, besides the concentric lines of growth, diverging costæ which give to the sharp edge of the valves an undulated appearance; examined with a lens, its surface is finely granulous, so much so, that one might think it formed of very fine granulations; but this apparent granulation is due to a multitude of microscopic perforations with which the shell is riddled. These perforations are, besides, very irregularly disposed on parallel bands which intercept quadrilateral spaces. He adds that the substance of the shell is formed of small calcareous prisms, somewhat attenuated at their extremity and disposed in parallel layers, which give to the fractured shell a fibrous aspect; these elements are closer together towards the edges of the shell than in their central portions.

The soft parts of the animal of *Waldheimia flavescens* have been admirably described and elaborately illustrated by several eminent anatomists. First by Owen in 1853, in the Introduction to vol. i. of my work on 'British Fossil Brachiopoda;' subsequently, in 1857, by Pierre Gratiolet, in his memoir above quoted, and in the following year by Albany Hancock, in his classical memoir "On the Organization of the Brachiopoda" (Phil. Trans. Roy. Soc. vol. cxlviii.). To these works the reader is referred for more complete anatomical details than we are able to reproduce in this monograph.

The body proper is small when compared with the size of the shell, and has both its valves lined by a delicate bilobed integument or membrane, termed the 'pallium' or mantle; this secretes the shell and is fringed with horny bristles. The mantle is composed of an outer and an inner layer, between which are situated the blood-channels or lacunæ. There are four principal arterial trunks in the dorsal lobe of the mantle, and these run direct to the front and bifurcate at intervals (see Pl. VII. figs. 15, 16 *d*). The aperture of the mouth is situated in the middle line between the pallial lobes, and on each side of it is a prolongation of the body provided with ciliated tentacula.

The muscles have been minutely described by the three anatomists above named. Five or six pairs are connected with the opening and closing of the valves, or with their attachment to, or movements upon, the peduncle. First of all the *adductor* or *occlusor* consists of two muscles, which, bifurcating near the centre of the cavity, produce a large quadrangular impression on the internal surface of the dorsal valve. The function of

Fig. 5.



Waldheimia flavescens (after Hancock).

M, ventral valve; N, dorsal valve; *l*, loop; *v*, mouth; *z*, extremity of intestine; *a*, adductor; *c*, divaricators; *c'*, accessory divaricators; *b*, ventral adjustors; *b'*, peduncular muscle; *b''*, dorsal adjustors; P, peduncle.

this pair of muscles is the closing of the valves. Two other pairs have been termed *divaricators* by Hancock, and have the function of opening the valves. The divaricators proper are stated by the same eminent authority to rise from the ventral valve, one on each side, a little in advance of and close to the adductors, and after rapidly diminishing in size, become attached to the cardinal process, a space or prominence between the sockets in the dorsal valve. The accessory divaricators are a pair of small muscles which have their ends attached to the ventral valve, one on each side of the median line, a little behind the united basis of the adductors, and again to the extreme point of the cardinal process. The two pairs of muscles, apparently connected with the peduncle and their limited movements, have been minutely described by Hancock as having one of their extremities attached to this organ. The dorsal adjustors are attached to the ventral surface of the peduncle, and are again inserted into the hinge-plate of the smaller valve. The ventral adjustors are considered to pass from the inner extremity of the peduncle, and to become attached by one pair of their extremities to the ventral valve, one on each side of and a little behind the expanded base of the divaricators. The function of these muscles is not only that of erecting the shell, but also that of attaching the peduncle to the shell, and thus controlling the steadying of it upon the peduncle. These details and the figure taken from Hancock will sufficiently explain the functions of the different muscles. Hancock describes the peduncle as composed of a dense muscular, semi-cartilaginous mass of a cylindrical form.

The nature of the muscles has also been well described and illustrated by Owen, Gratiolet, and more recently by Van Bemmelen, in his anatomical memoir 'On the Structure of the Shells of Brachiopods and Chitons' *.

Owing to the strong and tight interlocking of the valves of *Waldheimia flavescens* and other species, by means of curved teeth and sockets, the Brachiopoda would seem to open their valves very slightly.

At p. 806 of the admirable memoir already alluded to, Hancock says that in *Waldheimia flavescens* and in other forms of the genus, the "loop originates in the hinge-plate in two necks or processes,—the crura, from which two points project downwards, called the crural processes. The upper or dorsal members of the loop, passing from these two lateral necks, stretch forward for about two thirds the length of the valve, then bend towards the ventral valve, and turning back upon their course, are united across the median line, a short way in advance of the crural processes. The lateral portions of the loop are curved a little outwards. The whole of this calcareous support, including the crura and crural processes, is a product of the inner lamina of the dorsal pallial lobe. This lamina, with the exception of a portion at each side, which is continuous with the similar lamina of the ventral lobe, forming with it the anterior wall of the perivisceral chamber, is turned downwards and forwards, and extends as far as the transverse portion of the loop. It then divides into two lobules, one passing to the anterior extremity of each of the lateral portions of this calcareous support, binding together the dorsal and ventral members. The loop in its sinuous course follows the margins of this bifurcated pallial process, and lies imbedded in its substance.

"The arms themselves taper to fine points, having taken their origin at each side of the mouth, which is situated at the back of the pallial chamber in a central position, opening downwards. They pass outwards and forwards in connection with the calcareous loop and the pallial lobules, running along the outer edge of the dorsal member of the former; they then turn back upon the reflected or ventral part of it, and on reaching the transverse portion bend inwards and doubling sharply upon themselves, again advance and go to form two vertical spirals turned towards the dorsal valve. The spirals are placed parallel to each other, and throughout the coil, consisting of two or three turns, they are united across the median line by a rather wide, stout, semicartilaginous membrane, which is attached behind the transverse portion of the loop."

The labial appendages have been magnificently illustrated by Owen in plates 1 & 2 of his chapter on the 'Anatomy of the *Terebratula*' already referred to. They are also minutely described and illustrated by Gratiolet in his 'Études anatomiques sur la Térébratule australe,' 1857.

These appendages are, in *Waldheimia flavescens*, as well as in other species of the

* 'Over den Bouw der Schelpen van Brachiopoden en Chitonen,' Leiden, 1882, and of which an English note will be found in the Ann. & Mag. Nat. Hist. 5th ser. vol. xi. p. 379, 1883.

genus, a pair of very remarkable organs, eminently characteristic of the Brachiopoda. They are often and more correctly termed *labial* appendages, on account of each member being a prolongation of the lateral portions of the lips of the margins of the mouth. They occupy the larger portion of the cavity of the shell in front of the visceral chamber;

Fig. 6.

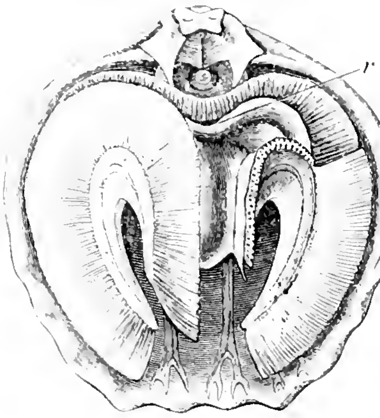
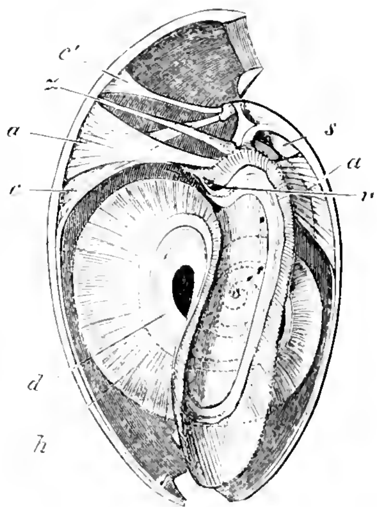


Fig. 7.



Waldheimia flavescens.

Fig. 6. Interior of dorsal valve, to show the position of the labial appendages. (A portion of the fringe of the cirri has been removed to show the brachial membrane and a portion of the spiral extremities of the arms.) Enlarged.

Fig. 7. Longitudinal section, with a portion of the animal. *d*, *h*, brachial appendages; *a*, adductor; *c*, *c'*, divaricator muscles; *s*, septum; *v*, mouth; *z*, extremity of alimentary tube. (The peduncular muscles have been purposely omitted.) Enlarged.

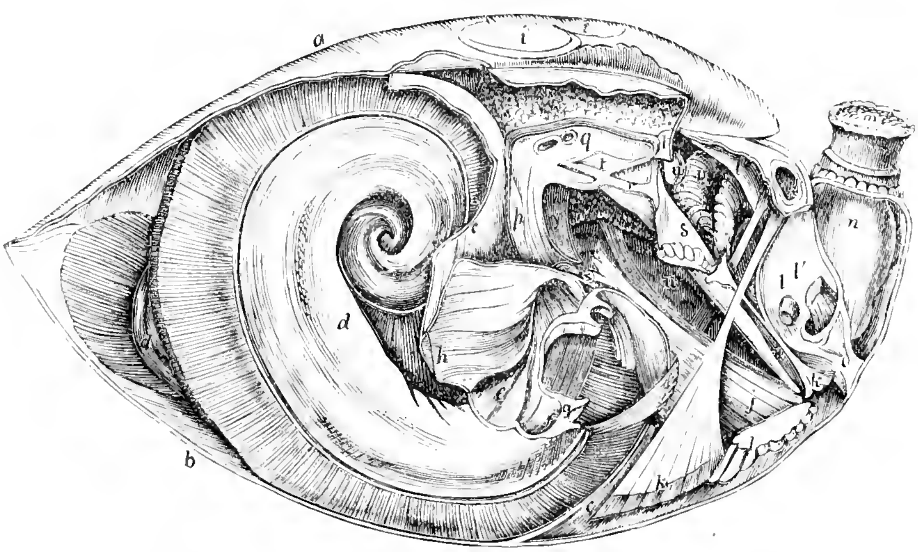
and are mainly composed of a membranous tube fringed on one side with long flexible hollow cirri, which are not capable of being protruded in those families and genera in which they are folded back upon themselves and supported by a skeleton, as in *Waldheimia*. Hancock says (Phil. Trans. vol. cxlviii. p. cxliii.) that the arms or labial appendages "are normally composed of a membranous tube or canal bearing a semicartilaginous grooved ridge. The latter stretches from end to end of the former, and gives support to the fringe of cirri. As far back as the commencement of the spirals the arms are as above stated; but for the entire length of the lateral portions of the loop, where the arms are doubled upon themselves, and where, of course, two tubes or canals might have been expected, there is only one, the two having, as it were, coalesced. These large canals at the roots of the arms are continuous with those of the spirals, and terminate in blind sacs, one at each side of the œsophagus, close to the mouth. On making a transverse section of this part of the arm, the enlarged terminal portion of the brachial canal is seen connected with the external edges of the dorsal and ventral members of the loop; and the pallial lobule, stretching between the inner edges, forms a sort of inner tube. This inner tube opens widely into the perivisceral chamber, is in fact a prolongation of this chamber, and terminates at the anterior extremity of the lateral portion of the loop, forming what may be designated as the brachial pouches. The cirri are undoubtedly contractile to some extent, and are also endowed with the power of motion individually, as proved by the observations of Mr. Barrett. It would likewise appear that the entire fringe of cirri can be elevated or depressed, there being ample means provided for the purpose." Many other highly important details have been recorded by Owen, Gratiolet, and Hancock, which I regret I am unable to reproduce.

Mr. Hancock states, at p. 811 of his memoir, that "the mouth, in all the Brachiopods, as previously stated, is situated in the brachial groove, at the posterior junction of the arms, and is a simple, oval, transverse slit, or orifice devoid of any armature. In *W. australis* there is, however, a slight bulging-out of the posterior wall immediately within the orifice, which is somewhat like the valvular appendage of *Plumatella*, and may perhaps assist in swallowing. The alimentary tube assumes the form of a siphon bent in the vertical plane, the arch turned towards the dorsal valve; the œsophagus represents the short, the stomach and intestine the long arm."

There is no anal outlet in this species. According to the same author, the mesentery is divided into two portions, the dorsal and ventral: it sustains the alimentary canal in the vertical plane, and altogether with it divides the anterior portion of the chamber into lateral halves. The gastro-parietal bands are three in number, two lateral and one median.

In *W. flavescens*, Mr. Hancock says, "the genitalia are formed of thick bands,

Fig. 8.



Lateral view of the Viscera of *Waldheimia flavescens*, after Hancock.

a, anterior layer of mantle; *b*, posterior layer; *c*, anterior walls of the body between the mantle-lobes; *d*, arms; *p*, gullet; *q*, stomach, with cut biliary ducts of the left side; *r*, right hepatic mass; *s*, intestine ending cæcally between *j* and *k*; *v*, so-called "auricle" of the right "pseudo-heart," the left being almost wholly removed; *w*, pyriform vesicle fixed to the back of the stomach, and probably performing the function of a true heart; *z*, œsophageal ganglia. (This figure is also given by Huxley on page 28 of his 'Introduction to the Classification of Animals,' 1869.)

somewhat convoluted and branched; they are of a full yellow colour, and are thrust into the trunks and main branches of the great pallial sinuses" (p. 817).

"The heart is a simple, unilocular, pyriform vesicle, suspended from the dorsal aspect, and projects freely into the perivisceral chamber" (*loc. cit.* p. 834).

Prof. Huxley, in his 'Introduction to the Classification of Animals,' 1869, says that "The precise characters of the true vascular system of the *Brachiopoda* probably require still further elaboration than they have yet received; and the same may be said, notwithstanding the valuable contributions of F. Müller and of Lacaze-Duthiers, of their development; but the shell, the pallial lobes, the intestine, and the nervous and the atrial systems, afford characters amply sufficient to define the class" (p. 30). He also says (p. 29), "In all *Brachiopoda* which have been carefully dissected, a singular system of cavities and canals situated in the interior of the body, but in free communication with the surrounding medium, has been discovered. This, which I shall term the 'atrial' system (from its close correspondence with the system of cavities, which has received the same name in the Ascidians), has been wrongly regarded as a part of the true vascular system, and the organs by which it is placed in communication with the exterior have been described as 'hearts.' There are sometimes two and sometimes four of these 'pseudo-hearts,' situated in that part of the body-wall which helps to bound the pallial chamber. Each pseudo-heart is divided into a narrow, elongated, external portion (the so-called 'ventricle'), which communicates, as Mr. Hancock has proved, by a small apical aperture with the pallial cavity; and a broad, funnel-shaped, inner division (the so-called 'auricle'), communicating, on the one hand, by a constricted neck with the so-called 'ventricle,' and on the other, by a wide, patent mouth, with a chamber which occupies most of the cavity of the body proper, and sends more or less branched diverticula into the pallial lobes. These have been described as parts of the blood vascular system; and the arterial trunks, which have no existence, have been imagined to connect the apices of the ventricles with vascular networks of a similarly mythical character, supposed to open into the branched diverticula. In fact, as Mr. Hancock has so well shown in his splendid and exhaustive memoir published in the 'Philosophical Transactions' for 1857, the true vascular system is completely distinct from this remarkable series of 'atrial' chambers and canals, the function of which would appear to be to convey away excretory matters and the products of the reproductive organs, which are developed in various parts of the walls of the atrial system."

In an exquisitely beautiful enlarged illustration in his 'Anatomy of the *Terebratula*,' Owen represents the brachial aponeurosis and spiral arms of *Waldheimia flavescens*, showing the central part of the nervous system, with the brachial and the beginning of the pallial nerves.

27. WALDHEIMIA VENOSA, Solander, sp. (Plate VIII. figs. 1–5; Plate IX. fig. 1.)

Anomia venosa, Solander, G. Dixon, A Voyage round the World, Appendix no. 1, p. 355 and fig., 1789.

Terebratula globosa, Valenciennes, apud Lamarck, An. sans Vert. vol. vi. p. 246, 1819, with reference for figure to Encyclop. Méthod. p. 239, figs. 5 *a*, *b*, 1789.

Terebratula dilatata, Valenciennes apud Lam., An. sans Vert. vol. vi. p. 245, 1819.

Terebratula Gaudichaudi, Blainville, Dict. Sci. Nat. 1824.

Terebratula globosa, Anton, Verzeichniss der Conchylien, p. 23, 1839.

Terebratula eximia, Philippi, Küster, Conch.-Cab. vol. vii. p. 39, pl. 2. figs. 9 & 10, 1843.

Terebratula Fontaineana, d'Orbigny, Voy. Amér. Mérid. vol. v. p. 675, pl. 85. figs. 30 & 31, 1847.

Terebratula (*Waldheimia*) *globosa*, Reeve, "Monogr. of *Terebratula*," Conch. Icon. pl. ii. fig. 3, 1860, and pl. vi., 1861.

Terebratula (*Waldheimia*) *globosa*, Reeve, Ann. & Mag. Nat. Hist. vol. vii. p. 173, 1861.

Terebratula (*Waldheimia*) *dilatata*, Reeve, Conch. Icon. pl. vi. fig. 2, 1861.

Terebratula physema, Valenciennes, MS.; Reeve, Conch. Icon. pl. vi. fig. 23, 1861.

Waldheimia venosa, Davidson, Ann. & Mag. Nat. Hist. 3rd ser. vol. viii. p. 36, 1861.

Terebratula venosa, Cunningham, Voyage of H.M.S. Nassau, Trans. Linn. Soc. vol. xxvii. p. 488, 1871.

Waldheimia venosa, Dall, Amer. Journ. of Conch. vol. vi. p. 109, 1870, and Proc. Acad. Sci. Philadelphia, p. 182, 1872.

Shell large, longitudinally oval, ovately globose, widest about the middle, longer than wide. Dorsal valve convex, with a shallow flattened longitudinal depression or sinus along the middle, commencing at about half the length of the valve and extending to the front. Ventral valve a little more convex than the opposite one, with a slightly produced and flattened mesial fold commencing near the beak and extending to the front; beak moderately incurved and truncated by a rather large circular foramen, with thickened margin and completed anteriorly by a deltidium in two pieces; beak-ridges sharply defined. Surface of valves smooth, marked only by concentric lines of growth. Shell-structure punctate. Colour light olive-horny. Loop long and reflected; cardinal process and hinge-plate large. Under the hinge-plate a rather strong mesial septum extends to a third or a little more of the length of the valve, and on either side on the bottom of the shell are situated the adductor and other muscular scars. Length 3 inches 2 lines, breadth 2 inches 8 lines, depth 2 inches.

Hab. Tierra del Fuego; Falkland Islands (Dixon); Port William, Falkland Islands (B. J. Sulivan); Coquimbo; off Cape Possession in about 15 fathoms; Port Famine (Cunningham).

Obs. This is the largest recent Brachiopod at present known, and its history has been somewhat confused. It was, however, well described and figured in 1789 by Captain George Dixon, who says, at p. 355 of his work 'A Voyage round the World':—"At Falkland Islands we met with a curious kind of shell of the *Anomia* genus of Linnæus, of which, though the species are numerous in a fossil state in most parts of the world, few have been discovered recent, or fresh from the sea. Only one of this sort was before known in Europe, which was brought over by my late worthy commander, the much regretted Captain Cook, in his first voyage round the world. It was in the Portland Museum, and was named by the late celebrated Dr. Solander, in his MSS. description of the shells of that splendid cabinet, *Anomia venosa*; the specimen is now in the collection of Mr. Calonne, of London. This kind (as do all that are properly of this genus) adheres to coral rocks by a ligament that comes from the animal through the hole in the larger valve. The internal structure peculiar to the shells of this genus is very singular, and consists of two testaceous rays, which commence near the hinge in the lesser valve, where they adhere; from whence, leaving the shell, they proceed to near the edge, then bend towards the other valve, and turn back to their commencement, where they unite. This internal part is very delicate, and breaks upon the smallest touch, but is thicker in the parts nearest to the large valve. The shell takes its name from certain parts of the animal, which run in a branched form along the inside of the shell, which being held to a strong light, or a candle, gives a beautiful veined appearance. The outside is smooth and of a pale brown colour. The specimen from which the engraving was made, is in the private collection of Mr. George Humphrey, dealer in natural curiosities, London" (Plate VIII. fig. 1).

In 1819 Valenciennes briefly described the same species by the name of *Terebratula globosa*, referring at the same time to plate 239, fig. 2, of the 'Encyclopédie Méthodique' for a figure of his species. The figure in the 'Encyclopédie' is not well drawn; but the specimen from which it was taken is in the collection of the Jardin des Plantes, and was lent by M. Valenciennes to Lovell Reeve, who gave a good figure in plate vi. fig. 3 of his 'Monograph of *Terebratula*' in 1861. In 1843 the same species received the name of *T. eximia* from Philippi and Küster; that of *T. Fontaineana* from d'Orbigny, and to a large specimen of the same form in the collection of the Jardin des Plantes, measuring 2½ inches in length, M. Valenciennes gave the MS. name of *physema*. Under this name it is also described and figured by Reeve in his 'Monograph of *Terebratula*' in 1861. The specimen was brought from Coquimbo by M. Gaudichand in 1833 (Plate VIII. fig. 6). In his description of this specimen Mr. L. Reeve observes that "It would be satisfactory if the species could be confirmed by the discovery of further specimens. It is intermediate in its characters between *T. dilatata* and *T. globosa*, inclining rather to the latter species, of which it may prove to be a colossal broadly inflated variety," and this I have no doubt it is.

It was Valenciennes, however, who described and gave the names to all the recent Brachiopoda published in 1819 in the 'Animaux sans Vertèbres' of Lamarck, that celebrated zoologist having unfortunately lost his sight at that period.

I am quite convinced, after the inspection of the original specimen and figure of *T. dilatata*, Val., as well as from Reeve's figures in plate vi. fig. 2 of his 'Monograph' (the type having been lent to him by M. Valenciennes out of the collection of the Jardin des Plantes), that it is only a smaller and more transverse form of *Waldheimia venosa*. Several other specimens of the same form which have also passed through my hands have tended to confirm this view, which had already been expressed by Mr. W. H. Dall in his memoir published in the 'American Journal of Conchology,' vol. vi. p. 109, where he notes also that the *T. Gaudichaudi* of Blainville is another synonym of *W. venosa*. In a paper I published in the 'Ann. & Mag. Nat. Hist.' for August 1867, I described and figured the largest example of *W. venosa* that had been discovered, which had been dredged in 1843 or 1844 by Rear-Admiral B. J. Sulivan at Falkland Islands, in the same locality whence the type of the species had been procured by Dixon. Admiral Sulivan informed me, when lending me his specimen, that the depth at which the animal lived was from 6 to 7 fathoms, the bottom on which the shell lay being a compact quartzose sand only, as no mud ever came up with the dredge, although a stiff muddy clay underlies the sand, on which anchors hold very firmly.

Waldheimia venosa, like all its congeners, is variable in external shape. The foramen is larger in some specimens than in others. As is the case with *W. lenticularis* when quite young and sometimes until half its growth, *W. venosa* is either almost circular or transversely oval. *W. dilatata* seems to be a half-grown individual with a large foramen (Plate IX. fig. 1).

W. venosa has often been confounded with *Laqueus californicus* of Koch, both species attaining large dimensions; but the loop in both is entirely different, and in the last-named species the beak is much more incurved, the foramen very small, and separated to a greater or less extent from the umbo of the dorsal valve by a deltidium in two pieces.

In Vol. clxviii. of the Phil. Trans., 1879 (Transit of Venus Exped.), Mr. Edgar A. Smith mentions *Waldheimia* (*Terebratula*) *dilatata*, Lamarck, as having been obtained at Observatory Bay at a depth of 4 fathoms. I may, however, remark that the 'Challenger' Expedition did not bring back a single specimen of Solander's species.

28. Waldheimia lenticularis, Deshayes, sp. (Plate IX. figs. 2–13.)

Terebratula lenticularis, Deshayes, Revue Zoologique par la Soc. Cuviérienne, p. 359, 1839, and Mag. de Zoologie, d'Anatomie comparée et de Paléontologie, p. 41, figs. *a, b, c, d*, 1841; G. B. Sowerby, Thes. Conchyl. vol. i. p. 360, pl. lxxii. figs. 108–110, 1846; Davidson Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 365, 1852; L. Reeve, Monogr. of *Terebratula*, Conch. Icon. pl. 2. fig. 4, 1860.

Waldheimia lenticularis, Gray & Woodward, Brit. Mus. Cat. of the Brachiopoda, p. 58, 1853; Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 182, 1873.

Neothyris lenticularis, Douvillé, Bull. Soc. Géol. de France, 3e sér. t. vii., 1879.

Waldheimia lenticularis, E. Deslongchamps, Notes sur les Modifications à apporter à la Classe des Terebratulidæ, pl. xvii. figs. 5–7, 1880.

Shell large, orbicular, elongated oval, globose, longer than wide, thick, rounded laterally, less so in front. Dorsal valve uniformly convex or slightly depressed at or close to the frontal margin. Ventral valve deeper, and a little more convex than the dorsal one and slightly longitudinally carinated; beak rather sharply incurved, overlying the umbo of the opposite valve, and truncated by a small circular foramen, separated from the hinge-line by a wide, narrow, concave deltidium in two pieces; beak-ridges very sharply defined. Surface smooth, marked by concentric lines of growth, punctate. Colour pinkish red or yellowish horny. Loop simple, long, and reflected; cardinal process rather large and prominent; under it a mesial septum extends to about one third of the length of the valve on either side the adductor and other muscular scars. Length 2 inches 2 lines, breadth 1 inch 11 lines, depth 1 inch 3 lines.

Hab. Lives abundantly attached to rocks in the Straits of Fouveau, New Zealand, in 15 fathoms. It occurs also in great numbers in the Pleistocene rocks of New Zealand.

Capt. F. W. Hutton, in his 'Catalogue of the Tertiary Mollusca of New Zealand,' p. 35, 1873, quotes the following localities:—"Wanganui, The Deans, Waipara, Waitotari, Chatham Islands." The fossil is also well described and figured by Prof. E. Suess from the 'Novara' Expedition, in his fine memoir "Fossile Mollusken und Echinodermen aus Neu-Seeland," Palæontologia, p. 56, pl. x. figs. 3, 4 (1866).

Obs. I have in my possession a very large series of specimens of this fine species from

2 up to 23 lines in length. When young and up to nearly half its growth the shell is almost circular and broadest anteriorly, tapering at the beak, and nearly as wide as long; with age the shell becomes elongated and gibbous.

I have carefully observed and drawn the modifications that take place in the shape of the loop, of which I give some illustrations in Plate IX. figs. 11, 12, 13. My figures agree well with those published by M. E. Deslongchamps in his 'Etudes Critiques' above quoted, and they do not differ from those peculiar to other species of the genus. In a specimen two lines in length the whole loop is small, not extending further than to about half the length of the valve, its principal lamellæ, as well as the reflected portion, becoming attached to the extremity of the upper sides of a perpendicularly elevated septum, as in *Magasella*. After a time the septum becomes less elevated, the principal stems of the loop acquire greater length, and give off at about half their length a horizontal lamella, which is also fixed to the septum, as in *Terebratella*; later on this horizontal lamella detaches itself from the septum, the principal stems of the loop become more separate, and the reflective portion assumes the appearance of that of a full-grown *Waldheimia*.

Waldheimia lenticularis was well described and figured by Deshayes in 1841, and also by G. B. Sowerby and L. Reeve. It has had the good fortune to preserve the same specific name, although located in the genera *Terebratula*, *Waldheimia*, and *Neothyris*. As observed by Reeve, in his 'Monogr. of *Terebratula*,' "Were it not that the habitats of this and the preceding species [*Terebratula* (*Waldheimia*) *globosa*] are well authenticated, it would be difficult to believe that there is any specific difference between them. This is rather lighter [with an] inflated growth, and the colour is remarkable, but the characters n other respects are the same in detail throughout. The foramen is probably as small as in *T. globosa*; in all the specimens of *T. lenticularis* that I have seen it is more or less eroded, according to the circumstances of its attachment. The loop is precisely the same in both species." There are, however, differences between *W. venosa* and *W. lenticularis* which must not be overlooked. In well-preserved specimens of the last-named shell the foramen is small, in fact much smaller than in *W. venosa*, and separated from the hinge-line by a well-developed deltidium in two pieces, in this respect more nearly resembling *Laqueus californicus*. The beak is more incurved, and the dorsal valve more uniformly convex. The colour is also very different in the two species. It is also a smaller shell.

29. WALDHEIMIA KERGUELENENSIS, Davidson. (Plate X. figs. 7–17.)

Waldheimia kerguelensis, Davidson, Proc. Roy. Soc. vol. xxvii. p. 437, 1878, and (*W. kerguelenensis*) Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 40, pl. iii., 1880.

Shell ovate, ventricose, longer than wide, light yellowish white, smooth. Dorsal valve most convex near the umbo, a slight mesial depression commencing about the middle of the valve extends to the front, and is more or less distinctly margined on either side by a faint raised line or ridge; front line slightly depressed or nearly straight. Ventral valve rather more convex than the opposite one, and more or less distinctly keeled by the presence of a wide, convex, but slightly raised fold, which corresponds with the depression in the dorsal valve. Beak moderately produced and incurved, truncated by a small circular foramen laterally margined by two small disunited deltidial plates. Cardinal process prominent, and formed of three distinct parts. In the interior of the dorsal valve, and under the incurved extremity of the umbo and hinge-plate, there rises a wide short and massive septum, and on either side on the bottom of the valve the muscular scars are visible. Loop delicate, elongated and reflected. Shell-perforations numerous. Length 2 inches, breadth 1 inch 4 lines, depth 1 inch 2 lines.

Hab. It was dredged by the 'Challenger' Expedition in great numbers off Marion Island, west of Kerguelen Island, at a depth of 100 fathoms. Two examples of *Platydia anomioides* were attached to one of the specimens. Also at Balfour Bay, near Kerguelen Island, in 20 to 60 fathoms, south of the same island at a depth of 150 fathoms. Three examples of *Rhynchonella nigricans*, var. *pixidata*, were obtained with it.

Obs. I have examined several specimens of the animal that had been dredged alive by the expedition, as well as of the shell from 1 line up to 24 lines in length. Some examples were nearly circular and as broad as long, but the larger number were of an elongated oval shape, becoming ventricose with age. When the peduncle by which the shell adhered to foreign bodies was sufficiently long, and did not interfere with the animal's limited movements, the beak was much incurved and the foramen small; but in most cases the peduncle was exceedingly short, and the shell came into contact with the hard bodies to which it was moored, causing erosion and the consequent enlargement of the foraminal aperture. The animal closely resembles in general character that of *Waldheimia flavescens*, so admirably described by Owen and Hancock.

Some specimens bear a certain resemblance to *Waldheimia lenticularis*; but this last is smaller, more ovate or regularly oval, and more especially in the young and intermediate stages of growth. Having forwarded two examples for Mr. Dall's examination, he informs me:—"I have carefully compared it with d'Orbigny's *Waldheimia Fontaineana*, and feel more sure than ever of the correctness of my reference of his species to *Waldheimia venosa*. It is certainly not this fine species (*Waldheimia kerguelenensis*)," though it is possibly identical with the shell erroneously described and figured by G. B. Sowerby, at p. 359, and plate xxi. figs. 99–101, of his 'Thesaurus Conchyliorum,' in 1846, as the *Terebratula globosa*, Lamarck. The specimen Sowerby figured under that name (said to have been taken from Lamarck's collection) is now in the British Museum, and Sowerby was certainly mistaken in stating "It agrees perfectly with the representation in the 'Encyclopédie Méthodique,' tab. 339. fig. 2"!

30. WALDHEIMIA GRAYI, Davidson. (Plate X. figs. 1–4.)

Terebratula Grayi, Davidson, Proc. Zool. Soc. 1852. p. 76, pl. iv. figs. 1–3.

Terebratula (Waldheimia) Grayi, L. V. Schrenck, Reisen und Forschungem in Amur-Lande, p. 465, 1854–56.

Waldheimia Grayi, E. Suess, Sitzungsb. Akad. Wissenschaften, Bd. xxxvii. p. 201, 1859.

Terebratula (Waldheimia) Grayi, L. Reeve, Conch. Icon. pl. 2. figs. 5 *a*, *b*, *c*, 1860, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 175, 1861; Journal de Conchyl. p. 123, 1861.

Waldheimia Grayi, Carpenter, Rep. Brit. Assoc. 1863, p. 636.

Waldheimia Grayi, A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 99, 1863; Davidson, Proc. Zool. Soc. p. 304, pl. xxxi. figs. 7 & 8, 1871; Dall, Am. Journ. of Conch. vol. vi. p. 110, 1870, and Proc. Acad. Sci. Philadelphia, 1873, p. 182; G. Dunker, Index Moll. Maris Japonici, p. 252, 1882.

Shell variable in shape, squarely subpentagonal or subtriangularly semicircular, longer or broader than wide. Hinge-line either nearly straight or very obtusely angular, shorter or longer than the breadth of the shell; lateral margins rounded, nearly straight or gently curved in front. Dorsal valve very moderately convex, somewhat flattened and more or less longitudinally depressed along the middle. Ventral valve very much deeper and more convex than the dorsal one; beak short, bent backwards, nearly straight or very little incurved, and obtusely truncated by a large, transversely oval, incomplete foramen, always more or less eroded, margined anteriorly by the dorsal valve and by two small labial rudimentary deltidial plates; beak-ridges strongly marked, leaving between them on the hinge-line a wide triangular almost flat area. Surface of valves marked by a number of strong bifurcating radiating angular costæ, of which the central one is usually the largest. Valves traversed by numerous more or less prominent scale-like zigzag concentric lines or ridges of growth. Shell-structure punctate. Colour yellowish, with concentric bands of crimson colour, deeper in tint at or near the projecting concentric ridges of growth. Proportions very variable. Two large examples measured:—

Length 1 inch 4 lines, breadth 1 inch 3 lines, depth 10 lines.
,, 1 ,, 2 ,, ,, 1 ,, 7 ,, ,, 9 ,,

In the interior of the dorsal valve the cardinal process is wide and narrow, the hinge-plate large, mesial septum strong, extending to about half the length of the valve. Loop long and simple: the principal stems attached to the base of the hinge-plate extend to about four fifths of the length of the valve before becoming reflected.

Hab. Hakodadi, Mososeki, Japan, in 7 fathoms (Adams). Strait of Corea (Belcher and St. John), in 37 fathoms. Dall mentions also Catalina and Monterey.

Obs. This very remarkable and beautiful shell is, as already stated, very variable in shape, so much so, indeed, that some malacologists have felt disposed to divide it into two species; and, as observed by Dall, it is sometimes hardly possible to distinguish it exteriorly from some specimens of *Terebratula transversa*, Sow., var. *caurina*, Gould, or *T. occidentalis*, Dall, except by the loop, which in *W. Grayi* is simple, while in the others it is three times attached, as in *Terebratella*.

Prior to 1852, the shells of the species under description had erroneously been referred to the *Terebratula* (*Kraussina*) *rubra* of Pallas, to which they also bear some external resemblance; and it was only after careful examination of the interior calcareous support of the labial appendages that I discovered that they belonged to two very distinct genera. As observed by Lovell Reeve, in his 'Monograph of *Terebratula*,' the foramen of the shell naturally becomes more or less eroded and enlarged according to the roughness with which the creature is buffeted about in the place of its attachment, owing to the shortness of its peduncle. He also observes that the deltidial plates meet in the middle in very young examples, and that the ribs of *W. Grayi* are not really scaled, but scales are formed on them by the overlapping of the concentric lines of growth. The ribs are also somewhat irregular in some specimens.

Waldheimia Grayi is extremely abundant in its favourite haunts. In Corean waters it was dredged in great abundance by Admiral Sir Edward Belcher during the voyage of H.M.S. 'Samarang.' A. Adams and Capt. St. John obtained it in similar abundance, and say that it could be collected by thousands in certain places where it had been washed on shore. Mr. Dall has observed that the blood in this species is red.

31. WALDHEIMIA SEPTIGERA, Lovén, sp. (Plate XI. figs. 1–10.)

Terebratula septigera, Lovén, Index Molluscorum Litora Scandinaviæ occidentalia habitantium, Öfversigt af K. Vet.-Akad. Förh. 1846, no figure.

Waldheimia septigera, Gray & Woodward, Cat. of Brach. in the Brit. Mus. p. 59, 1852; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. xvi. pl. x. fig. 1, 1855; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzunsgb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 200, 1859.

Terebratula (Waldheimia) septigera, Reeve, Monogr. of *Terebratula*, Conch. Icon. pl. iii. fig. 10, 1860.

Terebratula peloritana, Seguenza, Notizie succinte, p. 19, 1862.

Waldheimia peloritana, Sequenza, Memorie della Soc. Ital. di Scienze Naturali, vol. i. p. 49, pl. vi. fig. 10, 1865.

Terebratula septata, Jeffreys (not Philippi), Brit. Conch. vol. ii. p. 14, 1863.

Waldheimia septigera, Seguenza, Mem. della Soc. Italiana di Scienze Nat. vol. i. p. 44, pl. vi. figs. 1–10, 1865; Bull. Soc. Géol. France, 2nd ser. vol. xxv., 1868; Bull. Malacologica Italiana, anno iii., 1870.

Terebratula septata, Jeffreys, Proc. Zool. Soc. 1878, p. 407, pl. xxiii. fig. 1 (not Philippi); G. O. Sars, Bidrag til Kundskaben om Norges arktiske Fauna: Mollusca Regionis Arcticæ Norvegiæ, Christiania, pl. i. fig. 2, 1878 (not Philippi).

Terebratula floridana, Jeffreys (not Pourtales), Proc. Zool. Soc. p. 407, 1879.

Waldheimia septigera, Dall, Bull. Mus. Com. Zool. Harvard, vol. iii. p. 13, pl. 1. fig. 4, pl. 2. fig. 9, and Proc. of the California Acad. of Sciences, p. 182, 1872; H. Friele, "Bidrag til Vestlandets Mollusk-fauna, Vidensk.-Selsk. Forhand. p. 57, pl. 1. fig. 2, 1875, and The Development of the Skeleton of the genus *Waldheimia*, Archiv for Mathematik og Naturvidenskab, Bd. ii. p. 380, pl. iii. figs. 5, 6, and pl. iv. figs. 12–14, 1877; E. Deslongchamps, Études Critiques sur les Brachiopodes, p. 98, pl. i. figs. 17 & 18, pl. xv. figs. 4–6, and pl. xvi. figs. 1–3, 1884.

Shell somewhat square, ovate or subpentagonal, broadest anteriorly, more attenuated posteriorly, longer than wide, lateral edges rounded, wide and nearly straight in front, anterior margin sinuated, corners obtusely rounded anteriorly. Dorsal valve evenly convex to about half its length; anterior half divided into three lobes, the central one by far the largest and widest, forming a slightly raised, rounded, wide mesial fold. Ventral valve deeper than the dorsal one, with a wide concave sinus commencing at a short distance from the beak, and gradually widening until it reaches the front; beak incurved and truncated by a rather large circular foramen, completed and separated from the hinge-line by a deltidium in two pieces; lateral portions of the beak rounded. Surface of valves smooth, but marked by numerous fine concentric lines of growth. Colour light yellowish or greyish white. Shell-structure punctate. Dimensions variable, two large specimens measured:—

Length 1 inch 8 lines, breadth 1 inch 4 lines, depth 1 inch.
,, 1 ,, 8 ,, ,, 1 ,, 1 line, ,, 10 lines.

In the interior of the dorsal valve, the cardinal process is so small that it can hardly be differentiated from the hinge-plate, and from under which a mesial septum extends to one half the length of the valve. Loop long, simple and reflected, the lamella of the reflected portion being wide, the principal stems nearly parallel.

Hab. Off Norway, Finmark, &c., in 100 to 300 fathoms. Atlantic coast of Spain. Dredged by the 'Porcupine' Expedition at various northern stations, at depths from 75 to 755 fathoms (Jeffreys). In British Seas between Shetland and Faeröe, by Jeffreys and J. Murray, in 345 to 570 fathoms. Vigo Bay (M'Andrew). Off Marocco and the Canary Islands ('Talisman' Expedition) in 331 to 861 fathoms.

Obs. The shell and some parts of the animal have been carefully examined. Mr. Dall says that its visceral area is very small, the muscular attachments being even smaller than in *Waldheimia floridana*. The stomach, produced into a point without differentiation of the intestine, is very much shorter than in *W. floridana*.

The development of the skeleton or loop in this species has been well studied and illustrated in two papers by Herman Friele in 1875 and 1877, and by E. Deslongchamps in 1884. Dr. Gwyn Jeffreys and myself have also followed out the same investigations. Herr Friele begins by informing us that he has not been able to examine the first stages in the development of the loop in this species, as he had done for that of *Waldheimia cranium*; that the youngest examples of *W. septigera* he has seen measured 1, 2, and 3 lines in length, and represented the second stage of *W. cranium*, in which the united lamellæ begin to split apart at the anterior end; and that the only essential difference at that age is in the form of the septum, being 4·5 millimetres and 5·5 millimetres respectively. The next stage he terms the *Megerlia* stage, the shell having attained 4 lines in length. In this stage in *Waldheimia cranium* the lateral walls were broken down by an aperture appearing in the middle of each and widening backwards. In *W. septigera* the break occurs, on the contrary, on the posterior end of the walls, and extends in a forward direction, the similarity at this stage to *Terebratella* being striking. The connection between the process of the lamellæ and the septum is severed in a specimen 6 lines in length, and in a specimen 8 lines in length the lamellæ are separated and the character of the loop is that of the adult *Waldheimia*. In Plate XI., figs. 7, 8, 9, 10 are from Friele's memoir, showing the modifications above described.

Waldheimia septigera was described for the first time by Lovén, in 1846; but having neglected to give a figure of his species, the shell was very little known until 1855, when I gave a figure of it in the Ann. & Mag. Nat. Hist. In 1863, in vol. ii. of his 'British Conchology,' and subsequently in a paper in the Proc. Zool. Soc., Dr. Gwyn Jeffreys erroneously maintained that Lovén's *Waldheimia septigera* was a synonym of Philippi's *Terebratula septata*, and this mistaken view he maintained to the last. In 1846, Signor Seguenza, after much trouble and skill, examined the perfect loop in several adult examples of Philippi's *T. septata*, and found it to be three times attached, as in *Terebratella*, while the loop in *W. septigera* is only twice attached, as in *Waldheimia*. The same indefatigable palæontologist also examined the loop of his Pliocene *Terebratula peloritana*, and found it to agree with that of *Waldheimia septigera*, of which he admits it to be a synonym.

My valued and distinguished friend Dr. Gwyn Jeffreys was again mistaken when he said, at p. 408 of his paper in the 'Proceedings of the Zoological Society' for 1878, that *Waldheimia peloritana* and *W. floridana* appear to be the same variety of *Terebratula septata*. Having had all the developed specimens in my hands, I am able to give my full support to Prof. Seguenza's statement.

Waldheimia septigera and *W. Raphaelis* are much more nearly related than either of them are to *W. floridana*. *Terebratella Mariæ* (Adams), from Japanese waters, is also said by Dr. Gwyn Jeffreys to be possibly a variety of *W. septigera* (his *T. septata*); but in the small specimen of *T. Mariæ* I have been able to examine the loop was three times attached, as in *Terebratella*.

Waldheimia septigera, under the name of *W. peloritana*, has been well described and illustrated by Signor Seguenza, in his Monograph of the Brachiopoda from the Tertiary deposits of Messina in Sicily, p. 49, pl. vi. figs. 1–10 (1865). It occurs plentifully in the Upper Pliocene rocks at Gravitelli.

32. WALDHEIMIA RAPHAELIS, Dall. (Plate XI. figs. 11–13.)

Waldheimia Raphaelis, Dall, Am. Journ. of Conch. vol. vi. p. 3, pl. vii. figs. *a, b, c, d*, 1870; Davidson, On Japanese recent Brachiopoda, Proc. Zool. Soc. 1871, p. 303, pl. xxxi. fig. 9.

Shell elongated, longer than wide, somewhat subtrigonal, widest about the middle and anteriorly, tapering posteriorly, nearly straight or gently curved outwardly in front. Dorsal valve moderately convex, with a very wide mesial fold, commencing at about a third of the length of the valve, uniformly and gently convex, or divided longitudinally by a small mesial groove. Ventral valve deeper and more convex than the dorsal one, with a broad deep mesial sinus commencing at a short distance from the extremity of the beak, and becoming deeper and wider as it reaches the front margin; on either side of the sinus the valve slopes abruptly to the lateral margins. Beak slightly incurved and truncated by a large circular foramen, separated from the hinge-line by deltidial plates. Surface smooth, marked only by concentric lines of growth; punctures oval-shaped outside, smaller, more distant, and circular on the interior surface of the valves. Colour light yellowish, with a slight rufous tinge. In the interior of the dorsal valve the cardinal process is small, quadrate, and stout; under it commences a small septum that does not reach to quite half the length of the valve. Loop long, reflected portion broad; crura much curved at their extremity. Length 1 inch 10 lines, breadth 1 inch 5 lines, depth 1 inch $1\frac{1}{2}$ lines.

Hab. Japanese coast, near Yeddo (Plumpelly and Dall). Sagami Bay, depth 100 to 200 fathoms (Döderlein).

Obs. I have seen five good examples of this remarkable species. In Mr. Dall's and Dr. Döderlein's specimens the fold in the dorsal valve is gently convex throughout; in a fine example I obtained from Mr. G. B. Sowerby the fold was probably exceptionally divided into two lobes by a median groove. The shell is named after Prof. Raphael Plumpelly, its nearest ally being the *Waldheimia septigera* of Lovén.

Waldheimia septigera, *W. Raphaelis*, and *W. floridana* belong, as was justly remarked by Mr. Dall, to a peculiar group in the genus *Waldheimia*, and are specifically distinct. The first is from northern European seas, the second from those of Japan, and the third from the Florida coast or reefs.

33. Waldheimia floridana, Pourtales. (Plate XII. figs. 1–5.)

Waldheimia floridana, Pourtales, Bull. Mus. Comp. Zoöl. Harvard, vol. i. p. 127, 1868; Dall, Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 12, pl. i. figs. 1–3, 1871.

Eudesia floridana, Bull. Mus. Comp. Zoöl. arvard, vol. ix. p. 103, 1881.

Shell triangular, widest anteriorly, tapering posteriorly, generally as wide or wider than long; anterior margins strongly flexuous. Dorsal valve uniformly convex posteriorly, anteriorly divided into three lobes, the central by far the largest, forming a wide moderately elevated fold; lateral edges of valves flexuous, anterior corners rounded. Ventral valve deeper than the dorsal one, with a large wide mesial sinus commencing at a little distance from the extremity of the beak and gradually widening as it reaches the front; lateral lobes nearly flat or gently concave, sloping rapidly from the outer side of the fold and sinus to the edges of the shell. Beak incurved and truncated by a small circular foramen, very little separated from the hinge-line by a narrow deltidium in two pieces; beak-ridges rounded. Surface smooth. Colour greyish or brownish white with a slight touch of yellow. Length 11, width 12, depth 8 lines.

In the interior of the dorsal valve the cardinal process is small, the hinge-plate rather large, and from under its base a mesial septum of small elevation extends to about two thirds of the length of the valve. Loop simple, very broad and separate anteriorly, narrow posteriorly. Stomach spherical, with a long cylindrical intestine.

Hab. Very abundant, attached to Florida Reefs, depth 100 to 200 fathoms, on rocky bottom (Pourtales); off Sand Key, 125 fathoms (Sigsbee); off Havana, 175 fathoms (Dall).

Obs. Thanks to the great liberality of Prof. A. Agassiz, I have been able to examine a large number of specimens of this remarkable and well-characterized species from the dimensions of five up to eleven lines in length. When quite young and up to a somewhat advanced period of its growth, the shell is longer than wide, the fold and sinus being scarcely indicated in very young examples. Dall, in his excellent description of this species, states that it belongs to a peculiar group including *W. floridana*, *W. septigera*, and *W. Raphaelis*; he adds:—"Thus it is seen that the smallest species [*W. floridana*] is by far the widest and most inflated proportionately; the second species is the flattest in proportion to its length; and the third the most elongated."

"The greater portion of the mantle of *W. floridana* is of the most extreme tenuity and perfect transparency. It is furthermore so closely attached to the shell as to render its removal intact—even with the aid of acid—a matter of great difficulty. With this exception, the examination of its anatomy is easy. . . . . The soft parts are mostly of a translucent whitish color. The number and disposition of the muscles are similar to those of *W. australis*, already described by various authors. The muscles themselves are of a glistening tendinous appearance, except at their points of attachment, where they are of a more or less dark yellowish-brown. The peduncle is moderately long, and the portion which is external or contained in the foramen is covered with a dark, horny, reddish-brown membrane or skin, and the attached extremity is trumpet-shaped. Upon opening the shell in its normal position, the median spires of the brachia are seen to be somewhat widely separated, and between them is stretched a fine translucent membrane extending forward from the under lip of the mouth and following the downward curve of the median lobes. In this great extension of this membrane this species differs from *T. caput-serpentis* and *W. australis*, in which species the cirrhi of the median lobes touch at their extremities, and are separated by only a very narrow strip of membrane between their bases, so that the appearance is almost as if there was but a single broad band of cirrhi in the median line. This intervening membrane in ordinary specimens of *W. floridana* is about ·24 of an inch in width at its narrowest visible portion. The upper and lower bands of cirrhi in the lateral loops are also much more widely separated by a similar membrane than in *W. australis*. . . . . . The spiral portion in the middle lobe makes about two complete turns. . . . . . The mouth is, as usual, just in front of the posterior junction of the brachial bands, and is in a rather long flexuous groove, the edges of which are of a dark brown colour, and somewhat thickened. . . . . . The œsophagus is about half as long as the intestine, and has a slight curve, of which the convexity is anterior; it is transversely flattened close to the mouth, and is a little compressed laterally, behind that portion. It is of a nearly uniform calibre throughout. It has quite a thin lining membrane, which becomes thicker, though still smooth, in the stomach, and quite thick and longitudinally plaited in the intestine. The stomach is well differentiated from the alimentary canal and intestine, and is of an oval shape. It is embraced by the hepatic digitations, which are of a greenish-yellow color, and empty into the stomach by four ducts. The orifices of these ducts are of a compressed oval shape, obliquely inclined, and the anterior pair, which correspond to the right and left anterior congeries of hepatic digitations, are twice as large as the posterior pair, which similarly correspond to the anterior lobes or bunches of digitations. . . . . The intestine is twice as long as the œsophagus, of uniform calibre, and perfectly straight. It leaves the stomach abruptly without any dilatation of the portion adjacent to the latter organ, and reaches about half-way to the dorsal valve. The heart is situated behind the junction of the stomach and intestine. The termination of the intestine is abruptly rounded off and not at all pointed. It is entirely closed, and is upheld by the mesentery. It is also of a much darker color than the rest of the alimentary canal, being of a deep chestnut brown hue."

"The great pallial sinuses and their ramifications in *W. floridana* are of much less extent and disposed in quite a different manner from that which obtains in *W. australis*. The hæmal pallial system consists essentially of four branches which are remarkable for their straight course and the paucity of their ramifications. The neural pallial system is very similar, with a greater number of small sinuses about the perivisceral cavity, but in both lobes the narrowness and small extent of the sinuses, as compared with those of other species, is very marked, and the same is true with regard to the ovaries. But a very few exceedingly delicate spiculæ were observed in the floor of the greater sinuses. The heart consists of a very minute pyriform vesicle situated behind the intestine at its junction with the stomach, and sending one vessel in the hæmal direction along the median line of the stomach, and another on each side laterally. . . . . . The ovaries are very limited in extent and principally confined to that portion of the sinuses which surrounds the visceral cavity, only their ultimate extremities entering the larger branches of the great sinuses. . . . . . The ova were visible in all stages of growth. Those floating free in the lacunes were nearly spherical, and of a flesh-colour; their substance seemed of a granular consistency, due perhaps to the action of the spirit in which they were preserved. The immature ova were pyriform, attached to the ovary by their pointed ends. . . . . . No spermatophoræ or spermatozoa were observed in any of the specimens examined. The oviducts are situated as in *W. australis*. The lining-membrane of their trumpet-shaped portion was drawn into thin plicæ. Their apices were teat-shaped, with very small orifices. . . . . . The setæ are very slender and fine, irregularly marked with transverse lines, but smoother towards their outer ends. They protrude from their follicles, hardly more than one third of their length. . . . . The mantle edge was brownish and seemed to have a slightly villous epithelium."

I have reproduced this long extract from Mr. Dall's admirable memoir, as I have done in similar cases from the works of other authors, because all that relates to the animal of different species of the same genus is of the utmost importance. The animals of species of the same genus no doubt agree in their general character, but often differ considerably in their respective details, and these differences should always, when possible, be carefully noted. The animal of every species should also under favourable circumstances be anatomically examined and described.

In his "Contributions to the Fauna of the Gulf Stream at great Depths" (Bull. Mus. Comp. Zoöl. vol. i. p. 127), Count L. F. de Pourtales informs us, in his description of *Waldheimia floridana*, that "Very young specimens are flatter, rounder, and have a straight margin; they could scarcely be distinguished from the young of *Terebratula cubensis*, if it was not for the loop and septum seen by transparency. There is also some variety of form in the old; in some specimens the length is greater than the breadth, and there is considerable diversity in the sinuosity of the frontal margin. . . . . . It is always associated with *Terebratula cubensis*, the latter being still more common (in the proportion of about three to one), and making its first appearance in 100 fathoms."

34. Waldheimia (Macandrevia) cranium, Müller, sp. (Plate XII. figs. 11–23; Plate XIII. figs. 1, 2.)

Terebratula cranium, Müller, Zool. Danicæ Prodromus, p. 249, no. 3006, 1776.

Anomia vitrea, Chemnitz? (not Born), Conch.-Cab. vol. viii. p. 97, t. 78. figs. 707 & 709, 1795.

Terebratula cranium, Montagu, Trans. Linn. Soc. vol. xi. p. 188, tab. xiii. fig. 2, 1811; Turton, Conch. Dict. of British Isles, 1819.

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Shell lenticular or ovate globose, longer than wide, broadest about the middle, lateral margins rounded, anteriorly subquadrate or rounded, sometimes much thickened at the margins. Dorsal valve evenly convex, without fold or sinus. Ventral valve deeper than the dorsal and evenly convex; beak slightly incurved, short, and truncated by an incomplete circular foramen, margined anteriorly by the umbo and by two rudimentary deltidial plates, which are in many specimens absent; beak-ridges not very sharply defined. Surface smooth, marked only by concentric lines of growth. Colour yellowish white or light horny. Shell-perforations separated by interspaces of about equal size. Dimensions variable—length 1 inch 1 line, width 10 lines, depth 7 lines. In the interior of the dorsal valve there is no defined cardinal process or mesial septum, but two deviating septa commence under the extremity of the umbo and extend to a little more than one fourth of the length of the valve; loop long, attached to the base of the hinge-plate, and extending to about four fifths of the length of the valve before becoming reflected *. In the interior of the ventral valve the teeth are supported by strong dental plates.

Hab. *W. cranium* is an abundant shell near the coast of Norway and in the northern seas. It was dredged on several occasions by R. MacAndrew and L. Barrett between Vigten Islands and the North Cape, in 25 to 160 fathoms, attached to stones; only abundant at Omnæsöe. Dr. Gwyn Jeffreys dredged it many times during the 'Lightning' and 'Porcupine' Expeditions off the Faeröe Islands, in 164 and 208 fathoms, and as deep as 690 fathoms during the 'Porcupine' cruise in 1869. MacAndrew obtained it outside Vigo Bay in 30 fathoms, Wallich in Greenland, and the Marquis de Folin and Dr.

* So delicate and brittle is the loop at the point where the primary lamellæ become reflected, that both Dr. J. Gwyn Jeffreys and Dr. W. B. Carpenter for some time entertained the mistaken opinion that at that point they were naturally disunited. This led Dr. Jeffreys to remark on p. 13 of the second volume of his 'British Conchology':— "Having carefully cleaned the inside of a specimen of *T. cranium*, containing the dried remains of the animal, with a weak solution of potash, and examined several other perfect shells of different ages, I could not perceive the least appearance of a loop, which is so evident in *T. australis*. The lamellar processes in the lower valve of *T. cranium* are equal in length, and end in sharp points. They may be compared to the chariot-blades used by the ancient Scythians, and they somewhat resemble the falciform apophyses of *Teredo* and *Pholas*. In the young of *T. cranium* these processes are extremely short. Their arrangement and shape are so dissimilar in species closely allied in other respects, that I should be inclined to consider their importance, as characters of generic distinction, somewhat doubtful." It was some considerable time before I could convince my distinguished friend that the loop of *Waldheimia cranium* differed but little from that of *W. flavescens*.

P. Fischer off the south-west of France, in from 5 to 650 fathoms. It was also dredged by Prof. Sars, Friele, and others off the Norwegian coast; east coast of Shetland (Fleming and Jeffreys); North Hebrides by Dr. W. B. Carpenter and Sir Wyville Thomson, in 170–650 fathoms, &c.

Waldheimia cranium occurs fossil under the name of *Terebratula euthyra*, Philippi, in the Upper Pliocene rocks of Valle Lamato in Calabria, and near Catancaro near Reggio, at Gravitelli, Rometto, and other places near Messina in Sicily (Seguenza). Prof. Sars and others quote it from the glacial and post-glacial deposits of Norway. *Waldheimia cranium* has been recorded as from Halifax in Nova Scotia by the late Mr. Willis; but I have been informed by Mr. Dall, Mr. Whiteaves, and others, that what he took for the shell under description was a specimen of *Terebratella spitzbergensis*.

Obs. This species, its shell, animal, and different stages of development have been carefully investigated and admirably described by several competent zoologists. It has, however, been classed in the genera *Terebratula*, *Waldheimia*, and *Macandrevia*. In 1859, Prof. W. King considered that the species should be separated from *Waldheimia*, on account of the deviating septa and want of a mesial septum in the dorsal valve, as well as by the absence of dental lamina in the ventral one. I, however, with Mr. Dall, question whether the differences brought forward are of sufficient value to warrant us in admitting it as a separate genus; they are, at most, we think, subgeneric differences.

To Herman Friele we are indebted for a most valuable and important investigation into the modifications assumed by its loop, from the very youngest age up to the adult condition, which I now propose, in part, to transcribe from his memoir published in 1877. I also reproduce some of his figures on Plate XII., regretting that space will not permit me to give them all. He says:—"The earliest stage at which a coherent apophysary system of the *Waldheimia cranium* is observed, has a size of a little less than three millimetres [1 line], the hæmal valve being two millimetres [Plate XII. fig. 16]. Two long thin lamellæ project from the crura, connect with a filiform septum and run together in an acute angle in front, where they unite. By the connection of the lamellæ two close-set walls are given off, which by a reflection form a tube, the posterior end of which is closed. The size of the hæmal valve has reached 2·5 millim., but the state of things remains the same, save that both the loop (or the tube) and the lamellæ have expanded. [See Pl. XII. figs. 17, 17 *a*] *a* the lamellæ, *b* the two issuing vertical walls, or the lateral walls of the tube, *c* the closed tube (or the loop).

"The first visible change occurs *by an opening in the closed end of the tube* [figs. 18, 18 *a*]. The united lamellæ then begin to split apart at the anterior end. The hæmal valve has now attained the size of 1·5 millim. A continuous expansion of the loop-complex causes *a perforation in the lateral walls* [Pl. XII. fig. 19], and the septum becomes thinner and thinner. The next sizes observed were 5·2 millim. and 5·6 millim. (hæmal valve) [Pl. XII. fig. 21]. The same characteristics as those seen in [Pl. XII. fig. 19] are still in the main prevailing, but *the connection with the septum is broken off*, and there remains but a little lump of the latter at the bottom of the valve. The wedgeformed separation of the lamellæ have progressed so far [Pl. XII. fig. 21], that only a short band of connection is left between them; the apertures in the walls have likewise widened, and a narrow slip is all that still combines the lower and the upper parts.

"The stage of growth illustrated by [Pl. XII. figs. 19–21], may properly be designated the *Megerlea Stage*, and it would be difficult to recognize in this state either the individual described in [Pl. XII. figs. 16 and 17], or the fully developed *Waldheimia*. In order to become a mature *Waldheimia* the band between the lamel-processes and the loop must vanish and the connected lamellæ must separate." In another figure, which we have not reproduced, "the *hinder connection between the upper and lower parts is completely severed*, but the lamellæ are still, though slightly, connected." In the next stage the connection is cut, Pl. XII. fig. 22, and in fig. 23 we have the most mature *Waldheimia cranium*. Here Friele gives figures from one fifth of a line in length up to one line, the smallest of which is no bigger than a dot.

Waldheimia cranium has sometimes been confounded with *Liothyris vitrea*, to which it occasionally bears some general external resemblance; but the two forms are not only specifically, but completely generically distinct. Mr. Lucas Barrett was able to examine the animal alive, and states that "the oral arms are so fixed to the calcareous skeleton as to be incapable of motion, except at their spiral terminations. . . . . It has been supposed that these conjoined spiral ends can be unrolled like the proboscis of a butterfly; I never saw any disposition of the kind manifested. This species is more lively than *caput-serpentis*, moving often on its pedicle, and is more easily alarmed." The cirri are not protruded beyond the margins of the valve; when the shell is closed they are bent up; no currents were detected by Barrett, though frequently sought for. Dr. Gwyn Jeffreys states likewise (*op. cit.* vol. v. p. 163) that he has also frequently observed *W. cranium* turn round its peduncle, apparently in order to improve its position for the purpose of feeding, and that the valves on being touched close with a snap.

In Van Bemmelen's "Over den Bouw der Schelpen van Brachiopoden en Chitonen," 1882, and in his "Untersuchungen über den anatomischen und histologischen Bau der Brachiopoda Testicardinia," 1883, the author enters upon many anatomical and structural details with respect to *Waldheimia cranium*; he says that the number of cæca on the same part of the shell-structure in very old and young specimens was found to be the same; this fact, showing that the distance between two cæca (perforations) does not change with age, led him to the conclusion *that no intussusception occurs during the growth of the shell*. The bases of the calcareous prisms were found to be very regular-shaped at the margin of the shell (especially in *Terebratula* and *Terebratulina septentrionalis*); they became very irregular towards the older parts. The concentric lines of growth occurring on the outer surface were totally absent on the inner surface, which is explained by supposing the apposition at the margin to stop for some time, while the formation of new layers on the whole under surface continued. In *Waldheimia cranium* he found the sexes were separate.

Mr. Albany Hancock describes and figures the soft parts of the animal in his admirable memoir already so often referred to, and from which I now give a few extracts, with reproductions of his admirable figures of the dorsal and ventral views of *Waldheimia* *cranium* (Pl. XIII. figs. 1, 2). He says that in *Waldheimia cranium*, and in *Terebratulina caput-serpentis*, "the dorsal adjustor muscles are not attached to a hinge-plate, as in *W. australis*, but have their insertions in the ventral valve itself, and are very large and powerful. In both species the superior extremities of these muscles are seen at the surface of the animal, on each side of the median line, elongated in the antero-posterior direction and extending between the occlusors almost as far forward as the anterior margins. . . . The divaricators and the accessory divaricators in *W. cranium* are likewise united in the same manner as in the species before alluded to." Mr. Hancock further observes that "the arms in *W. cranium* and *T. caput-serpentis* are disposed in the same manner as in *W. australis*; and in the former the calcareous loop is precisely similar to that of the latter; but in *T. caput-serpentis* it is very much reduced, the extended lateral portions having almost entirely disappeared, little more than the transverse portion existing; and this, together with the crural processes, which are united below across the median line, forms a collar upon which the bases of the arms rest.

"In *W. cranium* the intestine is very short, terminating in a blind sac before it reaches the ventral wall of the perivisceral chamber. It tapers gradually to a point, which is rounded, and suspended in its place by the mesentery. The mucous membrane, lining the intestinal tube of *W. cranium*, is exceedingly thick, and produced into five or six excessively stout, longitudinal folds, which in transverse sections exhibit a pyramidal contour, their apices almost meeting in the centre of the tube . . . . In *W. cranium* the genitalia are arranged as in *W. australis*, only the bands do not extend so far forward, and are of a pale yellow colour. The red matter is also present, sprinkling the surface with distant round spots. The bands are very finely granular, and in no instance have I detected eggs in them. It is therefore probable that those examined were out of season." Mr. Hancock also observes:—"There is no modification to note in the perivisceral chamber in any of the Terebratulidæ that I have had an opportunity of examining. The pallial sinuses, however, vary in several species. Thus in *W. cranium*, though there are still four such sinuses in each lobe, the trunks are proportionately smaller, and more nearly of a size; the branches are fewer and more attenuated, but, as in the other species, divided dichotomously twice or thrice, without any very marked symmetry."

The animal of *Waldheimia cranium* although differing in some unimportant details from that of *Waldheimia flavescens* is essentially similar. In both the loop is the same, and there is no difference, of any great importance, in the shape of the shell. I therefore question the necessity of burdening the nomenclature by placing *W. cranium* and *W. flavescens* in different and distinct genera. But as the contrary view has been expressed by such excellent observers as Prof. W. King, Douvillé, Zittel, Waagen, Deslongchamps, and others, I would not wish to press my own views too far, in opposition to theirs. M. Douvillé seems to think that *W. cranium* possesses a special development of its loop; while M. E. Deslongchamps, at page 141 of his 'Études critiques sur les Brachiopodes,' 1884, differs from M. Douvillé, and expresses his opinion that the general appearance of the loop of *Macandrevia cranium* is actually the same as that attributed to *Waldheimia*. The shape of the principal stems shows the greatest resemblance to those of *Zeilleria*; but the position of the larger-sized adductor muscles is no longer the same as in *Waldheimia*, while the complete absence of a mesial septum and the shape of the largely divided hinge-plate would, in his opinion (Deslongchamps'), be valid grounds for separating the genus *Macandrevia* from *Waldheimia*.

35. WALDHEIMIA (MACANDREVIA) TENERA, Jeffreys, sp. (Plate XII. figs. 6–10.)

Terebratula tenera, Jeffreys, Ann. & Mag. Nat. Hist. 4th ser. vol. xviii. p. 250, 1876, and Proc. Zool. Soc. 1878, p. 405, pl. xxii. fig. 7.

Shell rather small, extremely thin and delicate, oval, longer than wide, rounded laterally, less so in front; surface smooth, marked only by fine concentric lines of growth, and perforated by minute canals. In the interior of the dorsal valve no cardinal process is observable; hinge-plate comparatively large, and divided into two parts by a narrow mesial depression, between which, in the middle, a very narrow delicate longitudinal ridge or rudimentary septum is present, which extends to about one fifth of the length of the valve. The inner slopes of the hinge-plate extend likewise in the shape of two septa of small elevation to about the same distance, first diverging, then converging to the anterior extremity of the small median ridge. At the base of the hinge-plate the principal delicate stems of the loop are attached, and these extend to about two thirds of the length of the valve before they are reflected. Colour light brown. Length 6, breadth 4, depth 3 lines.

Hab. Dredged by Dr. Gwyn Jeffreys during the return voyage of H.M.S. 'Valorous' from Davis Strait, in lat. 56° 11′ N., long. 37° 41′ W., at a depth of 1450 fathoms, on a sea-bottom of *Globigerina*-ooze and stones.

Obs. I have seen two or three perfect examples of this extremely delicate species, brought home by Dr. Gwyn Jeffreys. The shell seemed full-grown. A specimen about one line in length showed traces of one of its early stages of growth, in the presence of a small vertical septum, at about half the length of the valve, to which the loop at that age had an attachment, as Friele has so well described to be the case in *Waldheimia cranium*.

Dr. Gwyn Jeffreys observes that "this species differs from *T. cranium* in being only half the size in exact measurement, and consequently one fourth in bulk; it is of a different shape, texture, and colour, compressed instead of convex, having a much shorter beak and smaller orifice, with not half the proportionate number of tubercles; and the blades are closer together, and do not extend so far towards the front. In the young of each species the comparative number of tubercles and prominence of the beak are distinctly marked; and the septum in the present species is shorter, although conspicuous and gnomon-shaped."

Uncertain Species.

36. WALDHEIMIA WYVILLII, Davidson. (Plate X. figs. 5, 6.)

Waldheimia Wyvilli, Davidson, Proc. Roy. Soc. vol. xxvii. p. 438, 1878; and (*W. wyvillii*) Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 44, pl. iii. figs. 13 *a*, *b*, 1880.

Shell ovate or longitudinally oval, very thin, semitransparent, light brownish yellow, smooth, marked at intervals by concentric lines of growth. Dorsal valve moderately convex longitudinally, slightly flattened along the middle. Ventral valve deeper and more convex than the dorsal one, without sinus; beak incurved, truncated by an incomplete foramen, margined laterally by small deltidial plates. In the interior of the dorsal valve the loop is long and simple, the principal branches extending to a little beyond two thirds of their length before becoming reflected. Length 9, width 7, depth 5 lines.

Hab. Only one incomplete example was dredged by the 'Challenger' Expedition, off Valparaiso, at a depth of 2160 fathoms. *Terebratula Wyvillii* and *Discinisca atlantica* were obtained at the same time.

Obs. In external shape this species approaches *Waldheimia cranium*, which is, however, a thicker and more convex shell. The extremely delicate shell of *W. Wyvillii* is very remarkable, and reminds us of that of *W. tenera*, from which, however, it seems to differ in size and in some other particulars.

The fact that several of the species obtained at such depths as *Terebratula Wyvillii* and *Discinisca atlantica* possess such extremely thin and delicate glass-like shells, is certainly worthy of notice.

NOTE.—In accordance with the verbally expressed wishes of the late Thomas Davidson, LL.D., F.R.S., "The Davidson Collections of Recent and Fossil Brachiopoda" were presented to the nation, with the manuscripts and original drawings for many of his publications on the Brachiopoda, and the extensive series of works and pamphlets he had accumulated during nearly fifty years' investigation of this group of animals. The recent specimens are associated with the fossil species in the Geological Department of the Natural History Branch of the British Museum at South Kensington. The literature now forms part of the library of the same department in that Institution. [A. C.]

DESCRIPTION OF THE PLATES.

PLATE I.

Figs. 1–6. *Liothyris vitrea*, Born, sp., at various stages of growth. Mediterranean Sea (Davidson Collection, Geological Department, British Museum). 6. Interior of the dorsal valve, enlarged. *cp*, cardinal process; *sl*, short loop; *dg*, diverging grooves for the attachment of the pallial sinuses.

Fig. 7. Exterior of ventral valve of the same species, showing the four internal radiating furrows which serve for the attachment of the pallial sinuses, seen through the transparent shell.

Fig. 8. Interior of the ventral valve after E. Deslongchamps. *cv*, visceral cavity; *ap*, raised portion of the mantle forming the walls of the visceral cavity; *srl*, furrow corresponding to the lateral venous sinus; *svm*, furrow corresponding to the median venous sinus.

Fig. 9. Interior of the ventral valve showing the position of the muscular impressions. *a*, adductor or occlusor; *b*, ventral adjustors; *c*, divaricators.

Fig. 10. Malformation of *Liothyris vitrea* (after E. Deslongchamps), seen in profile, showing a longitudinal frontal septum in both valves.

Fig. 11. Full-grown spiculum, much magnified (after E. Deslongchamps), from a venous sinus near the raised part of the mantle of *Liothyris vitrea*.

Fig. 12. Portion of the shell of *Liothyris vitrea*, magnified (after Van Bemmelen), to show the perforations and imbricated arrangement of the prisms.

Figs. 13–13 *b*. *Liothyris vitrea*, var. *minor*, Philippi, from the Straits of Messina (Davidson Collection, Geol. Dept., British Museum).

Figs. 14–16. *Liothyris vitrea*, var. *Davidsoni*, A. Adams, from Satanomosaki, Japan. 14. (Davidson Collection, Geol. Dept., British Museum.) 16. Interior of dorsal valve.

Figs. 17, 18. *Liothyris arctica*, Friele, sp. 17. Exterior, of natural size. 18. Interior of dorsal valve, enlarged. (Davidson Collection, Geol. Dept., British Museum.)

Fig. 19. *Liothyris cernica*, Crosse, sp.: after Crosse's figure, Journ. de Conch. vol. xvi. pl. i. fig. 3. The specimen was obtained near the Island of Mauritius, from the stomach of a fish.

Figs. 20, 21. *Liothyris Bartletti*, Dall, sp., from near Santa Cruz (Museum of Comp. Zool., Harvard).

Plate II.

Figs. 1–4. *Liothyris Moseleyi*, Davidson. 1–1 *b*. Exterior of the shell. 2. Interior of dorsal valve, to show the loop. 3. Interior of ventral valve, enlarged, showing the muscles; *a*, occlusor; *b*, ventral adjustor; *c*, divaricator; *m*, mantle; *n*, dorsal pallial nerves; *d*, dorsal pallial arteries. 4. Interior of dorsal valve, showing the labial appendages. 'Challenger' Expedition. West of Kerguelen Island. (Zoological Department, British Museum.)

Figs. 5–7. *Liothyris uva*, Broderip, sp. 5–5 *b*. Type from Gulf of Tehuantapec (Zoological Department, British Museum). 6–6 *b*. A smaller specimen, from the same locality (Davidson Collection, Geol. Dept., British Museum). 7. Interior of dorsal valve, to show the loop.

Figs. 8–14. *Liothyris Wyvillii*, Davidson, at various stages of growth. 12. Interior of dorsal valve, to show the loop. Dredged by 'Challenger' Expedition at different places named in the description of species. (British Museum and Davidson Collection.)

Figs. 15, 16. *Liothyris subquadrata*, Jeffreys, sp. 15, 15 *a*, 15 *b*. Exterior of the shell after the type, in Davidson Collection, Geol. Dept., British Museum; 15 *c*. Shell-sculpture enlarged. From Setubal, coast of Portugal, near the mouth of the Tagus. 16. Interior of dorsal valve of the same species.

Figs. 17, 18. *Liothyris sphenoidea*, Philippi, sp.: 'Travailleur' Expedition; off Morocco. (Muséum d'Histoire Naturelle, Paris.) 18. Interior of dorsal valve, to show the loop.

Figs. 19–22. *Liothyris sphenoidea*, Philippi (=*cubensis*, Pourtales). 19, 19 *a*, 19 *b*, 21, 22. Florida reefs, dredged by M. de Pourtales (Davidson Collection, Geol. Dept., British Museum). 20. Ascension Island; dredged by 'Challenger' Expedition (Zoological Department, British Museum).

Figs. 23–23 *b*. *Terebratula* (or *Terebratulina*?) *Dalli*, Davidson. 23. Type, natural size: dredged by 'Challenger' Expedition, lat. 34° 37′ N., long. 140° 32′ E. 23 *a*, 23 *b*. Enlarged. The only known specimen is in the Zoological Department, British Museum.

Plate III.

Figs. 1–3 *a*. *Terebratulina Wyvillii*, Davidson. 1, 1 *a*, 1 *b*. Exterior of the type, dredged by 'Challenger' Expedition, N.W. of St. Thomas, West Indies, in 390 fathoms. 2. Interior of dorsal valve from same species (Zool. Dept., British Museum). 3. Smaller specimen dredged by the 'Travailleur' Expedition, from the western coast of Africa (Muséum d'Histoire Naturelle, Paris). 3 *a*. Shell-sculpture enlarged.

Figs. 4–5 *a*. *Terebratulina Crossii*, Davidson. 4, 4 *a*. Type from Japanese water (Coll. of M. H. Crosse). 5, 5 *a*. A smaller specimen, same habitat (Davidson Collection, Geol. Dept., British Museum).

Fig. 6. *Terebratulina Crossii*, Davidson. A large light salmon-coloured specimen obtained from Sagami Bay, Japan, by Dr. L. Döderlein, and from his Collection.

Figs. 7–11 *a*. *Terebratulina japonica*, G. B. Sowerby, sp. A series of specimens from Japanese waters (British Museum and Davidson Collection). 11, 11 *a*, represent the *Terebratula angusta*, Adams and Reeves, which is only a young *Terebratulina japonica*.

Figs. 12, 12 *a*. *Terebratulina caput-serpentis*, Linné, sp., from Sagami Bay, Japan, found associated with *T. japonica*. In the Collection of Dr. Döderlein.

Plate IV.

Figs. 1–5. Various stages of growth of *Terebratulina caput-serpentis*, Linné, sp. 1, 2. Large specimens in the Zool. Dept., British Museum. 3, 4, 4 *a*, 4 *b*. Specimens of ordinary size from the coast of Scotland. 5. A very young specimen (after E. Deslongchamps).

Fig. 6. A young specimen in which the crura of the loop are not yet united.

Fig. 7. Interior of the dorsal valve of *Terebratulina caput-serpentis* (after E. Deslongchamps), showing the labial appendages and the cirri. *ac*, cardinal process; *vc*, visceral cavity; *b*, mouth; *bc*, descending or primary portions of the arms; *br*, ascending or reflected portions of the arms; *mi*, interbranchial membrane; *e*, shield; *sp*, median portion of the arms spirally coiled.

Fig. 8. Dorsal view of *Terebratulina caput-serpentis* deprived of its shell (after Hancock). *a*, pallial lobe; *b*, body; *c*, peduncle; *d*, *d*, great pallial or genital sinuses; *e*, ramifications of ditto; *f*, muscular ties passing between the walls of ditto; *g*, genitalia seen through the walls of ditto; *h*, marginal fold; *i*, setæ; *j*, extreme pallial margin; *k*, depressions corresponding to the bases of the crura; *l*, ridge formed by the union of the pallial margins; *m*, edge of dorsal mesentery; *n*, liver seen through the walls of the perivisceral chamber; *o*, extremities of anterior occlusors; *p*, ditto of posterior occlusors; *q*, ditto of divaricators; *r*, ditto of dorsal adjustors.

Fig. 9. Ventral view of the same (after Hancock); the letters up to *j* agree with those of fig. 8. *k*, extremities of occlusor muscles; *l*, ditto of divaricators; *m*, ditto of ventral adjustors; *n*, ditto of peduncular muscle; *o*, peduncular nerves.

Fig. 10. Interior of the ventral valve of *T. caput-serpentis* (after E. Deslongchamps), showing the mantle in its entirety. *vc*, visceral cavity; *ap*, raised portion of the mantle forming the wall of the visceral cavity; *o*, organs of reproduction; *svl*, lateral venous sinuses; *svl**, trunks accruing from the division of the sinuses; *svm*, median venous sinus; *r*, small branches of the venous sinuses; on all the circumference one sees distinctly the festooned muscular border of the mantle, whereon are implanted a multitude of hairs (enlarged 5 diameters).

Fig. 11. Interior of the dorsal valve of the same species (after E. Deslongchamps), showing the mantle also in its entirety. The same letters indicate the same parts on this valve, and the parts correspond with those of the ventral valve, with the exception of *ab*, which shows the brachial apparatus in the shape of a ring (enlarged 5 diameters).

Plate V.

Figs. 1–30. *Terebratulina septentrionalis*, Couthouy, after Morse, "Embryology of *Terebratulina*," Mem. Soc. Boston Nat. Hist. vol. ii. pl. viii., 1873.—1. A cluster of eggs from the genital band. 2, 3, 4. Eggs from the perivisceral cavity immediately after their escape from the pallial sinuses. 5. First ciliated stage. 6, 7, 8. Successive stages of transverse division of embryo, showing long tuft of cilia at cephalic extremity. 9, 10, 11. From a single embryo, showing various outlines assumed while swimming. 12, 13, 14. Different embryos showing first appearance of caudal or peduncular segment. 15, 16. Representing the same embryo contracted and expanded. 17, 18, 19. Embryos just attaching themselves by their caudal segment. 20. Embryo showing first appearance of ventral (?) area by the bulging of the thoracic ring. 21, 22. Embryos in various stages showing widening of thoracic ring, and its gradual growth towards enclosing the cephalic ring. 23, 24, 25. Successive stages of the embryo, showing formation of dorsal and ventral areas by the folding and growth of the thoracic ring. In fig. 26 the head is still seen projecting from the dorsal and ventral folds of the thoracic ring. 27 to 30. Succeeding stages of embryos drawn in various positions. The deciduous setæ appear in these stages.

Fig. 31. One of the earliest stages of *Terebratulina septentrionalis*, after Morse (*op. cit.* pl. i. fig. 3), "in which the body has rapidly lengthened, and the peduncle is equal in length to the

remaining portion of the animal." *p*, peduncle; *pa*, point of attachment of peduncle; *cæ*, pallial cæca; *se*, setæ. ("Early Stages of *Terebratulina*," Mem. Soc. Boston Nat. Hist. vol. ii. pl. i. fig. 3.)

Fig. 32. A spiculum of *Terebratulina caput-serpentis*: highly magnified (after Hancock).

Fig. 33. Portion of the internal surface of the shell of *T. caput-serpentis*, showing the imbricated arrangement, and the internal orifices of the vertical perforations arranged in rows: magnified 100 diameters (after Carpenter).

Figs. 34, 34 *a*. *Terebratulina caput-serpentis*: very young, dredged by the 'Travailleur' Expedition. Coll. of the Marquis de Folin.

Figs. 35–37. *Terebratulina caput-serpentis*, var. *emarginata*, Risso, = var. *mediterranea*, Jeffreys; from the Mediterranean Sea; 37, was dredged alive between Pantellaria and Sciacca, Sicily. All in Davidson Collection, Geol. Dept., British Museum.

Figs. 38–40. *Terebratulina caput-serpentis*, var. *unguiculata*, Carpenter: 38, 39, exterior of shell; 40, interior of dorsal valve. Off Vancouver Island. (Davidson Collection, Geol. Dept., British Museum.)

Figs. 41–42 *a*. *Terebratulina Cailleti*, Crosse. 41–41 *c*. From Barbados (Davidson Collection, Geol. Dept., British Museum); 42, 42 *a*. Type, after Crosse's figure.

Figs. 43–52. *Terebratulina septentrionalis*, Couthouy, from off Halifax, Nova Scotia, and Lockport, Maine, at different ages (Davidson Collection, Geol. Dept., British Museum). 43, 44. Full-grown individuals. 47. A cluster of specimens attached to one another. 50, 51. Young examples. 48. Interior of dorsal valve and loop; 49. Dorsal valve, showing labial appendages. 52. Portion of shell, magnified.

Figs. 53–53 *b*. *Terebratulina Cumingi*, Davidson: type. From China seas.

Fig. 54. *Terebratulina abyssicola*, Adams and Reeve, sp.: after Reeve's figure. Off Cape of Good Hope. (Davidson Collection, Geol. Dept., British Museum.)

Plate VI.

Figs. 1–8 *b*. *Terebratulina cancellata*, Koch, sp. 1–7. Specimens dredged by the 'Challenger' Expedition off Moncœur Island, Bass Strait, in from 38 to 40 fathoms; 7. Interior of the dorsal valve, enlarged, showing the labial appendages. 8–8 *b*. A small dwarfed form, dredged by Mr. J. Brazier at Inner North Head, Port Jackson, N.S.W. (Davidson Collection, Geol. Dept., British Museum.) Specimens 1–7 in Zool. Dept., British Museum.

Figs. 9–14. *Terebratulina radiata*, Reeve, sp. Different forms from the Cape of Good Hope (Davidson Collection, Geol. Dept., British Museum). 12. Specimen showing black colour-markings.

Figs. 15–17. *Terebratulina*? *Murrayi*, Davidson. 15. Outline of shell, natural size. 15 *a*, *b*, enlarged. 16. Dorsal valve, with loop magnified. 17. Dorsal valve, showing mantle, enlarged. Dredged by the 'Challenger' Expedition near Kermadec Island, south of the Fiji Islands, depth 600 fathoms. (Zool. Dept., British Museum.)

Figs. 18–20. *Terebratulina*? *tuberata*, Jeffreys, sp. From Josephine Bank, 340 to 430 fathoms (Collection of Dr. Gwyn Jeffreys, now in the Smithsonian Institution, Washington, U.S.A.: figures all much enlarged. 19. Interior of the dorsal valve.

Figs. 21, 22. *Terebratulina*? *trigona*, Jeffreys, sp. A young and immature shell, dredged by Mr. Saville Kent off the coast of Portugal, at a depth of 500 fathoms (Coll. of Dr. Gwyn Jeffreys, Smithsonian Institution, Washington, U.S.A.). 22. The shell opened, to show the loop.

Figs. 23–25 *a*. *Terebratulina*? *incerta*, Davidson. 23, 24 *a*. Dredged by the 'Challenger' Expedition in lat. 1° 47′ N., long. 24° 26′ W. (Zool. Dept., British Museum, and Davidson Collection). 25, 25 *a*. Interior of dorsal valve, with loop, after Dall, magnified 2½ diameters; dredged by the 'Blake' Expedition off Bequea. (Smithsonian Institution, Washington, U.S.A.)

Plate VII.

Fig. 1. *Terebratulina* (*Agulhasia*) *Davidsoni*, King: natural size. 1 *a*, 1 *b*, 1 *c*. Shell enlarged.

Fig. 2. Ditto, interior of ventral valve, enlarged.

Figs. 3, 4. Ditto, interior of dorsal valve and sectional diagram of same, enlarged.

Fig. 5. Tubuli characteristic of *Terebratulina caput-serpentis* (1–5 after King). (Davidson Collection, Geol. Dept., British Museum.)

Figs. 6–14. *Waldheimia flavescens*, Lamarck, sp. (= *Terebratula australis*, Quoy). Different specimens from Port Jackson, N.S.W., showing modifications in shape and in ribbing. 10, (after G. B. Sowerby), shows the extent the animal opens its valves. 13, represents the var. *recurva*, Quoy, from Shark Point, Port Jackson. 12, 12 *a*. A young smooth shell, from Bottle and Glass Rocks, Port Jackson. All the specimens, with the exception of fig. 10, from the Davidson Collection, Geol. Dept., British Museum.

Fig. 15. Dorsal view of *Waldheimia flavescens*, the shell having been removed (after Hancock). *a*, pallial lobe; *b*, body; *c*, peduncle; *d*, great inner pallial sinuses, giving off branches to the margin; *e*, outer ditto; *f*, genitalia seen through the pallial membrane; *g*, red matter of ditto; *h*, marginal fold; *i*, setæ; *j*, circumpallial vessel; *k*, extreme pallial margin; *l*, median fissure, corresponding to longitudinal plate in valve; *m*, depression occasioned by the hinge-plate and the bases of the crura; *n*, orifices for the passage of the crura; *o*, ridge formed by the union of the pallial margins; *p*, extremities of anterior occlusors; *q*, ditto of posterior occlusors; *r*, ditto of divaricators; *s*, ditto of dorsal adjustors; *t*, liver seen through the wall of the body.

Fig. 16. Ventral view of the same; the letters up to and including *k* correspond to those of fig. 15. *l*, extremities of the occlusor muscles; *m*, ditto of divaricators; *n*, ditto of accessory divaricators; *o*, ditto of ventral adjustors; *p*, ditto of peduncular muscles; *q*, cæcal extremity of intestine, seen through the wall of the perivisceral chamber; *r*, peduncular nerves.

Fig. 17. Thin lamella of shell of *Waldheimia flavescens* (after Carpenter), showing the parallel disposition of the flattened prisms, and the regular arrangement of the passages which intervene between them; and at *a* the outcrop of these prisms of the internal surface of the shell. Magnified 100 diameters.

Fig. 18. Internal surface of *Waldheimia flavescens* (after Carpenter), showing the imbricated arrangement of the extremities of the prisms, which are seen longitudinally at *a*. Magnified 100 diameters.

Fig. 19. External surface of shell of *Waldheimia flavescens* (after Carpenter), showing the large trumpet-shaped ends of the vertical passages, covered in by opercular disks, which have radiating lines proceeding from them. Magnified 100 diameters.

Note.—Figures of the dorsal and ventral valves, of the muscular system, and of the labial appendages and animal of *W. flavescens* are given in the text at pp. 42, 45, 47, and 48 (woodcuts, figs. 3, 4, 5, 6, 7, & 8).

Plate VIII.

Fig. 1. *Waldheimia venosa*, Solander, sp. Type. (See Dixon, 'Voyage round the World,' 1789.) From Falkland Islands.

Figs. 2–2 *c*. *Waldheimia venosa*. The largest specimen known, dredged alive in Stanley Harbour, Falkland Islands, by Admiral B. J. Sulivan in 5 or 6 fathoms, 1844.

Fig. 3. *Waldheimia venosa*. Type of the *Terebratula globosa* of Lamarck, which was badly figured in the Encyclopédie Méthodique, pl. 239. fig. 2, 1789. (Muséum d'Histoire Naturelle, Paris.)

Fig. 4. Ditto. Type of the *Terebratula physema*, Valenciennes, after Reeve's figure, 'Monogr. of *Terebratula*, Conch. Icon.' pl. vi. fig. 23. From Coquimbo. (Muséum d'Histoire Naturelle, Paris.)

Fig. 5. Ditto. Interior of the dorsal valve of a full-grown specimen, to show the loop.

Fig. 6. Ditto. Type of the *Terebratula Fontaineana*, A. d'Orbigny, 'Voyage dans l'Amérique Méridionale,' vol. v. pl. 85. figs. 30 & 31, 1847. (Reduced $\frac{2}{3}$ natural size.) From Coquimbo.

PLATE IX.

Figs. 1, 1 *a*. *Waldheimia venosa*, var. *dilatata*, Lamarck. Type of Lamarck's *Terebratula dilatata*, from a drawing made in Paris from the type in the Muséum d'Histoire Naturelle, Paris.

Figs. 2–13. *Waldheimia lenticularis*, Deshayes, sp. A series of specimens of different forms and ages from the Straits of Fouveau, New Zealand, in 15 fathoms water (Davidson Collection, Geol. Dept., British Museum). 2–3 *b*. Large specimens. 10. Interior of dorsal valve, showing loop in the adult condition. 11–13 *a*. Modifications assumed by the loop previous to its attaining the adult state.

PLATE X.

Figs. 1–4. *Waldheimia Grayi*, Davidson. 1, 1 *a*, 2. Typical form. 3. Interior of dorsal valve, to show the loop. 4, 4 *a*, 4 *b*. Variety *transversa*. All dredged from Japanese waters except the specimen shown in fig. 2, which was dredged by Sir E. Belcher in the Straits of Corea. (Davidson Collection, Geol. Dept., British Museum.)

Figs. 5, 6. *Waldheimia Wyvillii*, Davidson. 5, 5 *a*. Exterior of shell. 6. Interior of dorsal valve, enlarged, showing the loop. Dredged by 'Challenger' Expedition, lat. 33° 31′ S., long. 74° 43′ W., depth 2160 fathoms. (Zool. Dept., British Museum.)

Figs. 7–17. *Waldheimia kerguelenensis*, Davidson. 7–15. A series of forms of different ages. 16. Interior of dorsal valve, showing the loop. 17. Interior of dorsal valve, showing the labial appendages. All dredged by the 'Challenger' Expedition south of Kerguelen Islands, also off Marion Islands. Found in depths varying from 100 to 150 fathoms. All the specimens figured are in the Zool. Dept., British Museum.

PLATE XI.

Figs. 1–10. *Waldheimia septigera*, Lovén, sp. 1–1 *c*. From Faeröe Sound, 570 fathoms (Davidson Collection, Geol. Dept., British Museum). 2–2 *b*. A very large broad specimen, after Sars. 3. A young example, from the British sea, between Shetland and Faeröe ('Porcupine' Expedition), depth 345 fathoms. 4. Interior of dorsal valve with its fully developed loop. 5. Profile view of the same (after Sars). 6. View of the loop seen from the front, much enlarged. 7–10. Different stages in the development of the loop, after H. Friele, figures magnified; all from Norwegian waters.

Figs. 11–13. *Waldheimia Raphaelis*, Dall. 11–11 *c*. A very perfect example from off the coast near Jeddo, Japan (Davidson Collection, Geol. Dept., British Museum). 12, 12*a*. A large typical example from Sagami Bay, coll. Dr. Döderlein. 13. Interior of dorsal valve, showing its fully developed loop. 12–13. In the Museum of the Smithsonian Institution, Washington, U.S.A.

PLATE XII.

Figs. 1–5. *Waldheimia floridana*, Pourtales, at different ages, dredged by Agassiz and de Pourtales off Florida reefs, between 100 and 200 fathoms (Davidson Collection, Geol. Dept., British Museum). 5. Interior of dorsal valve, to show the loop.

Figs. 6–10. *Waldheimia* (or *Macandrevia*) *tenera*, Jeffreys, sp. 6–6 *b*. Specimen of the natural size. 7. Interior of ventral valve, enlarged. 8. Interior of dorsal valve, to show the loop. 9. Posterior portion of the interior of the dorsal valve very much enlarged, to show the hinge-plate and septa. 10. A very young example in which a small pillar-shaped ventral septum is seen in the interior of the dorsal valve. These figures, drawn by Davidson, were published by Jeffreys in the Proc. Zool. Soc. for 1878. Dredged by Dr. Gwyn Jeffreys, lat. 56° 11′ N., long. 37° 41′ W., 'Valorous' Expedition, at a depth of 1150 fath. (Jeffreys Collection, Smithsonian Institution, Washington, U.S.A.)

Figs. 11–23. *Waldheimia* (or *Macandrevia*) *cranium*, Müller, sp. 11–15 *b*. A series of different ages. 11. A very large example (after Sars). 15–15 *b*. A very minute or first stage (after Friele). 16. The first stage of the development of the loops with a coherent apophysis (Friele). 17, 17 *a*. Specimen a little further advanced: *a*, lamellæ; *b*, vertical walls; *c*, tube (Friele). 18, 18 *a*. Opening of the posterior end of the tube (Friele). 19. Perforation of the lateral walls (Friele). 20, 21. Connection with the septum is broken (Friele). 22. The lamel-processes separated. 23. Adult and fully developed loop. All the specimens from Norwegian waters. (See Friele, Develop. Skelet. in *Waldheimia*, Archiv Math. og Naturvidenskab, ii. p. 380, pls. i. & ii., 1877.)

Plate XIII.

Fig. 1. *Waldheimia* (or *Macandrevia*) *cranium*, Müller, sp. Dorsal view of the animal, much enlarged (after Hancock). *a*, pallial lobe; *b*, body; *c*, peduncle; *d*, great inner pallial sinus; *e*, outer ditto; *f*, genitalia appearing through the walls of the sinuses; *g*, marginal fold; *h*, setæ; *i*, circumpallial vessel; *j*, extreme pallial margin; *k*, two lobes corresponding to cavities at the sides of the foramen; *l*, similar lobes corresponding to the cavities in the umbonal region of dorsal valve; *m*, ridge resulting from the union of the pallial margins; *n*, extremity of anterior occlusors; *o*, ditto of posterior occlusors; *p*, ditto of dorsal adjustors; *q*, ditto of divaricators.

Fig. 2. Ventral view of the same (after Hancock). The letters up to *k* as in fig. 1:—*l*, extremities of the occlusor muscles; *m*, ditto of divaricators; *m**, portions of ditto, corresponding to the accessory divaricators; *n*, ditto of ventral adjustors; *o*, ditto of peduncular muscle; *p*, peduncular nerves.

Figs. 3–9 *a*. *Terebratella coreanica*, Adams and Reeve, sp. 3. Type specimen figured by Reeve. 4–4 *c*. A fine and large specimen. 5, 5 *a*. A still larger example (*Terebratula miniata*, Gould), dredged by L. V. Schrenk, from Hakodadi, Japan. 6, 6 *a*. An elongate globose variety, dredged by Capt. St. John in Tsuga Strait. 7. Interior of dorsal valve, to show loop. 8, 8 *a*. Elongate variety (*T. Bouchardi*, Davidson). 9, 9 *a*. Var. *Bouchardi*, Davidson. Specimens 4, 5, 6, 7, and 8, in the Davidson Collection, Geol. Dept., British Museum; 9, in the Zool. Dept., British Museum.

II. *A Monograph of Recent Brachiopoda.*—Part II.

By Thomas Davidson, *LL.D., F.R.S., F.L.S., F.G.S., &c.*

Read 3rd June, 1886.

(Plates XIV.-XXV.)

Subfamily Terebratellinæ.

Genus TEREBRATELLA, d'Orbigny, 1847.

In this genus Alcide d'Orbigny proposed to include all those species in which the long reflected loop has its principal stems twice attached:—first by their crura to the base of the hinge-plate, and again by horizontal laminæ given off from about the middle of the principal stems, which afterwards become attached to the anterior extremity of a low mesial septum. The *Terebratula dorsata* of Gmelin was selected as the type.

In 1870 Mr. Dall proposed to separate from *Terebratella*, as thus defined, those forms in which the reflected portions united form a loop, and in which the mesial septum is very large, elevated, and projects beyond the anterior extremities of the loop. Type *Magasella flexuosa*, P. King.

It has been ascertained that great changes take place in the form of the loop of *Terebratella* during the progress of its development from the young to the adult condition, and that when young, and up to a certain age, it shows the loop and septum of *Magasella*. Indeed Mr. Dall has frankly admitted to me that some of the species referred to *Magasella* are immature forms of *Terebratella*; but for some others, such as *Magasella flexuosa*, P. King, *Magasella suffusa*, Reeve, which retain the *Magasella* loop and septum in their adult condition, he proposes to retain the subgenus *Magasella*.

We have recognized nine species of *Terebratella* and three uncertain ones, viz.:—

1. *Terebratella dorsata*, Gmelin.
2. —— *transversa*, G. B. Sowerby.
3. —— *coreanica*, Adams & Reeve.
4. —— *Blanfordi*, Dunker.
5. —— *spitzbergensis*, Davidson.
6. *Terebratella rubicunda*, G. B. Sowerby.
7. —— *frontalis*, Middendorff.
8. —— *cruenta*, Dillwyn.
9. —— *Mariæ*, Adams.

The uncertain species are *Terebratella pulvinata*, Gould; *Terebratella rubiginosa*, Dall, *Terebratella Frielii*, Davidson.

The very numerous synonyms have been added to the descriptions of the species.

37. Terebratella dorsata, Gmelin, sp. (Plate XIV. figs. 9–19.)

Anomie Magellanique striée, Davila, Catalogue Systématique des Curiosités de la Nature, vol. i. p. 312, pl. xx. fig. A, 1767.

? —— *magellanique*, Walchs, Naturforscher, p. 202, pl. iii. figs. 3, 4, 1774.

? —— *magellanique*, Favanne de Montcervelle, Conchyliologie, pl. xli. fig. A. 3, 1780.

Anomia striata Magellanica, Chemnitz, Neues syst. Conch.-Cabinet, vol. viii. p. 101, tab. 78. figs. 710, 711, 1785.

Terebratula dorsata, Gmelin, ed. Linné's Syst. Nat. vol. iv. p. 3348, 1788; Bruguière, Encycl. Méth. pl. 242. fig. 1, 1789; Lamarck, An. sans Vert. vol. vii. p. 246, 1819; G. B. Sowerby, A Catalogue of Shells of the late Earl of Tankerville, p. 28, 1825.

Terebratula bilobata, Blainville, Dict. Sci. Nat. vol. liii. p. 166, 1828 (refers for fig. to Encycl. Méth. pl. 242. fig. 1).

Delthyris dorsata, Menke, Synopsis Methodica Molluscorum, 2nd ed. p. 96, 1830.

Terebratula chilensis, Broderip, Trans. Zool. Soc. vol. i. p. 141, pl. 22. fig. 1, 1833; Owen, On the Anatomy of the Brachiopoda, Trans. Zool. Soc. vol. i. p. 146, pl. xxii. figs. 3–11, 1833.

Terebratula Sowerbii, Owen, On the Anatomy of the Brachiopoda, Trans. Zool. Soc. vol. i. p. 149, pl. xxii. figs. 15, 16, 1833; King, Zool. Journ. vol. v. p. 338, 1835.

Terebratula dorsata, Anton, Verzeichniss der Conchylien, p. 23, 1839; Küster, Chemnitz's Conch.-Cab. vol. vii. p. 23, pl. 1. fig. 17, pl. 2. figs. 14, 15, 1843.

Terebratula lupinus, Philippi, Neuen Conchylien, Archiv für Naturgeschichte, Jahrg. xi. Band i. p. 58, 1845.

Terebratula dorsata, King, Ann. & Mag. Nat. Hist. 1st ser. vol. xviii. p. 39, 1846; G. B. Sowerby, Thes. Conch. p. 346, pl. lxviii. figs. 15–17, 1846.

Terebratula Chilensis, G. B. Sowerby, Thes. Conch. p. 347, pl. lxviii. figs. 18, 19, 1846.

Terebratula Soverbii, G. B. Sowerby, Thes. Conch. p. 348, pl. lxviii. figs. 20–22.

Terebratula dorsata and *T. chilensis,* A. d'Orbigny, Voyage dans l'Amér. Mérid. vol. v. pp. 675, 676, 1847.

Terebratella chilensis, d'Orbigny, Mém. de l'Acad. des Sci. pl. vii. fig. 13, 1847.

Terebratella dorsata and *T. Chilensis,* Davidson, Sketch of a Class. of Recent Brach., Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 367, 1852, and Br. Foss. Brach., Pal. Soc. vol. i. Introduction, p. 65, pl. vi. figs. 11–13, 1853.

Terebratula dorsata, T. Chilensis, and *T. Soverbii,* Woodward & Gray, Cat. of the Brach. in the Brit. Mus. pp. 87, 88, 1853.

Terebratula dorsata, S. P. Woodward, A Manual of Mollusca, p. 217, fig. 115, 1856.

Terebratella dorsata, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 208, 1859.

Terebratula (Terebratella) Magellanica, Reeve, Conch. Icon. vol. xiii. pl. v. figs. 21, *a–d,* 1860; Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 176, 1861.

Terebratella dorsata, Dall, Amer. Journ. Conch. vi. p. 116, 1870; Proc. Acad. Nat. Sci. Philadelphia, p. 184, 1873; Zittel, Handb. der Paläontologie, p. 705, fig. 552, 1880; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zoology, vol. i. p. 44, pl. iv. fig. 4, 1880.

Shell somewhat transversely oval, wider than long, or of a suborbicular trapezoidal form, broader posteriorly, tapering anteriorly, with a mesial flattened sinus of moderate breadth and depth, commencing at about one third of the length of the valve and extending to the front. Ventral valve deeper than the dorsal one, with a moderately broad, gently convex mesial fold of small elevation, corresponding to the sinus in the opposite valve; margin flexuous in front, the fold and sinus projecting a little beyond the curved lateral margins; beak moderately produced, incurved, and truncated by a large circular foramen, very little separated from the hinge-line by a deltidium in two pieces; beak-ridges sharply defined, and leaving a flattened space between them and the long obtusely angular hinge-line. Surface of valves marked with numerous narrow angular ribs, increasing in number at various distances from the beak and umbo by the interpolation of shorter ribs between the longer ones, and crossed at intervals by concentric lines of growth. Shell-structure punctate. Of a very light yellowish white or ochreous colour. Length 1 inch 8 lines, breadth 1 inch 10 lines, depth 11 lines.

In the interior of the dorsal valve the cardinal process and hinge-plate are well defined. The loop is long and doubly attached, first to the hinge-plate, again by horizontal laminæ given off from the principal branches of the loop to a slightly elevated mesial septum, previously becoming deflected.

Hab. Straits of Magellan; Bay of Valparaiso, in depths of from 60 to 90 fathoms (Cuming); Royal Sound, Kerguelen Island ('Challenger' Expedition).

Obs. This fine species has received several denominations, and some considerable difference of opinion has been expressed as to the name the shell should retain. The first notices I can find of the shell are those of Davila in 1767, Favart d'Herbigny, Walchs in 1774, Favanne in 1780, and Chemnitz in 1785. These early naturalists had described and figured the species under the designation of the Magellan striated *Anomia*; and as that name is not binomial, Gmelin, in 1778, named it *Terebratula dorsata*, and, I believe, the larger number of malacologists have preferred that designation, although some others have insisted on retaining the name of *Magellanica* for the shell, which Gmelin should have adopted. The names *chilensis* and *Sowerbii* are certainly synonyms, and L. Reeve would likewise add to them the *T. flexuosa* of P. King. If this view were adopted, one would have also to include the *Terebratula rhombea*, Philippi, and, in all probability, the *Terebratula lupinus* of the same author; but as these last-named species have large *Magasella*-shaped septa and are adult, it may be better, at any rate provisionally, to locate them in the subgenus *Magasella*. I am the more inclined to adopt this view, as many specimens of *Terebratella dorsata*, when compared with others of *Magasella flexuosa*, of equal dimensions and age, can be distinguished by the absence of the elevated mesial septa. *Terebratella dorsata* varies also somewhat in shape and striation; young specimens have their valves quite smooth, and even in some full-grown examples the umbo and beak remain smooth, the ribbing commencing a little lower down. In 1867 Commodore Acton dredged in the Straits of Magellan a very large number of specimens of *Terebratella dorsata*, from the dimensions of one line in length up to twenty, and on his return kindly presented me with a series of examples illustrating the different ages of the shell.

When quite young, there exists in the interior of the dorsal valve a large and elevated mesial plate or septum, from the anterior sides of which the principal stems of the loop take their second attachment. Over these, but quite separate, are two small anchor-shaped lamellæ, which are attached to the sloping portion of the septum facing the hinge-plate. After a time these anchor-shaped lamellæ become united, and their lower edges are connected with those of the primary branches; by degrees the principal stems of the loop are separated again, become larger, and give off a transverse branch, which fixes itself to the upper anterior edge of the then low median septum.

In 1847 A. d'Orbigny proposed his excellent genus *Terebratella*, giving the full-grown condition of *Terebratula dorsata*, Gmelin, as his type. King's *Terebratula Sowerbii*, from the Straits of Magellan, is nothing more than a rust-coloured example of *Terebratella* *dorsata*. It is always necessary to give the characters of a species from its adult condition, noting the changes its apophysary system undergoes during the different stages in its development.

In 1845 Dr. Philippi described, under the name of *Terebratula lupinus*, a young smooth example of *Terebratella dorsata*, in which the dorsal valve still retains the elevated *Magasella* septum. The type is preserved in the Berlin Museum. Philippi did not figure his so-termed species, and I am indebted to Prof. E. v. Martens for a series of excellent figures of the species (Pl. XIV. figs. 20 *a*, *b*, 21 *a*).

In 1833 Prof. Owen described, with great care and minuteness, the soft parts of the animal in the species under description. He says that "the arms and *viscera*, as in *Lingula*, are inclosed between the lobes of the mantle, which are precisely adapted to the inner surface of their corresponding valves, and are in such close contact with them as to require great care in separating the valves from them. That lobe of the mantle which corresponds to the perforated valve, is traversed longitudinally by four large vessels; the opposite lobe is similarly traversed by two such vessels. . . . The margins of the mantle are thickened . . . the marginal *cilia* are so minute as only to be perceptible by means of a lens. At the posterior part of each of the lobes the expanded fleshy extremities of the muscles are seen; those which were attached to the perforated valve being nearer the hinge by their whole length, than the anterior pair of the opposite valve. Each of the oval muscular disks is composed of an anterior larger muscle and a posterior smaller one. Through the transparent mantle may also be seen the green-coloured follicular liver intervening between and surrounding the muscles, and the folded ciliated arms." Prof. Owen then describes at some length the great arterial trunks, adding that "The size of these vessels at once suggests their subserviency to other purposes than that of merely returning the blood necessary for the nutrition of the mantle. . . . Corresponding to the large branchial veins there appear under the microscope much smaller vessels, which I regard as the branchial arteries; these run parallel with the middle of the branchial veins, and terminate in the margins of the mantle from which the veins commence. These margins present the following appearances when viewed with a high magnifying power:—they are puckered at regular distances, the puckering being apparently caused by the insertions of delicate *cilia*, which pass as far within the mantle as they project beyond it; in the interspaces of the *cilia* the margin of the mantle is minutely fringed: and within this fringe is a canal, which extends along the whole circumference of the lobe, and from which the branchial veins appear to take their origin: the marginal canal is contracted where the *cilia* are inserted into it, which gives it a sacculated appearance, like that of the canal of Petit in the human eye. The uniform results of repeated observations on all the specimens of *Terebratula* which I have had at my disposal, convinced me that the vascular mantle was the chief, if not the sole respiratory organ; and the utility of the marginal *cilia* in reference to this function can now be readily appreciated, in consequence of the discovery of the remarkable property which *cilia* possess of exciting determinal currents in the surrounding water."

After having stated so much, Prof. Owen then describes the shape and double attachment of the loop, and adds, "the interspace between the two folds of the calcareous loop is filled up by a strong but extensile membrane, which binds them together, and forms a protecting wall to the *viscera*; . . . The arms in *Ter. chilensis*, when detached from the supporting processes and unfolded, exceed the length of the shell by two thirds of that length; and their length is to their breadth as eight to one. Their stem, from which the *cilia* airse, as it has not to execute the movement of *Lingula*, so it is much more slender. The *cilia*, therefore, are proportionally increased, in order to excite the necessary currents in the water; which, being directed between the folds of the arms towards the mouth, as to a focus, carry thither the nutrient molecules, which are retained by the natural sieve formed by the decussating *cilia* of the terminal processes in front of the mouth; and though this apparatus is apparently less perfect than in *Lingula*, it is evidently adjusted in due relation to the support of so small a mass of body as exists in *Terebratula*."

Prof. Owen then refers to the muscles and peduncle; but as these bear a general resemblance to those already noted in *Waldheimia* and in other genera, we will not repeat his description here. He also describes the alimentary canal, the œsophagus, and liver: this last he states to be "a bulky gland of a green colour and minute follicular texture; it is disposed in two principal masses, which lie on each side of the alimentary canal, and between the two lateral arches of the testaceous loop in those species of *Terebratula* which possess that appendage . . . In two of the larger specimens of *Ter. Sowerbii*, the *ova* were lodged external to the liver, and had also insinuated themselves between the layers of the mantle-lobes, in close proximity to, and partly surrounding, the branchial vessels. They are probably discharged in this way from the mantle, having previously been exposed to the influence of the branchial currents. . . . In dissecting a *Terebratula* I have found it most convenient to cut transversely through the perforate valve, so as to leave the orifice and the pedicle connected to the opposite valve, by which means the disposition of the muscles is satisfactorily seen, and the delicate parts within are less liable to be disturbed than by attempting to separate the entire valve." I regret not being able to reproduce Prof. Owen's admirable illustration.

The muscular system of *Terebratula dorsata* has also been described by Prof. W. King in the Ann. & Mag. Nat. Hist. ser. 1, vol. xviii. p. 39, 1846.

38. Terebratella transversa, Sowerby, sp. (Pl. XVI. figs. 6–9.)

Terebratula transversa, G. B. Sowerby, Descriptions of thirteen new Species of Brachiopoda, Proc. Zool. Soc. 1846, p. 94; Thes. Conch. vol. i. p. 361, pl. 72. figs. 114, 115, 1846.

Terebratula caurina, Gould, Proc. Boston Soc. Nat. Hist. iii. p. 347, 1850; Gould, U. S. Explor. Exped. xii. Shells, p. 468, pl. 44. fig. 582; Otia Conch. p. 97, 1862; Carpenter, Supp. Rep. Brit. Assoc. 1863, p. 636.

Terebratella caurina, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 207, 1859.

Terebratula caurena, P. P. Carpenter, Rep. Brit. Assoc. 1856, p. 298.

Terebratula (*Terebratella*) *transversa*, L. Reeve, Conch. Icon. Monog. *Ter.* pl. v. fig. 22, 1860; A Revision of the History, Synonymy and Geographical Distribution of the Recent *Terebratulæ*, Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 176, 1861.

Terebratella caurina, Dall, Amer. Journ. of Conch. vol. vi. p. 119, pl. vi. figs. 1, 2, 3, 1870.

Terebratella occidentalis, Dall, Proc. Acad. Sci. of California, vol. iv. p. 182, pl. 1. fig. 7, 1871.

Terebratella transversa, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 185.

Terebratella occidentalis, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 184.

Terebratella transversa, J. E. Whiteaves, On some Marine Invertebrata from the West Coast of North America, Canadian Naturalist, n. s. vol. viii. p. 468, 1878, and On some Marine Invertebrata from Queen Charlotte Island, Report Geol. Surv. Canada, 1878–79, p. 195 (1880).

Shell very variable in shape, usually quadrispherically transverse, wider than long, broadest posteriorly or near the hinge-line, which is very obtusely angular, almost straight, very little shorter than the breadth of the shell; marginal line flexuous and sinuated in front. Dorsal valve moderately convex, channelled longitudinally along the middle by a concave depression or sinus. Ventral valve much deeper than the dorsal one, with a longitudinal elevation or fold extending from the beak to the front; beak short, slightly incurved, and truncated by a large incomplete foramen, margined anteriorly by a portion of the umbo of the opposite valve, and laterally by two small deltidial plates; beak-ridges strongly defined, leaving between them and the hinge-line a flat or gently concave smooth area. Surface of valves either smooth or more or less covered with faint or strong angular ribs, here and there bifurcating, or with a short rib interpolated between the larger ones. Shell-structure perforated by minute canals. In the interior of the dorsal valve the hinge-plate is divided; cardinal process small, and from under it a mesial septum of small elevation extends to about half the length of the valve. Loop long, doubly attached, first to the base of the hinge-plate, then to the anterior extremity of the mesial septum by means of an oblique lamina given off from about the middle of the length of the principal stems of the loop, when, after having attained their greatest length, they become reflected in the shape of a loop. Colour varying from light ashy yellow to a light or dark livid purple or red mixed with yellow, deeper in colour on the lines of growth. Length 1 inch 3 lines, breadth 1 inch 7 lines, depth 10 lines.

Hab. Off Vancouver Island, mouth of Cumshewa Harbour, in 20 fathoms; Houston-Stewart Channel, in 15–20 fathoms (Whiteaves); Puget Sound to Sitka (Swan), Alaska territory, peninsula of Aliaska; Neeath Bay, from Aleutian Islands to Oregon (Dall); coast of California at Monterey (Cooper and Dall); Catalina Island (Cooper).

Obs. Dall justly observes, in his description of this species, in the 'American Journal of Conchology' for 1870, that "it presents every possible variation from longitudinally oval to quadrispherically transverse, that many are unsymmetrical, and most of them overgrown with Polyzoa, Serpulæ, and Corallines." He also mentions that "some specimens have from thirty to forty ribs or many fewer, and varying very much in prominence; some have none at all, and others have their valves smooth and half ribbed, some ribbed only on the umbones, others again near the margin." I have detected all these modifications even in the limited number of specimens I have been able to examine.

To the completely smooth examples, Sowerby, in 1846, gave the name *transversa*; to a ribbed individual, Gould, in 1850, applied that of *caurina* (Pl. XVI. figs. 10–12), and, in 1871, Dall named a red variety, from the coast of California, *Terebratella occidentalis*. Feeling somewhat uncertain with respect to the last-named species, I forwarded to Mr. Dall a red specimen, of which I give figures (Pl. XVI. figs. 13 & 14), and which agreed in every detail, except in colour, with specimens from Sitka and Vancouver Island. In returning it to me Mr. Dall wrote that it was his *Terebratella occidentalis*, which may prove to be a southern race of *Terebratella transversa* of Sowerby; and I quite believe this to be the case. The lines of growth, Mr. Dall states (under *T. caurina*, Revision of the Terebratulidæ, Amer. Journ. Conch. vol. vi. 1870, pp. 120, 121), "are usually strong and often imbricated, especially when the radiating ribs are strong. . . . The punctures are smaller, more circular, and fewer in number than in *Terebratella pulvinata*. An examination of the young shells only about ·2 inch in extreme width, showed some interesting points. The septum is calcified very early, and is thick, prominent, bifurcate at its extremity, and serrated on its anterior edge. The bifurcation is the first indication of the septal processes, which are the last to be calcified; and when the extremely thin hæmal processes are yet incomplete, the young shell closely resembles a *Magas*. In the beak of the neural valve just inside the foramen, is a very prominent thin lamina or septum which half closes the foramen. In the adult the muscular system is not largely developed. The pedicel muscles are the strongest. The cardinals are slender and their bases are spread over a wide extent of the neural valve, but the muscular impressions are imperceptible. The adductors are small and slender. The brachia follow the lateral loops of the apophyses and cross below the mouth on the reflected portion and the septal processes. There is no central spiral lobe. The fringes are in a single row, flattened and extremely thin; in an adult they are about ·13 inch long. They are much more slender than in *Terebratulina* or *Megerlia*. When fully extended they are far from the margin of the valves. The mouth is circular, situated between the adductors. The visceral part of the system is protected by a thin tough membrane. The colour of the animal is reddish or brownish, the ovaries vary in the same way. The perivisceral fluid is of a reddish-yellow colour. The umbones of both valves are generally eroded by contact with stones. The animal seemed to have the power of turning half around on its peduncle at will."

Although the name *transversa*, Sowerby, should be retained for the species, the smooth variety is less abundant than the costated one. The ribs are, in some specimens, quite simple, and the variety *occidentalis* has, according to Dall, been sometimes mistaken for the *Waldheimia Grayi*, Davidson, from Japanese waters.

39. TEREBRATELLA COREANICA, Adams & Reeve, sp. (Plate XIII. figs. 3–9.)

Poulette de la Tartarie, Lamanon, Voyage de la Pérouse autour du Monde, vol. iv. p. 119, pls. 1 and 8, 1797.

Terebratula coreanica, Adams & Reeve, Voyage of H.M.S. 'Samarang,' p. 71, pl. xxi. fig. 3, 1850.

Terebratella coreanica, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 367, 1852.

Terebratella Bouchardii, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 367, 1852, and Proc. Zool. Soc. 1852, pl. xiv. figs. 1–6; Woodward & Gray, Cat. of the Brach. in Brit. Mus. p. 88, 1853; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, p. 206, 1859.

Terebratella miniata, Gould, Proc. Boston Soc. Nat. Hist. vol. vii. p. 323, 1861.

Terebratula (*Terebratella*) *Coreanica*, Reeve, Monogr. of *Terebratula*, Conch. Icon. pl. vii. fig. 28, *a*, *b*, 1861; A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. ii. p. 99, 1863; L. v. Schrenck, Reisen und Forschungen im Amur-Lande, Zool. p. 468, pl. xviii. fig. 7, 1867.

? *Terebratella Lamanoni*, L. v. Schrenck, ibid. 1867.

? *Terebratella Coreanica*, Carpenter, Supp. Rep. Brit. Assoc. 1863, p. 636.

Terebratella Coreanica, Dall, Amer. Journ. Conch. vol. vi. p. 121, 1861, and Proc. Acad. Nat. Sci. Philadelphia, p. 183, 1873; Davidson, Proc. Zool. Soc. 1871, p. 304, pl. xxxi. figs. 4–5; G. Dunker, Index Mollusc. Maris Japonici, p. 252, 1882; C. E. Leschke, Japonische Meeres Conchylien, Suppl. p. 181, 1884.

Shell large, semicircular, or somewhat transversely or elongated oval, broadest posteriorly, slightly winged, with an almost straight or obtusely angular hinge-line, or broader about the middle, with a more obtusely angular hinge-line; lateral margins flexuous, more so in front. Dorsal valve convex, sometimes ventricose, channelled or depressed longitudinally along the middle. Ventral valve deeper than the dorsal one, strongly keeled longitudinally; beak incurved and truncated by a circular foramen, incomplete in some specimens, in others margined anteriorly by a deltidium in two pieces; beak-ridges strongly marked. In the interior of the dorsal valve the hinge-plate and cardinal process are large and well defined; a mesial septum of small elevation extends to about half the length of the valve. Loop large, attached to the base of the hinge-plate and by a transverse lamella to the anterior extremity of the septum before again proceeding and doubling itself in the shape of a loop. Shell smooth, orange-red throughout, or fulvous-white rayed with bright red, and traversed by concentric lines of growth stained with red at their edges; shell punctate. Proportions variable, a large example measured: length 1 inch 10 lines, breadth 1 inch 11 lines, depth 1 inch 1 line.

Hab. Corean Archipelago (Belcher); Hakodadi, Japan, in 7 fathoms, and Straits of Korea in 48 fathoms (A. Adams); dredged also at Hakodadi, in 1868, by L. v. Schrenck, and in 1872 by Capt. St. John in Tsuga Strait, in 35 fathoms ('Sylvia' Expedition); Sea of Tartary (Lamanon, Voyage de la 'Pérouse,' 1798).

Obs. This beautiful large red species was dredged, if I am not mistaken in my identification, by Lamanon in 1797, in the Sea of Tartary. He described and figured the shell, its loops and labial appendages, with tolerable accuracy, and showed that its loop was twice attached, although his large figure 11 is evidently incorrectly drawn. He gave it the name of "Poulette de la côte de Tartarie," and subsequently, in 1867, Dr. L. v. Schrenck named it *Terebratula Lamanoni*, after its discoverer. In 1850, Adams and Reeve described and figured two smaller examples, delicately painted with irregular crimson-scarlet rays, dredged by Sir Edward Belcher during the voyage of H.M.S. 'Samarang,' under the name of *Terebratella Coreanica*; and this name must be retained for the shell. To some larger examples Gould, in 1861, gave the name of *Terebratella miniata*, and I now consider the shell I described in 1852 by the name of *Terebratella Bouchardii* to be merely an elongated bleached example of *Terebratella coreanica*. This I am more ready to believe, as I subsequently procured an exactly similar-shaped specimen from the locality where *Terebratella coreanica* abounds, marked with red as in that species.

Terebratella coreanica is extremely variable in shape, as may be seen from the illustrations I give of it in Pl. XIII. figs. 3–9. The largest examples I have seen of the shell were obtained at Hakodadi during Dr. v. Schrenck's Russian Government dredging-expedition in Amur Land, 1854–56. Dr. v. Schrenck gives seven figures in pl. xviii. of his work; but fig. 7, representing the loop, is not correct, as I ascertained from a type specimen he kindly presented to me shortly after his return. In the specimen in question the reflected portion of the loop was much larger, and agreeing with the figure I give of it on Plate XIII. fig. 7.

I may also mention that search was made at the Jardin des Plantes for Lamanon's specimens, but none of them could be discovered.

Having examined some young examples of the shell under description, I found that its loop underwent similar modifications to those I have described as taking place in *Terebratella rubicunda*.

40. Terebratella Blanfordi, Dunker, sp. (Plate XV. figs. 9–12.)

Terebratula Blanfordi, Dunker, Index Mollusc. maris Japonici, p. 251, pl. xiv. figs. 4, 5, 6, 1882.

Shell thin, nearly as wide as long, rotundate quadrate, lateral margins moderately curved; hinge-line obtusely angular, front line long, with a greater or less inward curve. Dorsal valve moderately convex, with a broad shallow depression commencing at a short distance from the umbo, and gradually widening as it approaches the front. Ventral valve deeper and more convex than the dorsal one, with a similar broad depression commencing at a short distance from the beak and extending to the front. Beak rather small, incurved, and truncated by a circular foramen partly margined by a deltidium; beak-ridges sharply defined. In the interior of the dorsal valve the loop is long and doubly attached, first to the hinge-plate and then to the median septum, before becoming reflected. Surfaces smooth, marked here and there with fine concentric lines of growth. Colour dull yellow. Length of a large specimen 13, breadth 12, depth 8 lines.

Obs. This remarkable and well-characterized species is well described and figured by Dunker, who gives as its habitat Wakayama, Japan. It varies somewhat in contour; some specimens are more circular, and in some the frontal indentation is greater than in others. *Terebratella Blanfordi* is associated in the same sea-bottoms with *Terebratulina Crossii*, Davidson, and *Waldheimia Raphaelis*, Dall.

41. Terebratella spitzbergensis, Davidson. (Plate XVI. figs. 1–5.)

Terebratula ——, Lyell, On the Proofs of a gradual Rising of the Land in certain parts of Sweden, Phil. Trans. Roy. Soc. 1835, p. 36, pl. ii. figs. 32, 33.

Terebratula caput-serpentis, Hisinger, Lethæa Suecica, p. 83, 1837 (not of Linnæus).

Terebratella Spitzbergensis, Davidson, Proc. Zool. Soc. 1852, p. 72; Ann. & Mag. Nat. Hist. 2nd ser. vol. xvi. p. 442, pl. x. fig. 3, 1855; and Proc. Zool. Soc. 1871, p. 305, pl. xxx. fig. 13; M'Andrew, List of the Mollusca from Spitzbergen, Ann. & Mag. Nat. Hist. 2nd ser. xvi. p. 465, 1855; O. Torell, Bidrag Spitzbergens Molluskfauna, p. 121, pl. i. fig. 1, 1859; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissench. Wien, p. 204, 1859; L. Reeve, Conch. Icon. pl. vii. fig. 2, 1861, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 178, 1861.

Magasella Spitzbergensis, Dall, Amer. Journ. of Conch. vol. vi. p. 37, 1870; *Terebratella*, id. Proc. Acad. Nat. Sci. Philadelphia, p. 185, 1873.

Terebratella spitzbergensis, Jeffreys, Proc. Zool. Soc. 1878, p. 409, pl. xxiii. fig. 2; H. Friele, The Development of the Skeleton in the genus *Waldheimia*, Arch. für Mathematik og Naturvidenskab, pl. vi. 1877; G. Dunker, Index Mollusc. maris Japonici, 1882, p. 252.

Shell small, ovate, longer than wide. Valves uniformly and nearly equally convex; no fold or sinus in either valve; beak in ventral valve moderately produced, incurved and truncated by an incomplete, longitudinally oval foramen, margined anteriorly by the umbo of the dorsal valve and by two small lateral triangular deltidial plates; beak-ridges not very sharply defined. Surface of valves smooth, strongly punctate, and marked by fine concentric lines of growth. The apophysary system in dorsal valve composed of a doubly attached loop extending to about two thirds of the length of the valve, first attached to the base of the hinge-plate, the principal stems widening gradually and, at about half their length, becoming attached to the upper edge of an elevated median septum, then again extending towards the front before becoming reflected. Colour light whitish yellow. Length $4\frac{1}{2}$, breadth $3\frac{1}{2}$, depth $2\frac{1}{2}$ lines.

Hab. Homsund and Bellsund, Spitzbergen, 10 to 80 fathoms (Torell); Wellington Channel (Belcher); Shetland, 35 miles N.N.W. of Unst, in 90 to 100 fathoms; Channel Slope, about 185 miles from Cape Clear and Ushant, and 165 miles from the Scilly Isles, in 358 fathoms; Channel Slope, 339 fathoms; off Cape St. Vincent on the coast of Spain, 292 fathoms (Jeffreys); Gulf of St. Lawrence (P. P. Carpenter and Whiteaves); Japanese Waters (A. Adams); off Iceland ('Valorous' Expedition); Fossil at Uddevalle (Hisinger and Jeffreys); and in another raised bank near Christiania in 1866 by Messrs. Crosskey and Robertson.

Obs. I have seen a number of specimens of this small well-marked species; none of them exceed the dimensions above recorded. *Terebratella spitzbergensis* evidently enjoys an extended geographical range.

In 1834 Sir Charles Lyell collected in a Swedish postglacial deposit a single ventral valve of this brachiopod, while investigating the proofs of a gradual rising of the land in certain parts of Sweden. He simply called it a *Terebratula*, and gave two figures of it in the 'Philosophical Transactions' of the Royal Society for 1835. According to Torell the species was confounded in 1837 by Hisinger with *Terebratulina caput-serpentis.* In 1852 I described and figured the shell in the Ann. & Mag. Nat. Hist. from a perfect specimen lent to me by Mr. H. Cuming, and then gave it the name of *Terebratella Spitzbergensis*, which it has since retained. In 1859 Torell published an incomplete figure of the loop, but sufficient to show that it was doubly attached as in *Terebratella.* The young of *Terebratella spitzbergensis* have not yet been examined; but in a paper by Herman Friele on 'The Development of the Skeleton in the genus *Waldheimia*,' a whole plate is devoted to enlarged illustrations of the loop, and the author remarks that in one example "remnants of the lateral walls are still left on the lamel-processes at their point of connection with septum, which signifies an earlier stage like that in *Waldheimia*."

42. TEREBRATELLA RUBICUNDA, G. B. Sowerby. (Plate XV. figs. 15–29.)

? *Terebratella sanguinea*, Quoy & Gaimard, Voyage de l'Astrolabe, Zool. vol. iii. p. 556, pl. 85. figs. 7–8, 1834 (not *T. sanguinea*, Chemnitz).

Terebratella rubicunda, G. B. Sowerby, Proc. Zool. Soc. 1846, p. 92, and Thes. Conch. i. p. 351, pl. lxx. figs. 45–47, 1846.

Terebratella inconspicua, Sowerby, Proc. Zool. Soc. 1846, p. 93, and Thes. Conch. p. 359, pl. lxxi. figs. 102–104, 1846.

Waltonia Valenciennesii, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. v. p. 475, pl. xv. fig. 1, 1850.

Terebratella rubicunda, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 367, 1852; Woodward & Gray, Catalogue of the Brachiopoda in the British Museum, p. 89, 1853 (*T. inconspicua* is now considered a synonym of *T. rubicunda*): E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, p. 207, 1859 (*T. inconspicua* and a syn.); L. Reeve, Conch. Icon. pl. vii. fig. 27, 1861 (*T. inconspicua* a syn.); Dall, Amer. Journ. Conch. vol. vi. p. 117, 1870, and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 185.

Magasella inconspicua, Dall, Amer. Journ. of Conch. vol. vii. p. 67, 1871, and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 189.

Terebratella rubicunda, F. W. Hutton, Marine Mollusca of New Zealand, p. 85, 1873.

Shell somewhat orbicular or triangularly ovate, widest about the middle, acuminated posteriorly; dorsal valve moderately convex, channelled along the middle by a broad concave sinus, commencing at the umbo and extending to the front, where it is produced a little beyond the lateral curved margins of the valve. Marginal line flexuous on the sides. Ventral valve deeper than the dorsal one, with a convex, well-defined, mesial fold extending from the extremity of the beak to the front; beak incurved and truncated by a large circular foramen, lying close to the umbo or just separated from it by two rather large deltidial plates that barely meet in the middle; beak-ridges sharply defined. Surface of valves either entirely smooth or more rarely with small short rounded ribs commencing at a short distance from the lateral and frontal margins of the valves; surface of valves crossed by concentric strongly marked lines of growth. In the interior of the dorsal valve the hinge-plate is well defined, with a cardinal process at its posterior extremity. A mesial septum of small elevation proceeds from the base of the hinge-plate to about one half the length of the valve. Loop doubly attached, first to the base of the hinge-plate, and then by a transverse lamella proceeding from about the middle of the length of the principal lamella to the anterior extremity of the septum, when, after again extending a little further, the lamellæ become reflected and united. Colour pale or deep red, sometimes colourless. Length 1 inch 1 line, breadth 1 inch, depth 7 lines.

Hab. Fauveau and Cook's Straits, New Zealand; Dusky Bay (Hutton).

Obs. Terebratella rubicunda is an exceedingly abundant shell in the seas of New Zealand. It varies much in shape and character from the young up to the adult condition, and its loop passes through several modifications during the progress of growth. The youngest individual I have been able to examine measured three lines in length; at this stage and for some time after its septum is remarkable in shape and of considerable elevation as in *Magasella*, but low at its origin under the hinge-plate. It soon assumes an upward concave curve, to be followed by another still more oblique; where it attains its highest elevation, a flattened plane occurs and then gradually thins out by an abrupt inward curve, until it reaches nearly to the bottom of the valve, the anterior half of the septum presenting the form of a wide, elevated, flattened plate. In the young stage under description the principal laminæ or stems of the loop, after being attached to the hinge-plate, form a curve and become fixed by their anterior edges to the lateral sides of the septum; a little higher up, and attached to the edge of the septum, are two wide, curved, disunited anchor-shaped lamellæ. To this immature condition I gave in 1850 the name *Waltonia Valenciennesii*, which must be expunged. To a shell in the same condition, or a little older, G. B. Sowerby, in 1846, gave the name of *Terebratula inconspicua*. In 1852 I expressed the opinion that the shell "seems to be only a young and ill-grown specimen of *T. rubicunda*;" and in this opinion S. P. Woodward, E. Suess, and L. Reeve have concurred. Mr. Dall, however, maintains it as a distinct species, and places it in his genus *Magasella*. When a little older, or at about four or five lines in length, the septum becomes very much less elevated, and the principal lamellæ approach closely to the septum, where they become attached prior to continuing their course and becoming reflected. In the adult or full-grown state the septum is quite low, and at about half their length the principal lamellæ, which are now wide apart, give off a long, oblique lamella, which connects them to the anterior extremity of the septum. A glance at the figures on Plate XV. will show these different conditions better than any verbal description.

Groups of specimens at different stages of growth are often found attached to a single adult example. The shell is generally smooth throughout, but a tendency to plication is not uncommon on the anterior portion of the shell. The peduncle is very short.

Mr. Donovan states, in the second volume of his 'Naturalist's Repository,' that Solander had given the MS. name of *rubicunda* to the shell we now know as *Kraussina rubra* of Pallas, 1766; but as Solander did not publish his name, that of *rubicunda*, Sowerby, must be retained for the shell under description.

The intimate shell-structure of *Terebratella rubicunda* has been carefully investigated by Dr. W. B. Carpenter. In plate iv. of his chapter on the structure of the shells of Brachiopoda, contributed to vol. i. of my 'British Fossil Brachiopoda,' he gives three enlarged figures, one of these, which we reproduce (Pl. XV. fig. 25), is a portion of a vertical section of the loop-bearing valve, taken in the transverse direction through the origin of the calcareous appendages, which shows that the latter are not traversed by canals. In this figure the ordinary trumpet-like form of the vertical passages is shown, and the remarkable contractions which they exhibit in the inner and (probably) later-formed layer; in Plate XV. fig. 26 the occasional bifurcation of the vertical passages is represented.

43. TEREBRATELLA FRONTALIS, Middendorff, sp. (Plate XV. figs. 1–8 *a*.)

Terebratula frontalis, Middendorff, Beiträge zu einer Malacozool. Rossica, iii. 1849, Mém. Acad. St. Pétersbourg, t. vi. p. 518; and Reise in d. äusserst. Norden und Osten Sibiriens, 1851, Bd. ii. p. 241, t. xviii. figs. 9–14; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, p. 204, 1859; Dall, Amer. Journ. of Conch. vol. vi. p. 123, 1870; Proc. Acad Nat. Sci. Philadelphia, 1873, p. 184; Dall, Report on the Brachiopoda of Alaska and the adjacent shores of North-west America, ibid. 1877, p. 156; Dunker, Index Mollusc. maris Japonici, p. 252, 1882.

Shell somewhat subpentagonal, longer than wide, broadest about the middle, marginally curved, slightly indented in front. Dorsal valve posteriorly evenly convex, anteriorly divided by a narrow longitudinal depression or groove, commencing at a very short distance from the front margin. Ventral valve rather deeper than the dorsal one, with a very slight elevation close to the margin; beak rather large, truncated at right angles by an unusually large incomplete foramen, posteriorly margined to a considerable extent by the umbo of the dorsal valve and by two very small rudimentary deltidial plates; beak-ridges sharply defined, leaving between them and the hinge-line a small flattened space. Hinge-line obtusely angular. Surface of valves smooth, marked with strong concentric lines of growth; shell-punctures rather large and somewhat widely interspaced. In the interior of the dorsal valve the cardinal process is small, the hinge-plates are disunited and form two concave projections, on each side of which deep dental sockets are situated. The principal lamellæ of the loop are attached to the bases of the hinge-plate, and these by a curve meet a slightly raised mesial septum, to which they become again attached; at a short distance from this second attachment the lamellæ become reflected in a very remarkable and unusual manner. The large paired adductor muscular impressions are situated at the bottom of the valve, and at some distance from the mesial septum or ridge. In the ventral valve the curved articulating teeth are large and powerful. Colour ashen or yellowish grey. Length of a large specimen 11 lines by 10 in breadth and 6 in depth.

Hab. Western Aleutians from Atka Island westward; Atka, Amchitka, Attu (Dall); Ochotsk Sea (Middendorff); Japan seas (Capt. St. John). From low water to 45 fathoms; abundant in 10 fathoms.

Obs. This is a very good and well-characterized species, well but not completely figured by Middendorff in 1849. The shell was subsequently abundantly collected by Mr. Dall and Capt. St. John. The Japanese examples are a good deal smaller than those figured by the Russian author, as well as those dredged by Dall at Atka Island, in the Aleutian channel. Their interior is exceedingly remarkable, and differs in detail in many respects from that occurring in the larger number of species of the genus, first in the shape of the loop, and secondly in the position and dimensions of the adductor muscular impressions, which are very powerful. These characters and differences will become at once apparent by a glance at the figures, which I have drawn with all possible care and accuracy. The shell is thick and presents a coarse appearance.

44. Terebratella cruenta, Dillwyn, sp. (Plate XIV. figs. 1–8.)

Anomia sanguinea, Solander, MS. Portland Cabinet; Leverian Cat. sec. part 15.

Terebratula sanguinea, Leach, Zool. Misc. p. 76, tab. xxxiii. 1814 (not Chemnitz).

? *Terebratula sanguinea*, Lamarck, An. sans Vert. vol. vi. p. 247, 1819 (not Chemnitz?).

Terebratula cruenta, Dillwyn, Descrip. Cat. Recent Shells, vol. ii. p. 295, 1817.

Terebratula sanguinea, E. Donovan, Naturalist's Repository, vol. i. pl. 34, 1823.

Terebratula Zelandica, Deshayes, Revue Zoologique par la Soc. Cuvierienne, p. 359, 1839, and Mag. de Zoologie, Mollusques, pl. 12, 1841.

Terebratula rubra, G. B. Sowerby, Thes. Conch. i. p. 345, pl. lxviii. figs. 9–11, 1846 (not Pallas).

Terebratula Zelandica, G. B. Sowerby, Thes. Conch. p. 361, pl. lxxii. figs. 111–113, 1846.

Lampas sanguineus, Calonne, Cat. Humphrey, MS.

Terebratella Zelandica, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vo p. 367, 1852.

Terebratella Evansii, Davidson, Proc. Zool. Soc. 1852, p. 77, pl. xiv. figs. 7–9.

Terebratella cruenta, Woodward and Gray, Cat. of Brachiopoda in the Brit. Mus. p. 89, 1853.

Terebratella Zelandica, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 207, 1859.

Terebratella (Terebratula) cruenta, L. Reeve, Conch. Icon. pl. v. fig. 20, *a, b*, 1860.

Terebratella (Magas) Evansii, L. Reeve, Conch. Icon. pl. viii. fig. 31, 1861.

Terebratella cruenta, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 183; F. W. Hutton, Catalogue of the Marine Mollusca of New Zealand, p. 85, 1873.

Shell rather large, somewhat subpentagonal, subtransverse, ventricose, longer than broad. Dorsal valve convex, channelled longitudinally along the middle by a well-defined, flattened, mesial sinus or depression. Ventral valve deeper and more convex than the opposite one, with a longitudinal mesial fold of moderate breadth and elevation, somewhat flattened, extending from the beak to the front; margins flexuous both laterally and in front; beak incurved and truncated by a large circular foramen, separated from the hinge-line by a deltidium in two pieces; beak-ridges not very sharply defined. Surface of valves radiately costellated; ribs narrow, numerous, increasing in number at various distances from the beak and umbo through bifurcation and the interpolation of smaller and shorter riblets between the larger ones; surface of valves crossed at various distances by concentric lines of growth. In the interior of the dorsal valve the cardinal process and hinge-plate are large and well defined; the mesial septum, of low elevation, extends to half or a little more of the length of the valve. Loop large, doubly attached, the principal stems, before attaining their greatest length, give off a flat oblique lamella, which becomes fixed near the anterior extremity of the septum, the lamella proceeding again and doubling in the shape of a loop. Colour sanguineous or paler red, deepest in intensity at the lines of growth. Length 1 inch 10 lines, breadth 1 inch 11 lines, depth 1 inch 2 lines.

Hab. Very abundant in Cook's and Fauveau Straits, New Zealand.

Obs. This beautiful shell has been rather unfortunate on account of the many confusing names it has received. In 1823, Donovan, in vol. i. of his 'Naturalist's Repository,' described and figured the shell, and enters into long details with respect to its early history. He informs us, that it is one of those very choice accessions to the conchological knowledge of the last century, that it occurred to them upon the coast of New Zealand, and that after the Banksian Cabinet had been supplied, duplicates were presented to Dr. Solander, Captain Cook, the Duchess of Portland, Mr. Cracherode, and Mr. G. Humphrey, and to some others. That it was named and described for the first time, in manuscript, by Solander under the name of *Anomia sanguinea* *, was subsequently so designated in the museum of the Duchess of Portland; and that it appeared under the same appellation in the catalogue of that museum published in 1786. Donovan complains very bitterly that Dillwyn should not have adopted, in 1817, Solander's manuscript name, and should have given it instead that of *cruenta*, a name Solander had also made use of in manuscript for another species. Dillwyn was, however, justified in rejecting Solander's designation, since Chemnitz had previously, in 1785, applied the name *sanguinea* to another species; for manuscript names cannot claim a right to priority over any others that have been really published. It is to be regretted, however, that Dillwyn had selected for the

* "Obovato longitudinaliter sulcata, triloba: sinu profundo nate producta latere angulata foramen ambiante. *Solander's MSS* --*Hab.* in O. Pacifico, G. R. Forster "(Donov. Nat. Rep. I.).

New Zealand species the name of *cruenta*, which had, in manuscript, been applied by Dr. Solander to another species.

Although a well-marked species, *Terebratella cruenta*, Dillwyn, has been confused by some conchologists with others to which it does not belong, such as with the *Kraussina rubra* of Pallas (Solander's MS. *Anomia rubicunda*). Its young stage received from myself the name of *Terebratella Evansii* before I had ascertained that in the young the loop presented the character of *Magasella*. All the early authors prior to 1817 knew the shell we are describing by the name given to it by Solander. It is so named in the Leverian Cabinet, sec. part 15; also in Dillwyn's Conch. i. p. 293, 21; and in Leach's Zool. Misc. x. p. 76; and in Lamarck's 'An. sans Vert.' vol. vi. p. 247 (1819), for he refers to Leach's Zool. Misc., but was evidently in error when he gives, as its synonym, the *Anomia capensis* of Gmelin and Chemnitz. *Terebratella cruenta*, like all its congeners, is very variable in shape, and its loop passes through several metamorphoses, from the very young state up to the full-grown condition. I have already given the dimensions of the largest example in my collection, which I obtained some years ago from Mr. G. B. Sowerby. Up to six lines in length and much less the apophysary system is composed of a large central longitudinal septum, not exceeding half the length of the valve, arising rapidly in the form of a narrow elevated plate, almost reaching the centre of the ventral valve, to the middle of which, and to the base of the hinge-plate, are attached the principal stems of the riband-shaped lamellæ before becoming reflected. Mr. L. Reeve and several other malacologists have adopted my name *Evansii*, but I have had to relinquish it after a very careful study of a large number of specimens from one and a half up to twenty-two lines in length. At one time, as stated by Donovan, *Terebratella cruenta*, Dillwyn, was a rare shell, a specimen having fetched five guineas at the Leverian sale; now, however, it has become an almost common shell, and may be had for a few shillings.

45. TEREBRATELLA MARIÆ, A. Adams. (Plate XV. figs. 13, 14.)

Terebratella Mariæ, A. Adams, On some new Genera and Species of Mollusca from Japan, Ann. & Mag. Nat. Hist. 3rd ser. vol. v. p. 412, 1860, and Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 99, 1863; Davidson, On Recent Japanese Brachiopoda, Proc. Zool. Soc. 1871, p. 305, pl. xxx. figs. 15–17; Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 184, 1873; G. Dunker, Index Mollusc. maris Japonici, p. 252, 1882.

Shell small, somewhat squarely oblong, longer than wide, lateral margins very little rounded, nearly subparallel, front broad, almost straight. Dorsal valve moderately convex, with a broad, slightly raised, mesial fold, commencing near the front. Ventral valve much deeper than the opposite one, with a broad, slightly concave depression commencing at about half the length of the shell, and extending to the front; beak short, incurved and truncated by a circular foramen, anteriorly margined by two narrow deltidial plates. Front margin raised into a rounded wave, lateral margins flexuous. Surface smooth, traversed by fine concentric lines of growth; shell-structure finely punctate. Length 6, breadth 4, depth $3\frac{1}{2}$ lines. Colour white, glazed, semitransparent. In the interior of dorsal valve the loop, twice attached, extends to about two thirds of the length of the shell; mesial septum most elevated anteriorly, extending to within a third of the length of the valve; principal stems of the loop attached first to the base of the hinge-plate, and then at about a third of their length by a transverse lamella to the upper edge of the anterior extremity of the septum, when, after extending for some distance, they become widely reflected, the reflected lamella being much broader than that of the principal branches.

Hab. Dredged by Mr. A. Adams at Uraga in 21 fathoms; Gotto in 48 fathoms; and at Satanomosaki in 55 fathoms: all in Japanese waters.

Obs. This pretty little shell was briefly described, but not figured, in 1860 by A. Adams. It is an important species, and nearly approaches in shape and character to the Upper Pliocene *Terebratella septata*, described by Philippi in vol. ii. of his work, 'Fauna Molluscorum Regni utriusque Siciliæ,' p. 69, pl. xvii. fig. 7, 1844, and by Seguenza in vol. i. Memorie della Soc. Ital. di Scienze Naturali, 1865. *Terebratella septata* is, however, a much larger shell than the Japanese *Terebratella Mariæ*, measuring over an inch in length by ten lines in breadth. The principal branches of the loop seem to be closer, and the reflected portion broader, than in the two specimens of the recent shell that I have been able to examine. Dr. Gwyn Jeffreys considered *Terebratella Mariæ* to be the living representative of the Sicilian species; but this point cannot be definitely determined until more specimens of the Japanese species have been examined and compared.

Uncertain Species.

46. TEREBRATELLA PULVINATA, Gould, sp. (Plate XVI. fig. 15.)

? *Terebratula pulvinata*, Gould, Proc. Boston Soc. Nat. Hist. vol. iii. p. 347, 1850; U.S. Exploring Expedition, Shells, p. 467, pl. xliv. figs. 581 *a–e*.

Terebratula (*Waldheimia*) *pulvinata*, Gould, Otia Conch. pp. 97 & 255, 1862; Cooper, Geogr. Cat. California Moll. p. 3, no. 4, 1867.

Terebratella pulvinata, Carpenter, Check-List West Coast N. Amer. Shells, 1860; Dall, Amer. Journ. Conch. vol. vi. p. 117, 1870.

Terebratula pulvilla, Carpenter, Rep. Brit. Assoc. 1856, p. 213.

Shell orbicular, about as broad as long, widest posteriorly, tapering anteriorly, sides and front margins rounded, hinge-line obtusely angular. Dorsal and ventral valves regularly convex; beak small, truncated by a circular foramen lying close to the umbo of the dorsal valve, but slightly separated from it by a small deltidium in two pieces Colour light yellowish white. Length 10, breadth $10\frac{1}{2}$, depth 5 lines. In the interior of the dorsal valve the loop is long and doubly attached, first to the base of the hinge-plate, then to a mesial septum which extends from under the hinge-plate to about two thirds of the length of the valve.

Hab. Puget Sound, Oregon.

Obs. I have only seen the figures given of this shell by Dr. Gould, and a photograph of the type sent to me by Mr. Dall. I feel very uncertain with respect to its specific value, and have long been under the impression that it might be only one of the young stages of *Waldheimia venosa*. Mr. Dall, however, writes to me:—"*Terebratella pulvinata* is, I believe, an excellent species. It resembles, externally, the young flattish forms of *Waldheimia venosa*, but it is a perfect and mature *Terebratella* and in no way related to *Terebratella dorsata*. I may, however, remark that I have smooth examples of *T. dorsata* that I could scarcely distinguish from the figures of Gould's specimen. Gould's types can all be seen in the National Collection at Washington. Dr. Gould says that the surface of the shell, when examined by the aid of a lens, is tessellated with elongated dots arranged in quincunx, which seem to be specks of opaque white colour rather than punctures. *T. pulvinata* must, however, for the present, be looked upon as a doubtful so-termed species.

47. Terebratella (?) rubiginosa, Dall. (Plate XVI. fig. 19.)

Terebratella ——?, Dall, Amer. Journ. of Conchology, vol. vi. p. 122, pl. vi. fig. 4, 1870.

Terebratella suffusa, Dall, Amer. Journ. of Conchology, vol. vii. p. 65, 1871 (not of Reeve).

Terebratella rubiginosa, Dall, ibid. vol. vii. p. 65, and Proc. Acad. Nat. Sci. Philadelphia. 1873, p. 185.

Shell almost circular, about as broad as long; margins flexuous. Dorsal valve moderately convex, with a faint depression near the middle of the margin, but which is not noticeable in the younger portions of the valve. Ventral valve convex, rather deeper than the dorsal one; beak short, slightly incurved and truncated by an incomplete round foramen, margined by the umbo of the dorsal valve, and by two very small rudimentary lateral deltidial plates. In the interior of the dorsal valve the loop is long and doubly attached, first to the base of the hinge-plate, and then to a short mesial septum. Surface smooth to within a short distance from the margin, when the valve presents a few irregular rounded areas. Colour a rather light brown. Length 1 inch 1 line, breadth about the same.

Hab. ? Cape of Good Hope. (?? Types in the Smithsonian Cabinet.)

Obs. I am very doubtful with respect to the specific value of this species. In 1870, Dall referred it with uncertainty to the *Terebratella suffusa* of Reeve (Conch. Icon. pl. v. fig. 18), but after my subsequently sending him Reeve's type of *T. suffusa* for examination, he wrote back that as Reeve's type is possessed of a large elevated septum and loop like *Magasella*, he has given the name *Terebratella rubiginosa* to his species. In his description of the shell he informs us that "the crura are small, slender, short, and acute. The loop processes are exceedingly slender, mere threads in fact, and roundly deflected outward at first: bending inward just before the neural bend, they give off two moderately broad septal processes, which meet each other at the end of the septum at an angle of 60° (not at right angles to the septum and behind its end, as in *T. dorsata* or *chilensis*). The main processes are then deflected neurally, and the extreme 'bight' of the loop is straight and somewhat angulated at each side. The perforations externally are moderate, arranged in quincunx order, smaller and more regular than in *T. dorsata*, which is its nearest analogue."

Never having seen any specimen of *T. rubiginosa*, I can only reproduce Mr. Dall's statements upon the subject. He says that the species appears to him to be perfectly distinct from any other described *Terebratella*. The loop he figures is certainly very peculiar in its mode of attachment to the short mesial septum.

48. Terebratella Frielii, Davidson. (Plate XVI. figs. 16–17 *b*.)

Terebratella Frieli, Davidson, Proc. Royal Soc. xxvii. p. 438, 1878; and *T. frielii,* Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 46, pl. iii. figs. 19, 20, 1880.

Shell small, ovate, slightly longer than wide, smooth, white. Dorsal valve moderately convex, slightly flattened or depressed anteriorly. Ventral valve deeper than the dorsal one. Beak short, truncated by an incomplete foramen, laterally margined by two very short and small deltidial plates. In the interior of the dorsal valve, the loop, which extends to about two thirds of the length of the valve, is doubly attached, first to the hinge-plate, and then to a mesial septum. Length 5 lines, width 4 lines, depth 3 lines.

Hab. Two small specimens were dredged off Halifax by the 'Challenger' Expedition at a depth of 1340 fathoms; and two other examples close to the Philippine Islands, in 82 to 102 fathoms.

Obs. I feel much uncertainty, as I have stated in my 'Challenger' Report, with respect to the identification of the two small immature shells above described. I forwarded one of them to Mr. Dall for examination, and he wrote back that he could not positively identify it with any of the described species. Dr. Gwyn Jeffreys expressed a similar opinion, adding that the septum and cæcal tubercles are very peculiar and remarkable, and that he felt certain that it was an undescribed species of *Terebratella.* I therefore give it here, merely for reference purposes.

Subgenus Magasella, Dall, 1870.

To this subgenus six species have been referred, viz.:—

1. *Magasella flexuosa,* P. King.
2. —— *crenulata,* Sowerby.
3. —— *aleutica,* Dall.
4. *Magasella Adamsi,* Davidson.
5. —— *Gouldi,* Dall.
6. —— *Cumingi,* Davidson.

The following are uncertain species:—

Magasella patagonica, Gould.
—— *lævis,* Dall.
—— *Malvinæ,* d'Orbigny.
Magasella incerta, Davidson.
—— *radiata,* Dall.
—— *labradorensis,* Sowerby.

I am not, however, satisfied that even all those recorded as species can be definitely accepted. We know very little that is satisfactory about *Magasella* (?) *crenulata, Magasella aleutica, Magasella Adamsi,* and *Magasella Gouldi,* and still less about the six uncertain species. The material I have been able to collect was scanty and insufficient, and further investigations will be requisite whenever circumstances permit. It is therefore at present not possible to determine which are really good species, which varieties only, or synonyms. *Magasella flexuosa* and *M. Cumingi* are, however, good species, and have been carefully studied.

49. Magasella flexuosa, King, sp. (Plate XVII. figs. 1–5.)

Terebratula flexuosa, P. P. King, The Zool. Journ. vol. v. p. 337, 1835.

Terebratella flexuosa, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 367, 1852; Woodward & Gray, Catalogue of the Brachiopoda in the British Museum, p. 87, 1853.

Terebratula rhombea, Philippi, Archiv für Naturgesch. Jahrg. xi. Bd. i. p. 59, 1845.

Terebratula flexuosa, G. B. Sowerby, Thes. Conch. i. p. 347, pl. lxix. figs. 23, 24, 1846.

Terebratella dorsata, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 208, 1859.

Terebratula (Terebratella) suffusa, L. Reeve, Conch. Icon. pl. v. fig. 18, 1860.

Terebratula (Terebratella) Magellanica, L. Reeve, Conch. Icon. pl. v. fig. 21, 1860; and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 176, 1861.

Magasella flexuosa, Dall, Amer. Journ. of Conch. vol. vi. p. 135, 1870; and Proc. Acad. Nat. Sci. Philadelphia, p. 189, 1873; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 46, pl. iv. fig. 5, 1880.

Shell somewhat subtetragonal, about as broad as long, yellowish or light reddish brown, widest near the hinge-line, tapering anteriorly, lateral and frontal margins flexuous. Dorsal valve moderately convex, longitudinally depressed mesially from about half the length of the valve to the front. Ventral valve deeper than the dorsal one, longitudinally keeled. Beak short, incurved and truncated by a rather large incomplete foramen, completed by a small portion of the umbo of the dorsal valve, and by rather large lateral slightly-separated deltidia; beak-ridges well defined, leaving a flattened space or false area between them and the long obtusely angular hinge-lines. Surface of both valves ornamented with from thirty to forty radiating diverging angular ribs, curving to the lateral margins, straight along the middle, with shorter ribs interpolated. Shell-structure traversed by small canals. In the interior of the dorsal valve the loop is doubly attached. Mesial septum large, abruptly elevated at its anterior extremity, extending from under the hinge-plate to about two thirds of the length of the valve. The upper edge of the septum commences by presenting a gentle curve in the shape of a half-circle, then by an oblique nearly straight line reaches its greatest elevation, and again assumes an almost straight line, to be followed by an abrupt inward curve until it reaches near to the bottom of the valve, where it gradually terminates by another gentle curve. The greatest elevation attained by this vertical plate in a specimen ten lines in length was four lines. The principal stems of the loop at about two thirds of their length increase in breath and become fixed to the sides of the septum near the upper portion of the first slope, and, after proceeding a little further, become reflected, the anterior portion of the septum being prolonged for some distance in front of them (Pl. XVII. fig. 5). The muscular impressions are rather large, and are seen on the bottom of the dorsal valve on each side of the septum. The ribs observable on the surface of the valve are reproduced on their interior surface. Length and breadth about 1 inch, depth 6 lines.

Hab. Straits of Magellan, in the vicinity of Port Famine; Orange Harbour; Gulf of Patagonia, near Cape Horn, and not far from the Falkland Islands, in 1450 fathoms; Port Stanley, at a depth of 5 to 12 fathoms ('Challenger' Expedition). Captain P. P. King, R.N., the first discoverer of the species, states, "this shell was dredged in the Bay of Port Famine, attached to stones; it is a common shell in the Straits."

Obs. In external shape this shell nearly approaches *Terebratella dorsata*, Gmelin, and, indeed, L. Reeve places it among the synonyms of the last-named species. It differs, however, in being subtetragonal and tapering more anteriorly, with a less sharply defined mesial depression or sinus in the dorsal valve, and by its ribs being more angular, and more especially by its elevated mesial *Magasella*-shaped septum, which is always observable in the interior of the dorsal valve in its adult condition, while, on the contrary, in fully-developed examples of *Terebratella dorsata* of similar dimensions the septum rises but little above the bottom of the valve. The mode of attachment of the loop of the septum is also different in detail.

In 1845, Philippi described, in the 'Archiv für Naturgeschichte,' a *Terebratula* under the name of *T. rhombea*, a shell similar in shape and character to *Magasella flexuosa*. The type is in the Royal Zoological Museum of Berlin. Philippi did not figure his shell, and I am indebted to the kindness of Prof. E. von Martens for the figures I am able to give of the so-termed species, which I believe to be a full-grown example of *Terebratula flexuosa*, P. King (Pl. XVII. figs. 6–8 *a*). It is also stated to have been procured from the Straits of Magellan.

Terebratella flexuosa is the type of Dall's subgenus *Magasella*. He states that "the punctures [on the surface of the shell] are very large, circular, and under the glass recall the cells of Polyzoa. The margin of the valves is sharply crenulated from the extremities of the external plications."

Magasella flexuosa does not seem to attain to the dimensions of *Terebratella dorsata*.

Under the name *Terebratella suffusa*, L. Reeve describes (Monogr. *Terebratula*, pl. v. fig. 18) what he admits to be a doubtful species partaking of the general character of *Terebratula dorsata*. In 1861 Mr. Reeve kindly presented me with his type and the only specimen of the so-termed species with which he was acquainted. The specimen measures 9 lines in length by 8 in breadth and 5 in depth, and is not symmetrical, one half being narrower than the other, or, in other words, it is to some extent a malformation. Mr. Reeve says that it shows no indication whatever of a mesial depression in the dorsal valve; but this is a mistake, for in reality there exists a slight depression. In the interior of the dorsal valve there is a large prominent mesial septum to which the principal branches of the loop are attached previously to being reflected, exactly as we find to be the case in *Magasella flexuosa*, to which species therefore I would refer Reeve's species (Pl. XVII. figs. 14 *a*, *b*, 15). No specimen of this size of *Terebratella dorsata* presented a similarly shaped and elevated septum. *Terebratula suffusa* is evidently a malformation, and its habitat is not known, but it was in all probability obtained in the Straits of Magellan.

50. MAGASELLA CRENULATA, Sowerby, sp. (Plate XVII. figs. 9–11.)

Terebratula crenulata, G. B. Sowerby, Descriptions of 13 new Species of Brachiopoda, Proc. Zool. Soc. 1846, p. 91; and Thes. Conch. vol. i. p. 358, pl. 71. figs. 96–98, 1846.

Terebratella crenulata, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 368, 1852; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, p. 206, 1859.

Magasella crenulata, Woodward & Gray, A Catalogue of the Brachiopoda in the British Museum, p. 98, 1853.

Terebratula (*Magas*) *crenulata*, L. Reeve, Conch. Icon. Mon. *Terebratula*, pl. viii. fig. 32, 1861; and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 179, 1861.

Magasella crenulata, Dall, A Revision of the Terebratulidæ, Amer. Journ. of Conch. vol. vi. p. 137, 1870; and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 188.

Shell suborbicular, about as wide as long, margin rounded laterally, subtruncate in front. Dorsal valve moderately and uniformly convex, without fold or sinus. Ventral valve rather deeper than the dorsal one; beak produced, slightly incurved and truncated by a large complete foramen, separated anteriorly from the hinge-line by a deltidium in two pieces; beak-ridges sharply defined, leaving between them and the hinge-line a flattened false area. Marginal line flexuous and slightly sinuated in front. Surface of the valves often smooth at the beak and umbo, or marked throughout with from twenty to twenty-two rounded ribs, of which a few are due to the interpolation of shorter ones. In the interior of the dorsal valve the loop is doubly attached, first to the hinge-plate, secondly to an elevated mesial septum. Colour light yellowish white. Length 8, breadth 8, depth 4 lines.

Hab. Santa Cruz, Canaries (Cuming).

Obs. This small species still requires further study before being definitely admitted. The material I have had for examination consisted of only three examples. It is much more circular than Gould's *Magasella patagonica*, and seems to differ likewise from specimens of *Terebratella dorsata* of similar dimensions. The foramen was entire in the few examples that have come under my observation.

51. Magasella aleutica, Dall. (Plate XVII. figs. 16–17 *b*.)

Magasella aleutica, Dall, Preliminary Descriptions of new Species of Mollusca from the North-west Coast of America, Proc. California Academy of Sciences, vol. iv. pl. i. fig. 6, 1872; and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 188.

Shell small, ovate, greatest breadth about the middle, tapering posteriorly and anteriorly, slightly indented in front. Dorsal valve convex, most so near the umbo, with a very slight longitudinal depression commencing at about the middle of the valve and extending to the front. Ventral valve not much deeper or more convex than the dorsal one, margins nearly straight; beak short, incurved and truncated by an incomplete foramen, margined anteriorly by the umbo and by two small lateral deltidial plates; beak-ridges not sharply defined. Surface smooth, marked only by concentric lines of growth; salmon-coloured, brighter on the lines of growth, pale on the umbones. Length 6 lines, breadth 7, depth $3\frac{1}{2}$ lines. Loop doubly attached, very slender, except the lateral arms of the reflected portion, which are wide; septum rather broad from behind forward, not produced above the reflected portion of the loop.

Hab. In the Aleutian Islands, from Akeutan Pass to the Shumagins, attached to the under surface of rocks at extreme low water in spring-tides (Dall).

Obs. I have two examples of this small species presented to me by Mr. Dall, and in sending them to me he wrote:—"In regard to *Magasella aleutica* I am disposed to consider it an adult species, for very thorough dredgings in the region where it is common have failed to indicate any other species of which it might be the young. I have seen young *Terebratella frontalis*, and they appear to differ specifically from *Magasella* *aleutica*. *T. frontalis* has never been found at the Shumagin Islands, where *M. aleutica* abounds. Still all that can be said is hardly decisive, and must be left to individual judgment to be weighed, and future collectors to prove either way." Mr. Dall observes, in his description of the shell, that "the animal is rather sluggish, and living specimens kept in sea-water for several days exhibit no further signs of life than the slight opening of the valves. The soft parts are of a darker reddish colour, and show through the shell to some extent, as in *Waldheimia venosa*. There is some variation in form, some specimens being much broader than others."

52. Magasella Adamsi, Davidson. (Plate XVII. figs. 18, 19.)

Magasella Adamsi, Davidson, Proc. Zool. Soc. p. 307, pl. xxx. figs. 23, 24, 1871; Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 188; G. Dunker, Index Mollusc. maris Japonici, p. 253, 1882.

Shell small, nearly circular, as broad as long. Dorsal valve slightly convex, and marked with about eleven more or less prominent ribs, of which the ventral one, in the dorsal valve, is both the largest and the most elevated. Ventral valve deeper than the dorsal one, with about twelve ribs, of which the central ones are both the largest and most prominent, leaving a rather deep median sulcus between them; beak truncated by a rather large incomplete foramen; deltidium-plates small; shell-punctures large and prominent. In the interior of the dorsal valve the loop is doubly attached, first to the base of the hinge-plate and then to a large prominent septum, extending from under the umbonal beak to about half the length of the valve. Colour white. Length 9 lines, width 2, depth 1 line.

Hab. Two examples only of this small species were dredged by Mr. A. Adams, in 26 fathoms, in the Sea of Japan, off the island of Kuro-puna.

Obs. In one specimen the ribs were almost obsolete. We know, however, far too little about this shell to be able to speak in a decided manner with respect to its specific value. In external appearance it differs from all the known recent forms with which I am acquainted.

53. Magasella Gouldi, Dall. (Plate XVII. figs. 20–22.)

Magasella Gouldi, Dall, MS. in Davidson, Japanese Brachiopoda, Proc. Zool. Soc. 1871, p. 307, pl. xxxi. fig. 11 *a, b, c*; Dall, Amer. Journ. of Conchology, vol. vii. p. 67, pl. xi. fig. 11, 1871, and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 189; G. Dunker, Index Mollusc. maris Japonici, p. 253, 1882.

Shell very small, transversely oval, wider than long; hinge-line nearly as long as the breadth of the shell; beak somewhat produced and slightly incurved, with a large incomplete horseshoe-shaped foramen; deltidial plates very small and widely separated; false area flattened. Ventral valve deep; dorsal valve slightly convex, with a shallow longitudinal mesial depression or groove beginning at half the length of the valve and extending to the front surface of each valve; marked with about eighteen ribs, of these, two median ones lie in a kind of sulcus in each valve and extend from the umbo to the front, while the others are both irregular in width, stouter, and do not extend to more than half the length of the valve from the margin. The lines of growth are well marked. In the interior of the dorsal valve there is no hinge-plate or distinct cardinal process. The muscular scars are thick and excavated above; the septum and loop are similar to those described in *Magasella Adamsi*. The shell is yellowish, with strong rose-colour on the ribs and towards the edges. Length 2 lines, width nearly 3 lines.

Hab. Hakodadi, Japan, on *Terebratella coreanica*, in 60 fathoms (Stimpson).

Obs. I have never seen this shell; the above description was taken from a figure of the single specimen in the possession of Mr. Dall, which he kindly forwarded to me for examination, stating at the same time that it agreed with no other described species. It evidently approaches in character to *Magasella Adamsi*; but there are differences between the two that cannot be cleared away by the inspection of a single specimen. A search for more examples should be made in the locality where this one was obtained, in order to determine their real specific value.

54. MAGASELLA CUMINGI, Davidson, sp. (Plate XVII. figs. 23–32.)

Terebratella? Cumingii, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 368, 1852, and Proc. Zool. Soc. 1852, p. 78, pl. xiv. figs. 10–16.

Magasella Cumingii, Woodward & Gray, Catalogue of the Brachiopoda in the British Museum, p. 99, 1853; Woodward, A Manual of the Mollusca, p. 217, 1856; A. Adams, The Genera of Recent Mollusca, p. 577, pl. cxxxi. fig. 1, 1858.

Terebratula (Bouchardia) Cumingii, L. Reeve, Conch. Icon., Monogr. of *Terebratula*, pl. viii. fig. 30, 1861, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 179, 1861.

Terebratula (Bouchardia) fibula, L. Reeve, Conch. Icon., Monogr. of *Terebratula*, pl. viii. fig. 30, 1861, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 180, 1861.

Magasella Cumingii, Dall, A Revision of the Terebratulidæ, Amer. Journ. of Conch. vol. vi. p. 137, 1870, and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 188; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 48, 1880; É. Deslongchamps, Etudes critiques sur des Brachiopodes nouveaux ou peu connus, p. 204, 1884.

Shell very thick, ovato-oblong, marginally rounded laterally and in front, tapering posteriorly. Dorsal valve uniformly convex, or mesially slightly depressed, close to the front. Ventral valve deeper and more convex than the dorsal one, beak produced, incurved, and truncated by a small oval-shaped foramen beginning at the summit of the beak and directing itself on the opposite side to the area. Area triangular, elongated and excavated, deltidium narrow. Surface smooth, strongly marked with concentric lines of growth, salmon-coloured with a tinge of red. Shell articulating by means of two strong teeth in the larger valve and corresponding sockets in the smaller one. Hinge-plate large, hollowed out, with a narrow longitudinal elevation along the middle, cardinal process divided along the middle; a longitudinal mesial elevated triangular-shaped septum extends from under the hinge-plate to about two thirds of the length of the dorsal valve, and by a gentle curve reaches and touches the top of the larger valve near to its anterior portion, whence it descends by an almost perpendicular line to the bottom of the valve. The calcareous riband-shaped lamellæ first proceed from the socket-walls, directing themselves by a gentle curve to the anterior portion of the septum, where they become attached; above these another pair, which are anchor-shaped, are fixed close to the sloping portion of the upper edge of the septum, but later unite before becoming reflected. Length 5 lines, width 4, depth $2\frac{1}{2}$ lines.

Hab. This beautiful little species was dredged in large numbers by Mr. John Brazier at South Reef, Port Jackson, Heads and Pigs Rock, New South Wales. It was found alive in the first-named locality, and presented a salmon-red colour. Dead perfectly white specimens are to be obtained in large numbers. The 'Challenger' Expedition obtained it also at Port Jackson in from 2 to 4 fathoms. It is said to have been found also in Bass's Straits, South Australia (=*T. fibula*, Reeve). (See Pl. XVII. fig. 33.)

Obs. When I described this species in 1852, only two dead specimens were known in this country, and their habitat was uncertain. It is a very remarkable and excellent species, but its exact generic position has been the theme of some difference of opinion. Mr. L. Reeve says, in his Revision of the Terebratulidæ, Ann. & Mag. Nat. Hist. p. 11, 1861, that "it is in my opinion neither a *Terebratella* nor a *Magas*. It begins to show internally the callous thickening both of the valves and of the apophysis of *Bouchardia tulipa*, and is, above all, distinguished by the acuminated beak and terminal foramen peculiar to that and to the following species" [*T. fibula*]. I quite agree with him in this respect. There exist also differences between it and *Magasella*; still, for all that, it is to the last-named genus that the shell bears the strongest affinities, and I am disposed to coincide with Mr. Dall in placing it in that genus. *Magasella Cumingi* varies a little, according to age, in the manner in which its loop is attached to the sides of the mesial septum; thus in some specimens the anterior edge of the principal lamellæ are fixed to the septum quite independently of the upper anchor-shaped lamellæ, which in those examples have a separate attachment to the septum (Pl. XVII. fig. 30); again in other specimens the anterior edges of the principal lamellæ curve close along the sides of the septum, and become united to the lower edges of the anchor-shaped pair previous to becoming reflected (Pl. XVII. fig. 31).

In 1861, Mr. Lovell Reeve described and figured, in the paper already referred to, a shell a little larger, but so similar in shape and character to *Magasella Cumingi*, by the name of *Terebratula* (*Bouchardia*) *fibula*, that I am very much disposed to regard it as nothing more than an unusually large example of *M. Cumingi*. Mr. Reeve states, *l. c.* p. 180, that "This remarkable shell is curiously intermediate in its characters between *T.* (*Bouchardia*) *Cumingii* and *tulipa*. The beak is more acuminated than in the former; and the area of the deltidium, which in *B. Cumingii* and *tulipa* is excavately grooved, is in *B. fibula* flat. In respect of the callous development of the interior, it is about intermediate between the other two."

I may, however, observe that we are acquainted with only one specimen of the so-termed *T. fibula*, purchased by the British Museum from Mr. Calvert, a dealer in objects of natural history. It measures 7 lines in length by 6 in breadth, and is consequently larger than *M. Cumingi*, which does not seem to exceed $5\frac{1}{2}$ to 6 lines in length where it is usually found. The area in *M. Cumingi* is, it is true, usually excavated or concave, but in some examples it is almost flat, and upon that slight apparent difference it would not be right, I think, to record it as a separate species. The difference of habitat may perhaps have been more favourable to the development of the single example of

T. fibula hitherto discovered, which is said to have come from Bass's Strait, South Australia. Those who differ from me in this identication will find *T. fibula* described by Reeve in the following words :—

"Shell orbicularly ovate, solid, smooth, whitish, tinged with rose ; beak large, triangularly acuminated, erect ; foramen small, terminal, deltidium obsolete, area very large, flat ; valves nearly equally convex, sides callous within ; loop doubly attached, septum callously anchor-shaped." [Conch. Icon. pl. viii.]

Uncertain Species.

55. ? MAGASELLA PATAGONICA, Gould, sp. (Plate XVII. figs. 12–13 *a*.)

Terebratula Patagonica, Gould, Proceed. Boston Soc. Nat. Hist. iii. p. 347, 1850, and United States Exploring Expedition, Mollusca and Shells, p. 97, 1852.

Waldheimia Patagonica, Gould, Otia Conch. (Rectifications) p. 246, Index p. 256.

? *Magas patagonica,* Dall, Amer. Journ. of Conch. vol. vi. p. 133, 1870.

Magasella Patagonica, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 189.

Shell small, subpentagonal, slightly transverse or as wide as long, broadest near the hinge-line. Dorsal valve very slightly convex, with a shallow depression along the middle of the anterior half of the valve. Ventral valve deeper and more convex than the dorsal one ; beak short, incurved, and truncated by an incomplete foramen, margined anteriorly by a small portion of the umbo of the dorsal valve and by two small lateral deltidial plates. Surface of valves smooth at the beak and umbo, the anterior and lateral two thirds of the length of the valve being ornamented with about seventeen rounded divaricating ribs of different lengths. In the interior the hinge-plate is wide and excavated in the middle. The loop is doubly attached to the base of the hinge-plate, and to an elevated mesial septum. Shell-punctures prominent and circular. Colour waxen white. Length 6 lines, width 6, depth 3 lines.

Hab. Orange Harbour, Patagonia (United States Exploring Expedition).

Obs. This appears to be a doubtful species. Mr. Dall writes me that it may be a young *Terebratella dorsata,* but he is not certain that it is so. The shell, he adds, is a typical *Magasella* (which *T. dorsata* is not). Mr. Dall describes the species at considerable length on pp. 133, 134 of the 'American Journal of Conchology,' 1870 ; he says that the dorsal valve is provided with an inconspicuous but acute apex, and small, moderately wide cardinal process. "The hinge-plate is wide and excavated in the middle, or rather there is no transverse lamina before the cardinal process and between the sockets. Instead, two thin laminæ are placed between the under side of the sockets, extending obliquely inward for a short distance, and attached to the cavity of the apex, forming a triangular ridge in the median line, from which the septum takes its rise. The latter is broad and biangulate at its neural extremity. Two hæmal processes, provided with short pointed crura, proceed from the sockets and are attached, about midway between the valve and the apex of the septum, to the latter. From the posterior apical angle of the latter two broad, roundly-recurved processes are extended posteriorly. The anterior apical angle of the septum is extended a short distance in front of them, and is somewhat before the anterior front of the base."

As justly observed by Mr. Dall, this species must not be confounded with the fossil *Waldheimia patagonica*, Sowerby, mentioned in Darwin's 'Geological Observations on South America,' p. 252, pl. ii. figs. 26 & 27, 1846. More material is needed for comparison before the specific value of this so-termed species can be definitely ascertained. I have only seen one young example of the shell sent to me by Mr. Dall.

56. ? Magasella (? var.) lævis, Dall. (Plate XVIII. fig. 4.)

Magasella (? var.) *lævis*, Dall, A Revision of the Terebratulidæ, Amer. Journ. Conch. vol. vi. p. 136, 1870.

? *Terebratula Malvinæ*, d'Orbigny, Voy. Am. Mérid. vol. v. p. 674. no. 779, ix. pl. 85. figs. 27–29, 1847 (according to Dall).

"Shell perfectly smooth except for the light, but beautifully regular, rounded, concentric lines of growth. Outline nearly circular, beak somewhat produced, slightly recurved, with a large incomplete horse-shoe-shaped foramen. The false area sharply carinate and separated from the deltidia by a deep groove. The deltidia are short, moderately wide and widely separated. Shell not inflated, of a horn-colour, and conspicuously punctate. Margin of the valves straight, without any indentation or flexure. Teeth and sockets slender and weak, the whole texture of the shell being exceedingly delicate and papyraceous.

The cardinal process is hardly perceptible. The hinge-plate is very thin, excavated, and covers the posterior end of the mesial ridge which divides the cavity of the beak below the hinge-plate into two parts. The crura are very short and delicate, the hæmal processes at first slender, rapidly widen, throwing off a triangular lamina of shelly matter from the inner sides which reaches the septum and becomes consolidated with it between the anterior and posterior edges, so that the posterior edge of the septum forms a wall between the two triangular laminæ. In the last species [*M. flexuosa*] the edge does not project above the lozenge-shaped plate formed by the two laminæ, and in ? *Magas patagonica* there is only a rounded ridge between them. The septum is broad, arising close to the hinge-plate, obliquely forward, and is truncate at its extremity, which touches the opposite valve. The reflected loop is broad and quite circular. The cardinal muscles are attached in the apical cavity of the neural valve. The peduncle is short and stout, the other muscles are very slender.

Length ·34 in., breadth ·32 in., diameter ·16 in.

"A single specimen was found adhering by its peduncle to a large specimen of *Waldheimia venosa* from Orange Harbor, Patagonia. ? 'Les isles Malouines,' D'Orb. *l. c.*

"It is not unlike, in general appearance, a very minute specimen of *W.* [*Waldheimia*] *venosa*, except that the foramen is much larger, incomplete and of a different shape. It may be identical with D'Orbigny's species, of which the apophyses are not figured, but differs in its small size and rounded form."

Obs. I have reproduced Mr. Dall's full description, as I have never seen the specimen upon which the species (?) has been formed; but I think its acceptance must be considered provisional.

57. MAGASELLA ? MALVINÆ, d'Orbigny, sp. (Plate XVIII. fig. 5.)

Terebratula ? Malvinæ, d'Orbigny, Voyage Amérique Méridionale, vol. v. p. 674. no. 779, ix. pl. 85. figs. 27–29, 1846.

Shell small, ovate or longitudinally oval, broader than long; valves evenly convex, without fold or sinus; beak short, pointed, slightly incurved; foramen incomplete, margined anteriorly by a portion of the umbo of the opposite valve and by two lateral small deltidial plates; beak-ridges sharply defined, leaving between them and the hinge-line a flattened space. Shell perforated by minute canals. Interior details not known. Length 4 lines.

Hab. Obtained during soundings near the Isles Malouines by Dupetit Thouars.

Obs. I have never seen this so-termed species, and it was not to be found at the Jardin des Plantes. It is in all probability a young and immature shell. It is described here for the sake of reference, but cannot be admitted as a well made-out species.

58. MAGASELLA INCERTA, Davidson. (Plate XVIII. figs. 2, 3 *a*.)

Magasella incerta, Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 47, pl. iv. fig. 6 *a*, *b*, 1880.

Shell elongated, pear-shaped, broadest anteriorly, tapering posteriorly, very slightly and evenly convex, somewhat flattened, without fold or sinus, smooth, nearly white. Beak in ventral valve pointed, nearly straight, with a large incomplete foramen extending from under the extremity of the beak to the hinge-line, and margined partly by the umbo of the dorsal valve and by small lateral plates. In the interior of the dorsal valve a short, elevated, vertical mesial septum almost reaches to the bottom and middle of the opposite valve; it extends along the middle portion of the bottom of the dorsal valve to about half the length of the shell; to its sides and to the base of the hinge-plate are attached the principal stems of the loop, the reflected portion being small. Length 2, breadth $1\frac{3}{4}$, depth 1 line.

Hab. Twelve examples of this small shell were dredged by the 'Challenger' Expedition west of St. Thomas, Danish West Indies, at a depth of 390 fathoms.

Obs. I have reproduced the description and figures of this small species from my report on the Brachiopoda of the 'Challenger' Expedition. None of the specimens exceeded the proportions above given. They look as if they were young and immature examples of some species at present unknown; and I have given the shell a provisional name for reference-purposes. The types are in the Zoological Department of the British Museum of Natural History.

59. MAGASELLA RADIATA, Dall. (Plate XVIII. fig. 1.)

Magasella radiata, Dall, Report on the Brachiopoda of Alaska and adjacent shores of North-west America, p. 49, 1877.

Shell small, ovate, longer than wide, broadest and rounded anteriorly, tapering posteriorly. Dorsal valve very gently convex, somewhat compressed, with about 16 or 17 rounded radiating ribs of small elevation on both valves, commencing to rise at about one third the length of the valves, the beak and umbo being smooth. Ventral valve a little deeper than the dorsal one; beak slightly incurved and truncated by a large incomplete foramen, margined posteriorly by the umbo of the dorsal valve, and laterally by small deltidial plates. Shell-structure punctate. Colour waxy or ash-grey. Length 3 lines, breadth $2\frac{1}{2}$ lines.

Hab. Popoff Strait, Shumagin Island; one specimen, with *Magasella aleutica*, adhering to stones at the lowest tides (Dall).

Obs. In 1877 Mr. Dall did not figure his species, but subsequently, in 1885, he sent me the enlarged figure, which I have much pleasure in reproducing, and writes:—"The inside is like that of the ordinary *Magasella* form. I did not like to open my only specimen to get it drawn. I have young *Terebratella transversa* (=*caurina*) less than half the size, which show the imperfectly formed but still genuine *Terebratella* loop; hence I cannot ascribe this to the young state of that species, and as we have no other radiated form in Alaska yet known, I am at a loss to name an adult form from it."

60. MAGASELLA LABRADORENSIS, Sowerby, sp. (Plate XVI. figs. 18, 18 *a*.)

Terebratula Labradorensis, G. B. Sowerby, Proc. Zool. Soc. 1846, p. 95, and Thes. Conch. i. p. 362, pl. 71. figs. 89, 90, 1846.

Terebratula (*Terebratella*) *Labradorensis*, Sowerby?, L. Reeve, Conch. Icon. Monogr. *Ter.* pl. v. fig. 19, 1860, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 178, 1861.

Terebratella Labradorensis, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 185.

"Shell suborbicular, acuminated behind, obtuse, thickish, whitish; valves very unequal, obtusely radiately ribbed: marginal line somewhat flexuous; dorsal valve rounded in front, acuminated and obtuse behind; perforations large, entire; cardinal area large, somewhat flattened; deltidia rather large, united; mesial ridge indistinct; ventral valve nearly orbicular, slightly acuminated behind: margin of valves crenulated.—In the British Museum. From Labrador; C. Goodsir." (G. B. Sowerby.)

Obs. I know so little about this doubtful species, that I am obliged to content myself by reproducing Sowerby's description, in the hope that a search for more specimens may be effected in the locality whence the shell is said to have been obtained. In the 'Conch. Icon.' Lovell Reeve figures another species from Cuming's collection, said to agree with Sowerby's type; but I cannot help regarding this statement as very uncertain. The shell is more circular than the specimen figured in the 'Thesaurus Conchyliorum,' and is stated to be "a rather depressed transparent white orbicular species, of solid structure, ribbed with more strength and regularity than is common in the genus." I have written to gentlemen who have dredged in Canadian waters, but none of them have ever met with the shell.

Subfamily MEGERLINÆ.

Genus MEGERLIA, King, 1850.

This excellent genus was proposed in 1850 by Prof. W. King, at page 145 of his monograph on the "Permian Fossils of England," published by the Palæontographical Society, with the following diagnosis:—"A transversely oblong, uni-areagerous Terebratulidia. *Umbone* very slightly projecting. *Fissure* or *foramen* large, emarginate, and situated in the centre of the area. *Cardinal muscular fulcrum* excavated. *Loop* somewhat quadrate; confined to the posterior half of the shell; attached posteriorly to the crural base, and anteriorly to the medio-longitudinal plate. *Inner surface of valves* radiately pimpled. *Punctures* large. Type *Anomia truncata*, Gmelin."

We are acquainted with two recognized and one uncertain recent species, viz.:—

Megerlia truncata, Linné, sp., = var. *monstruosa*, Scacchi.
Megerlia (?) (*Ismenia*) *sanguinea*, Chemnitz, sp.
Megerlia Willemoesi, Davidson. Uncertain species.

As the generic characters have been fully given under *Megerlia truncata*, they need not be here repeated.

Mr. Dall, in his Catalogue of the Recent Species of the Class Brachiopoda, published in the Proceedings of the Academy of Natural Sciences of Philadelphia, pp. 186 and 187, 1873, groups the genus *Megerlia* into two sections:—

SECTION A (*Megerlia*). Lateral loops closed; shell transverse, sculptured.
1. *Megerlia truncata*, Linné.

SECTION B (*Ismenia*). Lateral loops open; shell more or less swollen, ovate, smooth.
2. *Megerlia Jeffreysi*, Dall.*
3. *Megerlia sanguinea*, Chemnitz.

The loop, as shown by Prof. E. Deslongchamps, undergoes certain modifications during its different stages of development. In 1870 Mr. Dall retained the *Anomia sanguinea*, Chemnitz, as generically distinct from *Megerlia truncata*, and placed it in the genus *Ismenia*, but in 1873 he regarded it as representing a section of *Megerlia*.

SECTION A.

61. MEGERLIA TRUNCATA, Linné, sp. (Plate XIX. figs. 11–20.)

Anomia truncata, Linné, Syst. Nat. ed. duodecima reformata, p. 1152, 1767; Andrea, Lettres écrites de la Suisse, tab. 1. figs. D, E, 1763.

Anomia disculus, Pallas, Misc. Zool. p. 184, t. 14. fig. 1, 1766.

Anomie, fig. *b*, *g*, Davila, Cat. Syst. et Raisonné des Curiosités de la Nature, pl. xx. 1867.

Anomia truncata, Chemnitz, Neues syst. Conch.-Cab. vol. viii. p. 90, tab. 77. fig. 701, 1785; Born, Mus. p. 118, tab. 6. fig. 14, 1778; Gmelin, ed. Linné's Syst. Nat. p. 3343, 1788.

* [See page 113 of this monograph, where Dr. Davidson is informed by Mr. Dall that the shell he first named *Frenula Jeffreysi*, and afterwards described as *Ismenia Jeffreysi*, is the young of *Laqueus californicus*, var. *vancouverinsis*.—A. C.]

Terebratula truncata, Bruguière, Encycl. Méth. pl. 243. fig. 2, 1789.

Anomia truncata, Poli, Test. Sicil. p. 191, t. 30. figs. 16, 17, 1791–1795.

Terebratula truncata, Retzius, Nov. Gen. Testaceorum, p. 14, 1788.

Terebratula truncata, Dillwyn, A Descriptive Cat. of Recent Shells, p. 292, 1817; Lamarck, An. sans Vert. vol. vi. p. 247, 1819; Sowerby, Cat. of the Shells of the Earl of Tankerville, p. 28, 1825; Risso, Europe Mér. vol. iv. p. 387, fig. 174, 1826; Blainville, Dict. Sci. Nat. vol. liii. p. 159, 1828, and = *T. disculus* on p. 138; Philippi, Enum. Moll. Siciliæ, vol. i. p. 95, tab. vi. fig. 12, 1834; Von Buch, Ueber Terebrateln, p. 66, 1834; Scacchi, Cat. Conchyl. Regni Neapolitani, p. 3, 1836.

Delthyris truncata, Anton, Verzeichniss der Conchylien, p. 22, 1839.

Terebratula truncata, Galvani, Illust. delle Coq. Fossili, 1845; Küster, Nov. ed. Chemnitz's Conch.-Cab. p. 28, pl. 3. figs. 11, 12, 1843; E. Forbes, Report on the Mollusca of the Ægean Sea, p. 141, 1843; Philippi, En. Moll. Siciliæ, vol. ii. p. 69, 1844; G. B. Sowerby, Thes. Conch. p. 354, pl. lxxi. figs. 64–67, 1846, and Ann. Sci. Nat. vol. viii. p. 66, pl. vii. figs. 11, 12, 16, 37.

Terebratella truncata, A. d'Orbigny, Considérations zoologiques et géologiques sur les Brachiopodes, Ann. Sci. Nat. Zool. vol. viii. p. 268, pl. 7. figs. 11, 12, 16, 37, 1847.

Orthis oblita, Michelotti, Foss. Mioc. de l'Italie, pl. i. fig. 21, 1847; Sismonda, Synopsis Methodica, p. 11, 1847.

Orthis truncata, Aradas, Coq. Foss. di Gravitelli, p. 14, 1847.

Megerlia truncata, King, English Permian Foss. p. 140, 1851.

Megathyris oblita, d'Orbigny, Prodrome, p. 134, 1852.

Megerlia truncata, Davidson, Sketch of a Classification of Recent Brach., Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 369, 1852; Introduction to vol. i. Brit. Foss. Brach. p. 68. figs. 11, 12, 1853.

Terebratula truncata, Costa, Fauna del Regno di Napoli, p. 33, pl. i. figs. 4–6, 1851.

Megerlia truncata, Woodward and Gray, A Cat. of the Brach. in the Brit. Mus. p. 103, 1856.

Megerlia truncata, S. P. Woodward, A Manual of the Mollusca, p. 219, fig. 122, 1856; H. & A. Adams, Genera of Recent Mollusca, p. 578, pl. cxxx. fig. 3, 1858.

Terebratella truncata and *T. oblita*, Pictet, Traité de Pal. vol. iv. p. 22, 1857.

Megerlea truncata and *M. oblita*, E. Suess, Ueber die Wohnsitze der Brach., Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. pp. 208, 209, 1859.

Terebratula truncata, Verani, Zool. des Alpes Maritimes, 1862; Risso, Europ. Mér. vol. iv. p. 387, fig. 174, 1862; Chemnitz, Man. de Conch. vol. ii. p. 205, figs. 1053–1055 (not 1052), 1862.

Megerlea truncata, E.-Deslongchamps, Recherches sur l'Organisation du Manteau chez les Brachiopodes articulés, p. 26, pl. iii. figs. 1–5, 1864.

Morrisia gigantea, Deshayes, Cat. des Mollusques de l'Ile de la Réunion (Bourbon), Annexe E, p. 37, pl. xxxii. figs. 9, 10, 1863.

Megerlia truncata, Seguenza, Pal. Mal. dei Terreni Terz. del distretto di Messina, Mem. Soc. Nat. di Scienze Nat. vol. i. p. 63, pl. viii. fig. 4, 1865; Brusina, Moll. Dalmati, Real. Soc. Zool. Botanica di Vienna, 1866.

Terebratula (*Megerlia*) *truncata*, L. Reeve, Conch. Icon. Monogr. pl. xi. fig. 47, 1861; Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 180, 1861, and Journal de Conchyl. vol. ix. p. 133, 1861.

Megerlea truncata, Weinkauff, Conchylien des Mettelmeeres, p. 287, 1867; Davidson, On Italian Tertiary Brach., Geol. Mag. vol. vii. pl. xxi. figs. 1, 2, 1870.

Megerlia truncata, Dall, Amer. Journ. of Conch. vol. vi. p. 129, fig. 14, 1870, and Proc. Acad. Sci. Philadelphia, 1873, p. 186; Monterosato, Cat. Conch. Med. p. 7, 1875; Gwyn Jeffreys, On the Mollusca of the 'Lightning' and 'Porcupine' Expeditions, Proc. Zool. Soc. 1878, p. 411; Zittel, Handb. der Paläont. p. 707, fig. 556, 1880; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 50, pl. iii. figs. 15–18, 1880; E.-Deslongchamps, Études critiques sur des Brachiopodes nouveaux ou peu connus, p. 157, pl. xix. figs. 1 5, 1884.

Shell transversely oval, semicircular or subquadrilateral, somewhat depressed, fulvous white. Hinge-line nearly straight, nearly as long as the breadth of the shell, with acute or rounded angles. Dorsal valve gently convex, sometimes much flattened, mesially depressed longitudinally from the umbo to the front, more or less indented in front. Ventral valve deeper than the dorsal one, and longitudinally keeled. Beak very little incurved, and truncated by a large circular incomplete foramen, margined anteriorly by the umbo and by two small rudimentary lateral plates; beak-ridges sharply defined, leaving between them and the hinge-line a flat area. Surface of valves marked with numerous fine radiating riblets, increasing in number at variable distances from the beaks by the interpolation of shorter riblets. Surface of valves crossed by concentric lines of growth. Shell-structure perforated by minute canals. Loop extending to little more than half the length of the valve, trebly attached, first to the base of the hinge-plate, then to a short median septum, and again by lateral branches departing from the reflected upper part of the loop to the upper anterior extremity of the septum. Brachial or labial appendages consisting of two ear-shaped processes connected by a membrane forming two large lateral lobes and a short median spiral one. Length 9 lines, breadth 10, depth 6 lines.

Hab. This species was dredged in great profusion by the 'Challenger' Expedition off Gomera, Teneriffe, in 70 or 75 fathoms. It is a common Mediterranean species, and abounds on the Atlantic shores. Signor Costa obtained it from near the Island of Capri, off Ischia, Palmieri, and in the Gulf of Taranto. Prof. E. Forbes states, in his Report on the Mollusca of the Ægean Sea, 1844, that he found it living at from 60 to 105 fathoms. It was also dredged off the coast of France, Morbihan, Ile de Noirmontier; Guetaria, North Spain, off Marocco and the Canaries ('Talisman' Expedition), in from 50–65 fathoms. The species has been quoted from New South Wales, but I doubt the accuracy of this statement, nor have I ever seen any specimens from Japanese waters. The habitat of the Philippine Islands, given by Woodward, also requires corroboration. The specimen figured by Deshayes as having been dredged off the Island of Bourbon (?) certainly belongs to the species under description; but it is erroneously named *Morrisia gigantea*, and its habitat also requires confirmation.

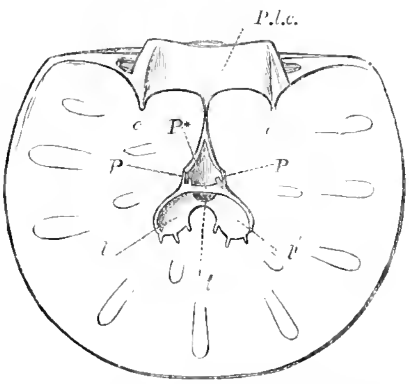
Megerlia truncata is a common fossil in the Upper Tertiary formations of Sicily, Italy, Nice, and elsewhere.

Obs. This is an abundant and well-known species, and the type of the genus *Megerlia*. As may be seen from the long list of references, it has been often described, and very generally so under the specific name of *truncata*. It bears a somewhat obscure external resemblance to some forms of *Orthis*, but, although it has been several times referred to that genus, it possesses none of its characters. In his admirable memoir entitled 'Recherches sur l'Organisation du Manteau chez les Brachiopodes articulés," 1864, M. E. Deslongchamps describes with minute detail the mantle of several forms, and especially that of *Megertia truncata*. He states that the microscopic flattened spicula of the mantle are still more abundant than in *Terebratulina*, have a very peculiar shape, and that the calcified portions are well defined in both valves. The flattened spicula are wide and nearly quadrilateral, with rounded extremities, the edges being festooned; they form denticulated calcareous plates, and vary sufficiently in arrangement in different genera of Brachiopoda to serve as distinguishing characteristics (Plate XIX. figs. 18 & 19).

M. E. Deslongchamps describes with much care and detail, at page 117 of his valuable memoir 'Notes sur les Modifications à apporter à la Classification des Terebratulidæ,' 1884, the different stages in the development of *Megerlia truncata*. He says that "the modifications the shell undergoes from the embryonic to the adult condition present a special character, and constitute a rather peculiar type, at least so far as concerns the brachial appendages. The shell assumes from the commencement a shape which is but little modified by age. It is only more flattened and nearly circular in the youngest individuals; ribs obscurely nodulous then mark the surface of the two valves. The foramen is nearly triangular, but with an elliptic shape. In growing, the shell becomes more and more transverse and subquadrilateral, with a slight tendency to indentation in front. The foramen enlarges posteriorly, but is never provided with more than two rudimentary deltidial plates even in its most adult condition.

"Rather curious and much more accentuated changes take place in the brachial appendages. We will examine them first in a shell two millimetres in length. . . . . The hinge-plate is very largely developed . . . . two small projections, *c*, indicate the places whence the principal stems of the loop will afterwards originate, but of which there is as yet no indication. Towards the middle of the bottom of the dorsal valve rises an apparatus very different from that we have hitherto observed, which first develops round the mouth. Two small pillars, *P*, *P*, rise from the bottom of the valve, then expand forward, forming two thin lamellæ, and expand in the shape of two half-moons, *l*, *l'*, furnished inside with small irregular asperities, and united at their two inner extremities, leaving free a little triangular space, *t*. This small space, to which we will apply the name 'escutcheon,' is completed above by the borders of the semilunar expansions just mentioned, and there constitutes the deflected lamellæ. These are united by a lamella in the shape of a bridge, *P**, which frames the escutcheon. The portion of the loop therefore that is first formed is that in the region of the deflected apophysis, and then no trace of the principal stems of the loop exists. This is contrary to what takes place in all the Brachiopoda we have hitherto recognized. (See woodcut, figure 9.)

Fig. 9.



Young example of *Megerlia truncata*, 2 millimetres in length (enlarged), after M. E. Deslongchamps.

P.l.c., hinge-plate; *c, c*, 1st indications of the principal stems of loops forming two small isolated projections; *P*, *P*, small pillars rising from the bottom of the valve, expanding forward in the shape of two half-moons, *l*, *l'*, furnished with points; *t*, the escutcheon; *P**, united lamellæ in the shape of a bridge.

"At the dimensions of 4 millimetres these two semilunar expansions, *l*, *l'*, have become elongated, and while becoming thinner have lost the small accessory projections of the first stage. The **Y**-shaped apophysis that connects the deflected lamellæ at the bottom of the valve forms a process more or less analogous to the pillar of *Platydia*; but their development ends there, and a true median septum is not produced, uniting the pillar to the hinge-plate, as is the case with *Zeilleria* or *Terebratella* proper. The calcareous appendage or loop of the genus *Megerlia* follows therefore, in this respect, the modifications of the *Terebratulæ* proper; but the analogy here ceases, for the observations of M. Friele have shown that in these last there exists an entire series of transformations, *Platidiform*, *Magadiform*, and *Terebratelliform*, bearing no analogy with those of *Megerlia*."

M. Deslongchamps then explains how in subsequent stages the principal lamellæ or stems of the loop become formed, and that this description of the modifications of the loop must, for the present. be restricted to *Megerlia truncata*, until those of the other recent and fossil species referred to the genus have been examined. He states that there are four vascular sinuses in the dorsal valve.

M. Deslongchamps observes (Recherches sur l'Organisation du Manteau chez les Brachiopodes articulés, pp. 27, 28) that "at the level of the bifurcation of the median septum the mantle, always lined by the pallial apparatus, rises up to join the walls of the visceral cavity, and thence is reflected throughout the length of the arms. Another part passes over the lower portion of the median septum, covers the branches connecting this septum to the principal and reflected branches soldered to the brachial appendage and to the transverse basis which unites them, and afterwards forms one membrane in the shape of an escutcheon, stretched like the skin of a drum between the free internal parts of these various lamellar apophyses. It there forms the lips of the mouth and of the interbrachial membrane, and is finally united to the corresponding portion of the mantle in the large or ventral valve. Throughout this perambulation the mantle is effectually protected by the pallial apparatus, the spicula of which are almost visible to the naked eye, except on the different branches of the brachial apparatus where they are absent. It results from this arrangement that the spicula form on the escutcheon a small area independent of the rest of the pallial apparatus, and limited in all its circumference by the laminæ of the brachial apparatus [Plate XX. figs. 18, 19]. . . . In the arms and their cirri the shape of the spicula is entirely different; they are arranged exactly like those of the same parts in *Terebratulina*, only their branches are larger and their divisions less numerous. These spicules have almost the aspect of those on the borders of the escutcheon, with this difference, that they are always more elongated in the transverse direction, that is to say perpendicularly to the axis of the length of the canals, and are much more cut out at their edges."

Dr. Gwyn Jeffreys, in the Ann. & Mag. Nat. Hist. for 1858, ii. pp. 123–4, in referring to *Megerlia truncata*, remarks that "Having examined Dr. Turton's specimen in my cabinet, which he is said to have procured from Torbay, and which is referred to in the footnote, p. 362, vol. ii. of the 'History of British Mollusca,' I am enabled to state confidently that it belongs to the above species, and not to *Terebratula detruncata* or *decollata*, as therein supposed. M. Collard-Descherres records *Terebratula truncata* as having been taken on the coast of Finisterre (Journal de Conchyliologie, tome ii. p. 393), and there is no reason to doubt the possibility of its being a British species."

Mr. Dall, at p. 130 of his memoir "On a Revision of the Terebratulidæ," in the American

Journal of Conch. vol. vi. p. 130, 1870, says that "The [Smithsonian] collection includes a specimen from New South Wales (coll. Angas), sent under the above name [*M. truncata*]. The shell and apophyses presented no constant difference from Mediterranean specimens. The animal was in a perfect state of preservation in both, and I noticed the following differences, of which only a much larger series would be sufficient to establish the constancy. The central spiral lobe of the brachia, prominent in the European species, seemed to be nearly wanting in the Australian shell. The fringes in the former were nearly twice as long, the individual filaments much more slender, and five or six times as numerous as in the latter."

MEGERLIA TRUNCATA, var. MONSTRUOSA, Scacchi. (Plate XIX. figs. 21, 22 *a*.)

Terebratula monstruosa, Scacchi, Osserv. Zool. no. 2, p. 17, 1838, and Cat. Conchyl. Regni Neapolitani, p. 8, 1836.

Terebratula monstruosa, Costa, Fauna del Regno di Napoli, p. 43, pl. ix. figs. 4, 5, 1851.

Megerlia truncata, var. *monstruosa*, Monterosato, Poche note sulla Conch. Med. p. 4, 1875.

When describing this shell, Scacchi observes that he suspects it might be a malformation of *Terebratula truncata*, a view reciprocated by Costa and by several other malacologists, and it is very probable that they are correct in their expression of opinion. Having had a number of specimens through my hands presenting the same peculiarities, I have preferred to retain for it the varietal name of *monstruosa*. In shape it is either circular or transversely oval, and usually smaller than *Megerlia truncata* proper. The dorsal valve is much flattened, and occasionally even somewhat concave and marked with ruts and irregularities due to the object upon which it lay closely impressed. There generally exists at the umbo a semicircular aperture or foramen, somewhat similar to that of *Platydia*, which affords passage, in part, to the short thick peduncle. The ventral valve is evenly convex; beak very short, with its extremity sometimes partly overlying the semicircular aperture in the umbo of the dorsal valve; foramen semicircular, completing that in the dorsal valve. Surface of ventral valve faintly marked by fine radiating raised lines or riblets, that of the dorsal valve with concentric lines. In the interior of the dorsal valve the loop is exactly similar to that of the typical *Megerlia truncata*. Colour yellowish. Length 6 lines, breadth 6, depth $2\frac{1}{2}$ lines.

Hab. Dredged alive near the Island of Corsica (Scacchi); also in the Bay of Naples.

Obs. Were it not for the loop many specimens of this variety or malformation might be taken for *Platydiæ*.

SECTION B.

62. MEGERLIA SANGUINEA, Chemnitz, sp. (Plate XX. figs. 1–8.)

Anomia sanguinea, Chemnitz, Neues syst. Conch.-Cabinet, vol. viii. p. 96, pl. 78. fig. 706, 1785.

Anomia sanguinolenta, Gmelin, ed. Linné's Syst. Nat. p. 3347, 1788; Dillwyn, Cat. of Recent Shells, p. 293, 1817 (not of Solander).

Terebratula sanguinea, Küster, Nov. ed. Chemnitz's Conch.-Cab. p. 33, pl. ii. figs. 9, 10, 1843.

Terebratula cruenta, E. Donovan (not of Dillwyn), The Naturalist's Repository, vol. ii. pl. lvi. fig. 1, 1824 (according to Donovan this is the *Anomia cruenta* of Solander, MS.).

Terebratula sanguinolenta, Blainville, Dict. des Sci. Nat. vol. liii. p. 142, 1828.

Terebratula erythroleuca, Quoy & Gaimard, Voyage de l'Astrolabe, vol. iii. p. 557, pl. lxxxv. figs. 8, 9, 1834; Deshayes, Nov. ed. Lamarck, An. sans Vert. vol. vii. p. 350, 1836.

Terebratula sanguinea, G. B. Sowerby, Thes. Conch. vol. i. p. 357, pl. lxxi. figs. 71–73, 1846.

Terebratula pulchella, G. B. Sowerby, ibid. p. 360, pl. lxxi. figs. 105–107, 1846.

Terebratella sanguinea, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 368, 1852.

Megerlia pulchella, Davidson, ibid. p. 369, 1852.

Terebratella sanguinea, Woodward & Gray, Cat. of Brach. in Brit. Mus. p. 90, 1853.

Megerlea pulchella, Woodward & Gray, ibid. p. 90, 1853.

Terebratella sanguinea, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 205, 1859.

Terebratula (*Terebratella*) *sanguinea*, Reeve, Conch. Icon. pl. vii. fig. 25 *a*, *b*, *c*, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 178, 1861.

Ismenia sanguinea, Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 99, 1863; Dall, Amer. Journ. Conch. vol. vi. p. 127, 1870.

Megerlia sanguinea, Davidson, Proc. Zool. Soc. 1871, p. 308, pl. xxxi. figs. 1, 2.

Megerlia sanguinea, var. *Reevei*, Davidson, ibid. 1871, p. 308, pl. xxxi. fig. 3.

Megerlea sanguinea, Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 187, 1873; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 52, pl. iii. fig. 14, 1880.

Frenula sanguinea, Zittel, Handbuch der Paläontologie, p. 708, 1880.

Megerlea sanguinea, G. Dunker, Index Mollusc. maris Japonici, p. 253, 1882.

Terebratella sanguinea, E. Deslongchamps, Études critiques sur des Brachiopodes nouveaux ou peu connus, p. 102, pl. xvii. figs. 1–4, 1884.

Shell thin, small, somewhat transversely oval, and quite regular, or almost circular, as broad as long, smooth, almost polished, with faintly marked concentric lines of growth. From white or yellow to a livid red, marked with brownish or reddish streaks, freckled with bright blood-red blotches, bounded on each side by white and yellowish streaks and patches or spots of red, which radiate towards the margin. Dorsal valve moderately convex, with a more or less defined mesial depression, commencing at about half the length of the valve and extending to the front. Ventral valve rather deeper than the dorsal one, uniformly convex, sometimes either slightly keeled or flattened along the middle. Beak moderately incurved and truncated by a circular foramen, very slightly separated from the hinge-line by a small deltidium; beak-ridges well defined, leaving a flattened space or area between them and the hinge-line. Shell perforated by canals. In the interior of the dorsal valve the loop does not extend much further than to about two thirds of the length of the valve; it is three times attached—first to the hinge-plate, then before attaining half its length to a longitudinal septum, and a third time by vertical laminae, which connect the lateral reflected extremities of the loop with the median septum. Length 7 lines, width 7, depth $3\frac{1}{2}$ lines.

Hab. Dredged by the 'Challenger' Expedition on the reefs of Zamboanga, at 10 fathoms depth. One example was obtained by the 'Astrolabe' Expedition at Tongatabu. I have very fine and large examples from off the Island of Zebu, in the Philippines, and off Honolulu, in the Sandwich Islands, attached to corals and stones. The Rev. J. Tenison Woods sent me specimens of the shell, both white and coloured, from near Bird's Island, North Australia. Mr. Adams dredged it at Mino-Sima, in 63 fathoms, and at Gotto in 48 fathoms. It was also obtained by Mr. E. Deplanche not far from the coast of Tahiti, and recently off Phare, New Caledonia. The variety *T. pulchella* is stated by

G. B. Sowerby to have been found by Mr. Cuming attached to corals at Calapan, Isle of Mindoro, also off the Island of Cocos (Lieut. Swainson). The shell has been dredged by Mr. J. Brazier off the Bottle and Glass rocks, Port Jackson, Australia, and at other places in the same region. (Pl. XX. figs. 9–11.)

Obs. Mr. E. Donovan, in vol. ii. (1824), of his 'Naturalist's Repository,' tells us that "this elegant little testaceous body is eminently entitled to the consideration of the naturalist, being no other than the true *Anomia Cruenta* of Dr. Solander's manuscripts, preserved in the Banksian library, and of the Portland Museum to which the Solandrian manuscripts refer; it is consequently the shell which has been so uniformly mistaken for and confounded with the *Anomia sanguinea* of the same author, and not unfrequently with his *Anomia rubicunda* also." Such may perhaps be the case; but as Solander did not publish a description of his shell, we are bound to take the name of the *Anomia sanguinea* described and figured by Chemnitz in 1785. To a bleached specimen from Japan, A. Adams, in 1863, gave the name of *Ismenia Reevei* (Pl. XX. figs. 12, 12 *b* of this work), and Mr. L. Reeve states, in his description of *T. sanguinea*, that "An examination of more than a dozen specimens of this charming species, most of them with the soft parts macerated, so as to afford excellent comparisons of the loops, has convinced me that Mr. Sowerby's *T. pulchella* (*Megerlia pulchella*, Davidson) is merely a variety of the old *Anomia sanguinea* of Chemnitz." If only Sowerby's figures of *T. sanguinea* and *T. pulchella* are compared, one might perhaps feel disposed to conclude that they represented different species; but when one examines, as I have done, a large number of individuals, it is soon found out that the two extreme forms are connected by intermediate or passage ones. The red spots on the shell also vary much in extent, and even shape, sometimes forming a longitudinal and rather wide mesial band with a small yellow band on each side, on which none are visible, and in some examples short ribs are also observable near the margin in both valves.

M. E. Deslongchamps, in his paper already referred to (p. 102), classes *T. sanguinea* with *Terebratella*, and describes some of the changes it undergoes from the youngest stage up to the adult condition. He says "that the brachial apparatus or loop is more complicated than that of true *Terebratellæ*, and very similar to what we observe in the *Megerliform* stage of *Waldheimia septigera*, but with an additional complication." In my opinion *T. sanguinea* is not a true *Terebratella*, and, if not a *Megerlia*, would require to be left with *Ismenia* or some other genus. In plate xvii. of the work just quoted, Deslongchamps figures the passages of *T. sanguinea* from the *Platydiform* into the *Magadiform* stage at the dimensions of 4 millimetres, the commencement of the *Megerliform* stage at 8 millimetres, and the *Megerliform* stage of the species at the dimensions of 10 millimetres (see our Pl. XX. figs. 4, 5, 6, 7, 8; and the corresponding explanations).

Mr. Dall, in his paper in the Amer. Journ. of Conch. vol. vi. p. 128, 1870, when describing *Ismenia sanguinea*, mentions that "There is some variation in the obliquity and breadth of the apophyses in different individuals, but the essential characters remain the same. The punctures in the shell are larger and more conspicuous than in any species of the group with which I am acquainted. The imbricating prisms of which the shelly structure is composed are beautifully conspicuous with a very low power, inside; and even the apophyses seem to exhibit the same or a similar structure, though impunctate. . . . . In general, the foramen is moderate and the deltidia are united, but in many cases the foramen is large and the deltidia are more or less widely separated, and the apex is produced. I cannot doubt the identity of *T. pulchella*, Sby., with *T. sanguinea* of Davidson and Chemnitz."

Uncertain Species.

63. MEGERLIA WILLEMOESI, Davidson. (Plate XIX. figs. 23–26.)

Megerlia Willemoesi, Davidson, Proc. of the Royal Soc. vol. xxvii. p. 438, 1878.

Mergelia willemöesi, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zoology, vol. i. p. 51, pl. iv. figs. 1–3, 1880 (erroneously labelled on plate *Magasella Willemoesi*).

Shell ovate, or longitudinally oval, broadest anteriorly, tapering posteriorly. Valves moderately convex, surface smooth, white. Dorsal valve moderately convex, not quite so deep as the ventral one, and somewhat flattened anteriorly so that the front line is slightly depressed. Ventral valve very convex, slightly flattened along the middle and especially so anteriorly. Beak produced, comparatively large and truncated by a circular foramen, separated from the hinge-line by a rather wide and high deltidium. In the interior of the dorsal valve the loop is three times attached—first to the hinge-plate, again to a median septum, and thirdly by perpendicular lamellæ which connect the lateral reflected extremities of the loop with the median septum. Length 7 lines, width 5, depth 4 lines.

Hab. Five examples of this interesting species, attached to branched Polyzoa, were dredged in company with *Terebratula uva* by the 'Challenger' Expedition, off Twofold Bay, South Australia, or between Sydney and Melbourne, in 120 fathoms.

Obs. I can add nothing with respect to this species to the description here reproduced from my 'Challenger' report. The discovery of more specimens would be desirable before the species is definitely admitted.

Subgenus LAQUEUS, Dall, 1870.

Type *Laqueus californicus*, Koch, sp.

When proposing this subgenus, Mr. Dall published the following diagnosis:—

"Shell with the reflected portion of the loop attached by slender processes, on each side, to the hæmal processes, at or near the points where the two septal processes branch off to the septum. Foramen complete. It will be observed that the reflected part of the loop is attached by the two (lateral) processes, not to the septum nor to the septal processes, but to the hæmal portions of the loop (which I have termed hæmal processes); thus the two septal processes, the two lateral processes, and the 'bight' of the neural loop, form a somewhat sinuous ring, intersected by the point of the septum, the hæmal processes and the two sides of the neural loop." (Revision of the Terebratulidæ, 1870, p. 123.)

This is a very good subgenus and has been generally accepted. We are acquainted with three recent species and a named variety *, viz.:—

Laqueus californicus, Koch.
—— *californicus*, var. *vancouveriensis*, Davidson.
Laqueus pictus, Chemnitz.
—— *rubellus*, Sowerby.

* [*Laqueus suffusus*, Dall, is figured on Pl. XIX. figs. 6, 7 *b*. It was subsequently placed as a synonym of *L. rubellus*, by Dall, but was considered by Davidson to be the young of *L. pictus* (p. 114).—A. C.]

64. Laqueus californicus, Koch, sp. (Plate XVIII. figs. 6–9.)

Terebratula californica, Koch, Küster, nov. ed. Chemnitz, Conch.-Cabinet, vol. viii. pl. 2 *b*. figs. 21–23, 1843.

Terebratula Kochi, Küster, ibid. vol. viii. pl. 2*d*. figs. 1–3, 1843.

Terebratula Californica, G. B. Sowerby, Thes. Conch. i. p. 352, pl. lxx. figs. 50–52, 1846.

Terebratula Californiana, Davidson, Sketch of a Classification of Recent Brachiopoda, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 364, 1852.

Waldheimia Californica, Woodward & Gray, Cat. of Brach. in Brit. Mus. p. 60, 1853; P. Carpenter, Rep. Brit. Assoc. 1856, p. 298; Cooper, Geogr. Cat. p. 3. no. 5.

Waldheimia californiana, E. Suess, Ueber die Wohnsitze der Brach. Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 202, 1859.

Terebratula (*Waldheimia*) *globosa*, L. Reeve (not of Lamarck), Icon. Conch. Monogr. *Ter.* pl. ii. fig. 3, 1860.

Laqueus californicus, Dall, Amer. Journ. Conch. vol. vi. p. 123, 1870, *L. Californica*, Proc. Acad. Sci. Philadelphia, 1873, p. 186; E. E. Deslongchamps, Études critiques sur des Brachiopodes nouveaux ou peu connus, p. 202, 1884; Zittel, Handbuch der Paläontologie, p. 706, 1880.

Shell large, longitudinally oval, inflated; margins slightly sinuous. Dorsal valve uniformly convex, with occasionally a very slight tendency to depression close to the frontal margin. Ventral valve a little deeper than the dorsal one, with sometimes a slight indication of a mesial longitudinal elevation or flattened fold; beak incurved, truncated by a small circular foramen, margined anteriorly by two wide deltidial plates; beak-ridges sharply defined, leaving between them and the hinge-line a flattened space. Surface of valves smooth, with concentric lines of growth, shell-perforations rather large. Colour livid yellowish brown or light reddish brown. Length 2 inches 6 lines; breadth 1 inch 11 lines; depth 1 inch. In the interior of the dorsal valve the hinge-plate is bifid; cardinal process inconspicuous. The septum, of small elevation, extends from under the middle of the hinge-plate to a little more than a third of the length of the shell; the principal lamellæ of the loop, after having been attached to the angles of the hinge-plate and giving off short curved crura, proceed a short distance, when they again give off two slightly oblique laminæ, which become attached to the anterior edge of the mesial septum. The principal stems of the loop then extend to within a short distance of the frontal margin, where they become deflected in the shape of a horse-shoe, giving off on each side a short lamella near their upper extremity, thus connecting the reflected portion with the principal stems of the loop close to the point where the two oblique lamellæ leave for their attachment to the mesial septum.

Hab. Coast of Barbara County, California, in 90 fathoms (Dall).

Obs. This fine species, little inferior in size to *Waldheimia venosa*, Solander, has often been confounded with it on account of its similarity in external shape. The two species are, however, perfectly distinct. The small foramen, widely separated from the hinge-plate in *Laqueus californicus*, at once distinguishes it from *Waldheimia venosa*, which possesses a much larger foramen but little separated from the hinge-line. The absence of a defined cardinal process in the interior of the shell and a very different arrangement of the loop further distinguish the two species.

The *Terebratula Kochi*, Küster, is only a smaller specimen of *Laqueus californicus*.

65. LAQUEUS CALIFORNICUS, var. VANCOUVERIENSIS. (Plate XVIII. figs. 10–13 *b*.)

Off Vancouver Island we find in large numbers a smaller race or northern form which Mr. Dall considers to be *Laqueus californicus*. The shell has also been quoted by Mr. J. F. Whiteaves from off Metla-katla, Queen Charlotte Islands, and from between Race Island Lighthouse and Victoria Harbour, in from 30 to 70 fathoms, as well as off the N.W. end of Texada Island, in 40 to 70 fathoms, west coast of North America. I have examined a number of specimens of this shell, some quite circular, others ovate and truncate anteriorly with a slight depression on the anterior third of the length of both valves. The foramen is also comparatively larger than in typical Californian examples of *Laqueus californicus*. Interiorly the loop and its attachments are similar to those of the Californian shell. It is decidedly of a livid yellowish-brown colour. After consulting with Mr. Dall upon the subject, he wrote me back, on the 17th of December 1884:—"The shells from Vancouver which I referred to *L. californicus* are, I am quite confident, a northern form of that species, less brightly coloured, thicker, and ruddier. I have northern specimens fully as large as the southern ones, and I believe my *Megerlia Jeffreysi* to be the young stage of it. The northern form might perhaps have a varietal name; but if we had plenty of specimens, I think they would be found to intergrade."

I had always felt much uncertainty with respect to the specific value of the so-termed *Megerlia Jeffreysi*, and was therefore pleased to hear Mr. Dall admit that it might prove to be a young stage of the northern form of *Laqueus californicus*. In 1871 it was briefly noticed by Dall in the 'American Naturalist,' vol. v. p. 55, under the name of *Frenula Jeffreysii*; in the same year in the 'American Journal of Conch.' vol. vii. p. 65, pl. ii. figs. 7–10, by the name of *Ismenia Jeffreysi*; and in the 'Proc. Acad. Nat. Sciences of Philadelphia,' 1873, p. 187, under the name of *Megerlia Jeffreysi*. It was dredged by Dall at Port Etches, Alaska Territory, in 14 fathoms chalky mud, as well as alive off the Semidi Islands. It is also said to have been obtained in the North Atlantic Ocean; but this statement needs confirmation.

66. LAQUEUS RUBELLUS, G. B. Sowerby, sp. (Plate XIX. figs. 1–5.)

Terebratula rubella, G. B. Sowerby, Proc. Zool. Soc. 1846, p. 94,; Thes. Conch. i. p. 350, pl. lxix. figs. 10–12, 1846.

Terebratella rubella, Davidson, A Sketch of a Classification of Recent Brachiopoda, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 368, 1852; Woodward & Gray, Cat. of Brach. in the Brit. Mus. p. 90, 1853; L. v. Schrenck, Reisen und Forschungen im Amur-Lande, p. 466, 1854–56; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 205, 1859.

Waldheimia cranium, A. Adams (not of Müller), Recent Brachiopoda found in the Seas of Japan, Ann. Mag. Nat. Hist. 3rd ser. vol. xi. p. 98, 1863.

? *Laqueus suffusus*, Dall, Amer. Journ. of Conch. vol. vi. p. 125, pl. vii. fig. *h*, 1870.

Laqueus rubella, Davidson, Proc. Zool. Soc. 1871, p. 306, pl. xxx. figs. 18–22; Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 186; G. Dunker, Index Mollusc. maris Japonici, p. 252, 1882.

Shell longitudinally nearly oval or ovate, longer than wide, straight or indented in front, lateral margins very gently sinuated. Dorsal valve uniformly convex to within a third or fourth of its length, when a flattish mesial depression, about four lines in breadth, commences and extends to the front. Ventral valve deeper and more convex than the dorsal valve, keeled along its posterior half, gently depressed mesially along its anterior half. Beak incurved, truncated by a small circular foramen, margined anteriorly by two small narrow deltidial plates; beak-ridges well defined, leaving between them and the hinge-line a narrow flattened false area. Colour yellowish red, varying in intensity or more vividly coloured at the concentric lines of growth, and sometimes rayed with bright red. Length 1 inch 3 lines, breadth 1 inch, depth 7 lines.

In the interior of the dorsal valve the loop is long, the hinge-plate divided along the middle. Mesial septum, not very prominent, extends from between the hinge-plates to rather less than half the length of the valve.

The principal lamellæ forming the loop after having become attached to the base of the hinge-plate soon give off a horizontal lamina which attaches itself to the anterior edge of the mesial septum, and after having attained its greatest length again becomes reflected, the upper lateral portions of the deflected loop becoming connected to the principal stems by an oblique lamella, close to the point where the horizontal lamella leaves for its attachment to the mesial septum.

Hab. Dredged by A. Adams, from a clear stony bottom off the small island of Kuro-Sima, at a depth of 35 fathoms, Japan; by Prof. R. Plumpelly at the wharf at Yokohama, Japan; and by Capt. St. John in the Strait of Corea, in from 23 to 35 fathoms.

Obs. Since Sowerby described this pretty shell in 1846, many much larger and finer examples have been obtained from Japanese waters. The shell does not appear to vary much in shape, and is distinguished from *Laqueus pictus* by its straight or slightly indented front. In 1870 Dall proposed a new species under the name of *Laqueus suffusus* (Pl. XIX. figs. 6, 7 *b*), but this he relinquished in 1873, locating his so-termed species as a synonym of *L. rubellus*; but I am myself more inclined to regard it as a young condition of *Laqueus pictus*. In colour *L. rubellus* varies considerably, some specimens are ashy white, others are of a general salmon-colour, which deepens into orange-red near the lines of growth or margins of the shell. In some examples, besides a general reddish tint, a few rays mark the lateral portions of the shell, but these are rarely so strongly defined as in Sowerby's figure, in which the coloration is exaggerated.

67. Laqueus pictus, Chemnitz, sp. (Plate XVIII. figs. 14–18.)

Anomia picta, Chemnitz, Conch.-Cabinet, vol. xi. p. 247, pl. 203. figs. 2011, 2012, 1785?; Anton, Verzeichniss der Conch. p. 23, 1839.

Terebratula picta, G. B. Sowerby, Thes. Conch. i. p. 351, pl. lxx. figs. 43, 44, 1846; Küster, ed. Martini & Chemnitz, Conch.-Cabinet, pl. ii *c*. figs. 8, 9, 1843; Davidson, A Sketch of a Classification of Recent *Terebratulæ*, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 364, 1852.

Waldheimia picta, Woodward & Gray, Catalogue of Brachiopoda in the Brit. Mus. p. 59, 1853; A. Adams, The Genera of Recent Mollusca, p. 575, 1858; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 201, 1859.

Terebratula (*Waldheimia*) *picta*, L. Reeve, Conch. Icon., Monogr. *Terebratula*, pl. iii. figs. 9 *a*, *b*, 1860; Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 175, 1860.

Waldheimia picta, A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 99, 1863; Dall, Amer. Journ. of Conch. vol. vi. p. 112, 1870.

Laqueus pictus, Davidson, Proc. Zool. Soc. 1871, p. 301, pl. xxxi. fig. 10; G. Dunker, Index Moll. maris Japonici, p. 252, 1882.

Shell ovate, longitudinally oval, broadest about the middle, somewhat acuminated or rounded anteriorly. Dorsal valve uniformly convex, no fold or sinus. Ventral valve rather deeper than the dorsal one, beak incurved, slightly overlying the umbo of the dorsal valve, and truncated by a small circular foramen slightly separated form the hinge-line by a deltidium in two pieces; beak-ridges sharply defined, leaving between them and the hinge-line a narrow flattened false area; marginal line almost straight. Colour yellowish red, sometimes bright red and marked in an irregular manner with zigzag light-yellowish ramifying spots. Length 1 inch 4 lines, breadth 1 inch, depth 8 lines.

In the interior of the dorsal valve the hinge-plate is well defined and notched along the middle; no distinct cardinal process. A slightly raised mesial septum extends along the bottom of the valve from the middle of the hinge-plate to less than half its length; the loop is long; the principal stems, after having become attached to the base of the hinge-plate, soon give off a horizontal lamella, which become attached to the anterior edge of the mesial septum, and again extends until it reaches its greatest length, when it is deflected to form the loop; before the reflected part has attained its terminations it gives off on each side an oblique lamella which becomes attached to the principal stems of the loop, close to the point whence the horizontal lamella leaves for its attachment to the mesial septum.

Hab. Dredged by A. Adams, in 55 fathoms, off Satanomosaki, Japan, and by Capt. St. John, in 23 and 24 fathoms, in the Corea Strait.

Obs. This is a fine shell, much sought after by collectors. Its red colour is rarely as bright as it is sometimes represented to be, the shell being generally of a dull yellow-red with radially interrupted spots of light yellow. Young specimens taper considerably anteriorly, are broader posteriorly, and of a salmon-colour. *L. pictus* has been successively placed in the genera *Terebratula*, *Terebratella*, and *Waldheimia*; but I was at last able to ascertain that its loop was positively that of a *Laqueus*. L. Reeve gives *Terebratula erythroleuca*, Quoy, as a synonym of the species under description; but this is a mistake, for it is really a synonym of the *Anomia sanguinea* of Chemnitz. He also quotes Java as the habitat of *Laqueus pictus*, but I have never seen any specimen from that locality.

Subfamily MAGASINÆ.

Genus BOUCHARDIA, Davidson, 1849.

Of this genus only one species has hitherto been discovered; its generic characters have been described under *Bouchardia rosea* and need not be repeated here.

68. BOUCHARDIA ROSEA, Mawe, sp. (Plate XX. figs. 13–18.)

Anomia rosea, Mawe, Intr. to Conch. tab. iv. fig. 4, 1823.

Terebratula rosea, G. B. Sowerby, Cat. of Shells of the late Earl of Tankerville, p. 28, 1825.

Terebratula tulipa, Blainville, Dict. Sc. Nat. liii. p. 144, 1828.

Terebratula rosea, Sander Rang, Manuel de l'Histoire naturelle des Mollusques, pl. 8. figs. 1–3, 1829; Deshayes, ed. Lamarck, An. sans Vert. vol. vii. p. 350, 1836.

Terebratula unguis, Küster, ed. Martini & Chemnitz, Conch.-Cab. p. 35, pl. 2 *b*. figs. 8–10, 1843.

Terebratula rosea, d'Orbigny, Voyage dans l'Amérique Méridionale, vol. v. p. 674, 1847.

Bouchardia rosea, Davidson, Bull. Soc. Géol. de France, 2e sér. vol. vii. p. 62, pl. i. figs. 1–6, 1849; Classification of Recent Brachiopoda, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 372, 1852.

Pachyrhynchus roseus, King, A Monograph of English Permian Fossils, Pal. Soc. p. 70, 1850.

Bouchardia tulipa, Woodward & Gray, Catalogue of the Brach. in the Brit. Mus. p. 100, 1853; S. Woodward, A Manual of the Mollusca, p. 218, 1856.

Terebratula rosea, Hanley, Recent Shells, p. 322, 1856.

Terebratula (Bouchardia) tulipa, L. Reeve, Conch. Icon. pl. viii. fig. 33, 1861.

Bouchardia tulipa, Adams, The Genera of Recent Mollusca, vol. ii. p. 577, 1858; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 210, 1859; Dall, Revision of the Terebratulidæ, Amer. Journ. of Conch. vol. vi. p. 141, 1870.

Bouchardia rosea, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 191.

Shell thick, with a nearly straight beak, longitudinally oval or spindle-shaped, longer than wide; surface smooth, marked here and there with concentric lines of growth. Colour yellowish red, pink throughout or sparingly rayed with bright crimson. Length 9 lines, breadth $5\frac{1}{2}$ lines, depth 4 lines. Dorsal valve very gently and uniformly convex posteriorly, anteriorly more or less depressed along the middle. Ventral valve slightly deeper than the dorsal one, longitudinally keeled; beak triangularly acuminated, almost erect, very little incurved, and truncated by a small terminal circular foramen widely separated from the hinge-line by a concave false area, with two narrow grooves along the middle; deltidium blended with the shell. Interior of the valves much thickened posteriorly. The interior of the dorsal valve is unusually thickened posteriorly, to about one third of its length; hinge-plate large and solid, provided with V-shaped diverging grooved ridges, and much elevated above the other portions of the shell, especially anteriorly. These long scooped-out ridges probably served for the attachment of the cardinal muscles. On each side, on a lower level, are the lateral portions of the hinge-plate, and close to the hinge-line on each side the dental sockets. No cavity exists under the hinge-plate, which is massive; but from its sunken base a mesial septum of about one third the length of the valve extends, this gradually rises until it becomes abruptly elevated anteriorly in the shape of a wide perpendicular plate, and to the posterior labial slopes of which are fixed anchor-shaped disconnected curved lamellæ, broad at their attachment to the sides of the septum and gradually tapering to a point At the bottom of the valve on each side of the septum are faintly impressed muscular scars. In the interior of the ventral valve the shell is much thickened at and near to the beak, as well as longitudinally; along its centre extends a wide slightly raised ridge with two oval-shaped muscular impressions on each side; two deviating massive ridges, deeply excavated along the middle, extend from under the beak to about one third of the posterior length of the valve. Teeth for the interlocking of valves strong. The positions of the occlusor, divaricator, and ventral adjustors in the ventral valve have been well defined by Woodward, at page 218, fig. 118, of his 'Manual of the Mollusca.'

Hab. Rio de Janeiro, 13 fathoms (Macgillivray); bleached dead shells can be picked up on the beach on the open coast just outside the mouth of the Bay of Rio, but generally much worn and imperfect (Derby).

Obs. The animal of this beautiful small species has not been hitherto examined. The shell varies very little in shape and character; its internal details are difficult to describe in words, but a glance at the figures will make all clear. The shell has been described under the specific names of *Terebratula rosea*, *T. tulipa*, *T. unguis*, and, I believe, *T. tulipa rosea*. Some uncertainty has also prevailed with respect to the name first published.

The form was well figured in 1823 by Mawe under the appropriate specific name of *rosea*, some years before that of *tulipa*, given to it by Blainville in 1828. Mawe appears to have adopted names chiefly from the manuscripts of Humphrey, Da Costa, and Solander, and several authors have taken the name *rosea* from Humphrey.

In 1849, noticing the great dissimilarities the species presented in its internal structure from other Terebratulidæ, I proposed to create a distinct genus for its reception, and gave it the name of *Bouchardia*, which has been very generally adopted since that period. Lovell Reeve, in his monograph on *Terebratula*, expresses himself to the effect that *T. Cumingi*, *T. fibula*, and *T. rosea* are distinguished from all other Terebratulæ by the structure of the beak of the shell.

At my request Mr. John Young, of the Hunterian Museum, Glasgow, carefully examined the shell-structure of *Bouchardia rosea* and *Magasella Cumingi*; he wrote me on the 20th of April, 1885:—

"I have carefully etched the valves of both species, so as to reveal more clearly the nature of these perforations. Both species have their shell-structure perforated after the same manner; but there are some differences in the perforations and in the shell-structure between the pores, which I will notice further on. Before etching, I examined both the outer and inner surface of the valves, to see what was revealed, and noted what I saw. In *Bouchardia rosea* the outer surface showed numerous minute oval punctures. The inner surface showed only punctures on the thinner portions of the valve near the margin, more towards the beak.

"In *Magasella Cumingi* the outer surface on both valves showed numerous minute oval pores. These were most distinctly seen around the margin of the valves. On the inner surface of the ventral valve the punctures are only faintly seen. On the inner surface of the dorsal valve the punctures are not visible except by transmitted light; they can be seen passing downward through the shell-structure. After etching the shells to a greater transparency the perforations become much more distinctly seen on the outer surfaces of both the valves. In *Bouchardia rosea* they appear to be smaller and a little more numerous than in *M. Cumingi*. The tubes in their upward passage through the structure of the shell are seen to be always inclined and directed towards the beak, and these tubes increase in diameter as they open on the surface, agreeing in this respect with what has been already recorded. With a 1-inch or $\frac{1}{2}$-inch power of the microscope, under a strong beam of transmitted light, the inwardly inclined tubes are very distinctly visible, especially on that portion of the shell nearest the beak. The tubes are more depressed in *B. rosea* than in *M. Cumingi*. Another distinction which I notice between the two shells is that *B. rosea*, when examined under a higher power of the microscope by transmitted light, shows a more distinctly marked imbricated structure than is seen in *M. Cumingi*. In the latter species the prismatic structure is seen to be bent around the tubes in a manner not observable in the former. I have noticed this bending of the prismatic structure around the tubes both in *Productus* and *Chonetes*. The real appearance of the perforations as they are seen on the surface of the shell appears to be due to the angle at which the round tubes reach the surface,—the more slanting the tubes within the shell the more oval will be the openings of the perforations. Another point I notice in connection with these perforations is, that from the middle of the valve, on each side, the tubes or canals incline outward and upward towards the beak, and where there is a tendency to any folding of the shell the tubes diverge on each side of the fold."

Subfamily Kraussininæ.

Genus KRAUSSINA, Davidson, 1859.

In 1852, while examining the interior of the valves of *Terebratula rubra*, Pallas, I was struck with the marked differences and peculiarities they presented, and in vol. ix. 2nd ser. of the 'Annals and Magazine of Natural History' I proposed a genus *Kraussia*, subsequently (1861) altered to *Kraussina*, for the reception of *T. rubra* and four recent species. The shells are subcircular, with a nearly straight hinge-line; beak truncated; foramen large and round; deltidial plates small, not united; beak-ridges well defined, leaving a flattened space or false area between them and the hinge-line. In the interior of the dorsal valve there are two wide, eye-shaped muscular impressions close to the hinge-line, with a small cardinal process between them. A mesial septum of small elevation extends to half the length of the valve, from the anterior extremity of which rise two oblique or deviating lamellæ, laterally expanded; no other apophysary system for the support of the labial appendages is present. The ciliated arms are unusually small, their fringes not extending to more than halfway towards the border of the shell; in the first part of their course, from the mouth forwards, the cirri are few or wanting, the whole brachial apparatus being supported by the small forked process above described, no other part of the apophysary system being calcified. This genus has been generally adopted. I have included in it *Kraussina rubra*, Pallas, *K. cognata*, Sowerby, *K. Deshayesi*, Davidson, *K. pisum*, Lamarck, *K. Lamarckiana*, Davidson, *K. Davidsoni*, Vélain, and *K. Atkinsoni*, Tenison-Woods.

In 1884 Prof. E. Deslongchamps (Études critiques sur des Brachiopodes nouveaux ou peu connus, pp. 120–124) proposed to remove the last two species from *Kraussina* proper, and to place them in a small subgenus *Megerlina*, on account of two additional short, projecting, curved, rudimentary lamellæ attached to each side of the septum, under the central deviating forked lamellæ characteristic of *Kraussina*. Full details having been given in the description of the species, it will not be necessary to repeat them here.

A glance at the figures will likewise assist in understanding the characters often better than verbal description.

69. Kraussina rubra, Pallas, sp. (Plate XX. figs. 19–23.)

Anomia Rubicunda, Solander, MS. (according to Donovan, Naturalist's Repository, ii. pl. lvi., not of Sowerby).

Anomia rubra, Pallas, Misc. Zool. p. 182, pl. xiv. figs. 2–11, 1766.

Anomia striata promontorii bonæ spei, Chemnitz, Neues systematisches Conchylien-Cabinet, vol. viii. p. 94, tab. lxxvii. fig. 103 *b*, *c*, 1785.

Anomia capensis, Gmelin, ed. Linné's Syst. Nat. vol. i. p. 3347, 1788.

Terebratula capensis, Bruguière, Encycl. Méth. pl. 243. figs. 4–9, 1789; Dillwyn, A Descr. Cat. of Recent Shells, p. 292, 1817.

Terebratula rubicunda, Donovan (not of Sowerby), The Naturalist's Repository, vol. ii. pl. lvi. figs. 2, 3, 4, 1824.

Terebratula rubra, Blainville, Dict. Sci. Nat. vol. liii. p. 138, 1828.

Terebratula capensis, Küster, Martini & Chemnitz, Conch.-Cab. p. 32, pl. 3. figs. 15–17, 1843; Krauss, Südafr. Moll. p. 32, pl. ii. fig. 10, 1848 (not *T. capensis*, Adams & Reeve, Voy. H.M.S. 'Samarang,' p. 71, pl. xxi. fig. 4, 1850).

Kraussia rubra, Davidson, Sketch of a Classification of the Recent Brachiopoda, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 370, 1852; Woodward & Gray, Cat. of the Brachiopoda in the Brit. Mus. p. 109, 1853; Davidson, Brit. Foss. Brach. vol. i. Introduction, p. 69, pl. vi. fig. 28, 1853; Woodward, A Manual of Mollusca, p. 219, 1856.

Kraussina rubra, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxvii. p. 210, 1859; Davidson, Ann. & Mag. Nat. Hist. 3rd ser. vol. viii. p. 39, 1861.

Terebratula (*Kraussia*) *rubra*, Reeve, Conch. Icon., Monogr. *Tereb.* pl. ix. fig. 37. 1861, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 181, 1861.

Kraussia rubra, Chem. Man. de Conchyl. vol. ii. p. 2056, 1862.

Kraussina rubra, Dall, Amer. Journ. of Conch. vol. vi. p. 138, 1870; Proc. Acad. Nat. Sci. Philadelphia, p. 190, 1873; Zittel, Handbuch der Paläontologie, p. 708, 1880; E. E. Deslongchamps, Études critiques sur des Brachiopodes nouveaux ou peu connus, pp. 121, 259, pl. xix. fig. 7, 1884.

Shell subcircular, either as broad as long or a little broader than long; hinge-line nearly straight, rather shorter than the breadth of the shell, with rounded corners. Dorsal valve semicircular, uniformly convex, with or without an extremely slight depression near the front. Ventral valve deeper and more convex than the dorsal one; beak slightly incurved, and truncated by a very large, incomplete foramen, margined anteriorly by the umbo of the opposite valve, and by two very small deltidial plates; beak-ridges sharply defined, leaving between them and the hinge-line a flattened false area. External surface of valves marked with numerous radiating ribs, increasing in number by bifurcation and by the interpolation of shorter ones. Surface of valves crossed by concentric lines of growth. Shell-structure punctate. Colour yellowish red, more intense coral-red mainly on the radiating ribs and at the concentric lines of growth. Length 1 inch, breadth 1 inch 1 line, depth 7 lines.

In the interior of the dorsal valve the hinge-plate is widely divided, and between the lateral portions are two large eye-shaped depressions due to the peduncle-muscles; between these last a slightly raised mesial septum begins, and extends to about half the length of the valve. From its anterior extremity arise two short, deviating, flattened and forked lamellæ, expanded at their extremities. The cirrated labial appendages are unusually small, the spiral lobe diminutive; these fringes do not extend to more than halfway towards the border of the shell. In the first part of their course, from the mouth forward, the cirri are few or wanting, the whole brachial apparatus being supported by the small forked process above described, no other part of the apophysary system being calcified. Cardinal process very small. Margin internally, sometimes sharply, spinously toothed.

Hab. Port Elizabeth, near the Cape of Good Hope, South Africa. Some small specimens were erroneously described by Dr. J. E. Gray, in the 'Annals and Magazine of Natural History' for 1872, under the mistaken name of *T. truncata*. They were found attached to *Ascidia*, and to the stems of large Algæ, off the coast of Natal.

Obs. Donovan states, in his 'Naturalist's Repository' for 1824, that Solander had given the MS. name of *T. rubicunda* to examples of the shell under description in the Portland Museum; but as manuscript names cannot claim priority over published ones, that of *rubra*, Pallas, must be adopted. It is also somewhat singular, as observed by Lovell Reeve, that the shell was not known to Valenciennes when preparing his monograph of the Terebratulidæ for Lamarck's 'Animaux sans Vertèbres,' or to G. B. Sowerby when publishing his 'Thesaurus Conchyliorum;' for therein he figures a specimen of *T. cruenta* with the mistaken name of *T. rubra*, Pallas. Reeve states likewise that Sowerby's *Terebratula algoensis* is a blackened fragmentary valve of *Kraussina rubra*. Krauss, on the contrary, says, in 'Die südafrikanischen Mollusken,' p. 32, that he looks upon *T. algoensis* as a synonym of his *Terebratula natalensis*—the *Kraussina pisum* of Lamarck; and this view may perhaps be the more correct one. The specimen, which consists of a single ventral valve, is in the Zoological Department of the British Museum.

In his 'Recherches sur l'Organisation du Manteau chez les Brachiopodes Articulés,' Caen, 1864, M. E. Deslongchamps' observations (p. 25) are to the effect that the vascular sinuses are composed of two large trunks, which commence close to the hinge-plate, and extend by a large curve parallel to the edges of the valves, and end anteriorly close to the median line, each of these branches, on the sides facing the lateral edges of the valves, giving forth six or seven branches, which bifurcate as they reach the edges of the shell. The spicula are very numerous in *Kraussina rubra*, but they are so small and disunited that they cannot be seen, except under an enlargement of about 40 or 50 diameters. At p. 121 of his 'Études critiques sur des Brachiopodes nouveaux,' 1884, the same authority states that he has been able to convince himself that in this species (*K. rubra*) the mantle was furnished with spicula of a very special shape, and much smaller than in the other Brachiopoda provided with these calcareous elements; that, thanks to the tenuity of these spicules and to their elongate shape, he has been able, from investigating them in the genus *Kraussina*, to recognize their function, which is that of protecting the organs of circulation. One system of spicula was destined to protect the venous sinuses of the mantle, a second that of the arterial organs.

M. Deslongchamps further states that he has only been able to examine adult examples of *Kraussina rubra*, and consequently can say nothing with respect to the modifications through which the young shell passes previous to attaining its fullest development, but that the disposition of this appendage in young *K. Davidsoni* establishes points of transition so complete between the genera *Megerlia* and *Kraussina* that there is not the slightest doubt in his mind as to the position of these genera in the zoological series, and that they certainly belong to one group. The analogy becomes apparent when the details of the adult *Kraussina Lamarckiana* and the transitory state of *Megerlia truncata* are considered.

I have never seen any very young examples of *K. rubra*; the smallest I have examined measured 4 lines in length, the largest 12, and no material difference could be perceived in the forked deviating lamellæ. I do not see that *Megerlia truncata* and *Kraussina rubra* are more nearly related than are *Terebratella*, *Laqueus*, and several others. We must value the characters of the genus or subgenus and species from the adult and full-grown condition, and not from that of the early stages of growth; for many specimens prior to attaining their adult condition and characters pass through several metamorphoses or modifications in shape, as has been so admirably demonstrated by Herman Friele, E. Deslongchamps, and others. There are also notable differences between *Megerlia* and *Kraussina* in the shape of the hinge-plate, muscular scars, and labial appendages, which must be taken into consideration.

70. KRAUSSINA COGNATA, Sowerby*, sp. (Plate XX. figs. 24–26, var.? 27–30.)

Terebratula cognata, Sowerby (not of Chemnitz), Thes. Conch. i. p. 346, pl. 68. figs. 12–14, 1846.
Kraussia cognata, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 370, 1852.
Terebratula (*Kraussia*) *cognata*, L. Reeve, Conch. Icon. pl. ix. fig. 38, *a*, *b*, 1861.
Kraussina cognata, Dall, Amer. Journ. of Conch. vi. p. 110, 1870.

Shell somewhat subtrapezoidal or elongated, semicircular; hinge-line nearly straight, almost as long as the width of the shell, with slightly rounded or angular extremities. Dorsal valve semicircular, rounded in front, with or without a slight longitudinal median depression along the anterior half of the valve. Ventral valve deep, and much more convex than the dorsal one. Beak short, very little incurved, foramen large and incomplete, margined anteriorly by the umbo of the dorsal valve, and by two small lateral deltidial plates; beak-ridges sharply defined, leaving between them and the hinge-line a triangular area. Surface of the valves radially marked by fine radiating ribs, increasing in number at various distances from the beak and umbo by the interpolation of shorter riblets, which are more sharply defined in some specimens than in others. Colour

* [No one can tell from Chemnitz's description and figures what really constitutes his *Cognata Anomia craniolaris basi perforata* (Neues syst. Conchylien-Cabinet. vol. viii. p. 78, tab. 76. fig. 688 *a*, *b*. 1785). That author's unsatisfactory description and illustrations in no way resemble those of the specimen described and figured by G. B. Sowerby in his 'Thesaurus Conchyliorum' (vol. i. p. 346, pl. 68. figs. 12–14. 1846). The *Anomia cognata* of Sowerby (not of Chemnitz) is now in the British Museum. Chemnitz's figure represents a smooth shell, ovate in form, and with a rounded hinge-line. Sowerby's *T. cognata* is squarely suborbicular, with a long, nearly straight, hinge-line, the external surface being covered with numerous small radiating ribs. Chemnitz's species is unidentifiable and should therefore be expunged, and the *Terebratula cognata*, Sowerby, retained as the type of the species.—T. D.]

pale yellow. Two specimens measured—length 11 lines, breadth 8 lines; length 9 lines, breadth 8 lines, depth 4 lines.

In the interior of the dorsal valve the hinge-plate is widely divided, and between the lateral portions are two large eye-shaped depressions left by the peduncle-muscles, between which a slightly raised mesial septum begins and extends to about half the length of the valve. From its anterior extremity arise low, short, deviating, flattened, and forked lamellæ expanded at their extremities.

Hab. South Africa, near the Cape of Good Hope.

Obs. This species is distinguished from *Kraussina rubra* by its general shape, the flatness of its dorsal valve, and its colour. In some specimens, such as in Sowerby's type, the ribs are very little marked and obliterated near the margin, but in others they are sharply defined; the mesial depression is, at times, also scarcely perceptible. Both *K. cognata* and *K. rubra* are, however, much more nearly related to each other than to other species of the genus. Mr. Lovell Reeve alludes to the spine-like projections round the inner margin of *Kraussina cognata*, a character common to several, if not all, the species of the genus. I have noticed them in *Kraussina rubra* as well as in *K. Lamarckiana*. At one time I was under the impression that the *Terebratula cognata* of Sowerby might be an unusually large specimen of *Kraussina pisum*, but I am now very doubtful whether such is the case.

71. KRAUSSINA DESHAYESI, Davidson. (Plate XX. figs. 31–31 *b*.)

Terebratula capensis, Adams & Reeve (not of Gmelin), Voyage of H.M.S. 'Samarang,' p. 71, pl. xxi. fig. 4, 1850.

Kraussia Deshayesii, Davidson, Proc. Zool. Soc. p. 6, pl. xiv. figs. 20, 21, 1852; and Ann. & Mag. Nat. Hist. vol. ix. p. 270, 1852; Woodward & Gray, Cat. of the Brachiopoda in the Brit. Mus. p. 111, 1853; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 211, 1859.

Terebratula (*Kraussia*) *Deshayesii*, L. Reeve, Conch. Icon. Monogr. of *Tereb.* pl. ix. fig. 35, 1861.

Kraussina capensis, Adams & Reeve (not of Gmelin), Dall, Amer. Journ. of Conch. vol. vi. p. 140, 1870.

Shell orbicular, subovate, about as long as wide, valves nearly equally deep or convex. In the dorsal valve a deep longitudinal depression or sinus extends from the umbo to the front, with a corresponding elevation or fold in the ventral one; beak short, incurved, and truncated by an incomplete foramen, margined anteriorly by the umbo of the dorsal valve and by two small lateral deltidial plates; beak-ridges sharply marked, leaving between them and the hinge-line a flattened space. Surface of valves marked with numerous fine radiating riblets, increasing in number by the interpolation of shorter ones, the whole surface of the valves being crossed by concentric lines of growth. Shell-structure largely punctate. In the interior of the dorsal valve two deviating central lamellæ rise from the anterior extremity of the very slightly raised mesial septum. Colour light yellow, marked with crimson rays. Length $5\frac{1}{2}$ lines, breadth 5 lines, depth 2 lines.

Hab. Dredged by Sir Edward Belcher off the Cape of Good Hope, in a depth of 120 fathoms.

Obs. This pretty little species is nearly related to *Kraussina pisum*, but is distinguishable from it by its more orbicular shape and crimson rays. The *Kraussina capensis* (Gmelin) being a synonym of *K. rubra*, Pallas, I proposed in 1852 to alter its name to *K. Deshayesi*. I regret not being able to agree with Mr. Dall's suggestion that the name *capensis* can be retained for this form, as it is a synonym of another species of the same genus. It is, moreover, well distinguished from *Kraussina rubra*.

73. KRAUSSINA PISUM, Valenciennes, apud Lamarck, sp. (Plate XXI. figs. 1–4.)

Terebratula pisum, Valenciennes, apud Lam. Animaux sans Vert. vol. vi. p. 330, 1819.

Terebratula Natalensis, Küster, Martini & Chemnitz, Conch.-Cab. vol. vii. p. 36, pl. 2 *b*. figs. 4–7, 1843.

Terebratula Algoensis, G. B. Sowerby, Proc. Zool. Soc. 1846, p. 95; and Thes. Conch. p. 362, pl. lxxi. figs. 91, 92, 1846.

Terebratula Natalensis, Krauss, Südafrikanischen Molluskenn, p. 33, pl. ii. fig. 11, 1848.

Terebratula pisum, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 370, 1852.

Kraussia pisum, H. & A. Adams, The Genera of Recent Mollusca, vol. ii. p. 579, pl. cxxxi. figs. 1*a*, *b*, 1858.

Kraussina pisum, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 211, 1859.

Terebratula (Kraussia) pisum, Lovell Reeve, Conch. Icon., Monogr. *Tereb.* pl. ix. fig. 36, *a*, *b*, 1861.

Kraussina pisum, Dall, Amer. Journ. of Conch. vol. vi. p. 140, 1870; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 54, pl. iv. figs. 7, 8, 1880.

Shell suborbicular or oval, often rather wider than long, light yellowish white. Dorsal valve very slightly convex, with a groove-like central longitudinal depression extending from the umbo to the front. Hinge-line nearly straight, and rather more than half as long as the breadth of the shell. Ventral valve deeper than the dorsal one, longitudinally keeled, beak slightly incurved, with a rather large incomplete foramen, and two small lateral deltidial plates; beak-ridges sharply defined, leaving a flattened area between them and the hinge-line. Surface of valves covered with numerous small radiating ribs, which increase in number at variable distances from the beak and umbo, owing to the bifurcation of many of the ribs and the interpolation of shorter ones. Valves crossed at variable intervals by fine concentric lines of growth. In the interior of the dorsal valve the hinge-plate is narrowed, a very slightly raised mesial septum extending from the middle of the hinge-plate to about half the length of the valve. From the anterior extremity arise two short, deviating, flattened, and forked lamellæ, expanded at their extremities; two eye-shaped depressions due to peduncular muscles lie on each side of the posterior extremity of the hinge-plate. The brachial appendages are small, and do not occupy a space larger than about half the length of the valve; central spiral lobe very small. Length 8 lines, breadth 8 lines, depth 3 lines.

Hab. This species was dredged by the 'Challenger' Expedition off the Cape of Good Hope, at a depth of 150 fathoms. It has also been obtained near Natal, and by Sir E. Belcher in the same localities.

Obs. This species is well distinguished from *Kraussina Lamarckiana* by its numerous delicate raised striæ, but it is scarcely distinguishable from *Kraussina Deshayesi*, except by its colour, the last-named species being rather more triangular in form and marked with deep crimson rays. *Kraussina Lamarckiana* is also a much smaller species than *Kraussina pisum*. At p. 33 of his 'Südafrikanischen Mollusken,' Dr. F. Krauss expresses the opinion that the *Terebratula Algoensis* of Sowerby is a synonym of the species under description: this is very probably the case, and not of *K. rubra* as was supposed by Lovell Reeve.

73. Kraussina (Megerlina) Lamarckiana, Davidson. (Plate XXI. figs. 7–11.)

Kraussia Lamarckiana, Davidson, Proc. Zool. Soc. 1852, p. 80, pl. xiv. figs. 22, 23; Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 370, 1852; Intr. to vol. i. of Brit. Foss. Brach. p. 69, 1853; Woodward & Gray, Cat. of Brachiopoda in the British Museum, p. 111, 1853; H. & A. Adams, The Genera of Recent Mollusca, vol. ii. p. 579, 1858; S. P. Woodward, A Manual of Mollusca, p. 218, fig. 120, 1858.

Kraussina Lamarckiana, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 211, 1859.

Terebratula (Kraussia) Lamarckiana, Lovell Reeve, Conch. Icon., Monogr. *Ter.* pl. ix. fig. 34, 1861; Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 182, 1861.

Kraussina Lamarckiana, Chemnitz, Man. de Conch. vol. ii. p. 206, fig. 1057, 1862; Dall, Amer. Journ. of Conch. vol. vi. p. 139, 1870; Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 190; Hutton, Cat. of the Marine Mollusca of New Zealand; Tenison Woods, Census of the Marine Shells of Tasmania, Proc. Roy. Soc. of Tasmania, p. 34, 1877; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 53, pl. iv. fig. 9, 1880.

Megerlina Lamarckiana, E. Deslongchamps, Études critiques sur des Brachiopodes nouveaux ou peu connus, p. 159, pl. xix. fig. 11, 1884.

Shell small, somewhat subquadrilateral, about as wide as long, flexuous, fulvous white or light brown. Dorsal valve slightly convex, with a rather deep longitudinal mesial depression. Hinge-line straight, and rounded at its angles. Ventral valve deeper and more convex than the dorsal one, longitudinally keeled along the middle. Beak slightly incurved, and truncated by a large incomplete foramen, laterally margined by two rudimentary deltidial plates; beak-ridges sharply defined, leaving a false areal space between them and the hinge-line. Surface of both valves ornamented by a number of small radiating costæ, increasing in number by the interpolation of shorter ribs. Length 4 lines, breadth $4\frac{1}{2}$ lines, depth 2 lines.

In the interior of the dorsal valve the hinge-plate is wide and concave, with two eye-shaped rudimentary scars between its outer margins. Under the middle of this plate a slightly raised mesial septum, thickened, and most elevated near its anterior extremity, extends to less than half the length of the shell; close to its anterior extremity arise two deviating, -shaped, broad lamellæ, slightly expanded and curved at their extremities; under these, on each side of the septum, are attached two slightly projecting, wide, curved rudimentary lamellæ, which simulate the part of the principal lamellæ attached, in other genera, to the sides of the septum. The bottom of the valve is costated and faintly tuberculated; a row of short, erect spine-like asperities rising perpendicularly close to and all round the inner margin. Brachial appendages small, the central lobe being the least. Shell perforated by small canals.

Hab. Dredged in great abundance by Mr. Brazier in Double Bay, Port Jackson, New

South Wales; and by the 'Challenger' Expedition near Sydney, attached to specimens of *Waldheimia flavescens*, found close to the shore. The Rev. Tenison Woods states that the shell occurs in abundance under stones at low water at Tamai Heads, also off the south-east coast of Australia and New Zealand, and occasionally at Long Bay. I have never seen any New-Zealand examples.

Obs.—This small species is distinguishable from *Kraussina pisum* by its much smaller dimensions and comparatively stronger ribs, as well as by some interior details. It has been fortunate in retaining its specific name unchanged since first described. I have through the liberality of Mr. Brazier been able to examine an extensive series of specimens from half a line up to four lines in length. When very young the shell is quite circular, with very few ribs, and these commence only at about half its length, and extend to the lateral and frontal margins. On account of the shortness of its peduncles the beak and umbo are often eroded and worn. In very young specimens the septum and deviating lamellæ are rudimentary and undeveloped. We are indebted to M. E. Deslongchamps for the discovery of the short accessory rudimentary lamellæ that are attached to the anterior lateral sides of the septum under the Y-shaped deviating lamellæ.

M. E. Deslongchamps describes the interior characters of this and its allied forms with considerable care and minuteness at p. 122 of his 'Etudes critiques.' He remarks, that having been able to observe the calcareous appendages in adult examples only of *Kraussina rubra*, he can affirm nothing positive as to the manner in which they have been produced, but that the disposition of these appendages—first in *Kraussina Davidsoni*, and, secondly, in *K. Lamarckiana*—establishes points of transition so complete between the genera *Megerlia* and *Kraussina* that he feels no uncertainty respecting the position of these two genera in the zoological series, and that they certainly belong to a single group. He states that the differences between the adult conditions of *Kraussina rubra* and *Megerlia truncata*, although seeming at first sight very striking, disappear or become much less conspicuous when an adult *Kraussina Lamarckiana* is compared with the transition-stages of *Megerlia truncata*, traces being found in *K. Lamarckiana* of all the parts that constitute the calcareous processes in *Megerlia* (*truncata*). M. Deslongchamps would therefore propose a subgenus *Megerlina* for the reception of *K. Lamarckiana* and *K. Davidsoni*, which, according to his views, constitute the passage-forms between *Kraussina rubra* and *Megerlia truncata*.

In his figure of *K. Lamarckiana*, M. Deslongchamps draws the hinge-plate simple and concave; but in my specimens it is quite similar to that of *Kraussina rubra*, with the two eye-shaped scars due to the peduncular muscles; and the only essential difference that I can see is the presence of the short, broad, curved lamellæ that are attached to the mesial septum under the upper forked deviating appendages.

The differences and resemblances between the different forms here alluded to will be better understood by a glance at the figures in Pls. XX. and XXI. The brachial appendages in very young specimens of *K. Lamarckiana* are extremely small, as well as the calcareous appendages for their support.

M. Deslongchamps informs us, moreover (*loc. cit.*), that in *Kraussina* the spicula are very thin, detached, and elongated, but in *Megerlina* they are more or less thick, and approach more to those of *Megerlia*.

So far back as 1852 (Proc. Zool. Soc.) I stated in my paper, "Descriptions of a few New Species of Recent Brachiopoda," that *K. Lamarckiana* "is distinct from *K. pisum* and *K. Deshayesii* by its somewhat tetragonal shape, stronger and fewer costæ, as well as by the details of its loop, relating it more than any of the other species of *Kraussia* to the section *Megerlia*," and I am glad to find that in 1884 M. Deslongchamps has confirmed the opinion I expressed in 1852.

74. Kraussina (Megerlina) Davidsoni, Vélain. (Plate XXI. figs. 12–14.)

Kraussina Davidsoni, Vélain, Archiv de Zoologie Expérimentale, 1877, p. 139, pl. v. figs. 23, 24; and Malacologie de l'Ile de St. Paul; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 21, 1880.

Megerlina Davidsoni, E. Deslongchamps, Études critiques sur des Brachiopodes nouveaux ou peu connus, p. 159, pl. xix. figs. 9, 10, 1884.

Shell small, rather thick, globose, variable in form, pouch-shaped, longer than wide, or slightly transverse and suborbicular. Dorsal valve convex, with a mesial depression or groove of greater or lesser depth. Ventral valve rather deeper than the dorsal one, longitudinally keeled; beak short, slightly incurved, and truncated by a large incomplete foramen, margined anteriorly by the umbo of the dorsal valve, and laterally by two small deltidial plates. Surface either partially smooth or radiately ribbed, ribs increasing in number by the interpolation of shorter riblets. Surface crossed by strongly marked concentric lines of growth. Colour darkish brown, verging on black. Length 4 lines, breadth 3 or $3\frac{1}{2}$ lines. In the interior of the dorsal valve the hinge-plate is comparatively large and concave, with two eye-shaped peduncular scars between its lateral portions. Septum of very small elevation, extending from the middle of the base of the hinge-plate to about half the length of the valve; from its anterior extremity arise two deviating Y-shaped lamellæ, slightly curved at their extremities; under these and also attached to the septum are two small rudimentary plates. The bottom of the valves is covered with large projecting tubercles, which are most prominent close to the margin of the shell.

Hab. This species was collected by M. C. Vélain in large numbers at the Island of St. Paul, in 1874, during the French expedition to observe the transit of Venus. M. Vélain states that these Brachiopoda live in abundance in the interior crater of the island, on its littoral side open to the sea; that during the ordinary low tides they are scarcely covered by water, and are alternately covered and left bare by the ebb and flow of the tide. They occur in an area of a few yards width, and, consequently, at shallow depths, doubtless because they find those conditions to which they are accustomed in other localities. M. Vélain informs me that during his lengthened stay at the Island of St. Paul no other species of Brachiopod was found; that the shell referred to by Mr. Dall as *Kraussina picta*, Val., Verh. zool.-bot. Ges. Wien, p. 894, 1865, as from the Island of St. Paul, has been nowhere described, and that the name must be attributed to an incorrect citation. This has subsequently been admitted by Mr. Dall.

Obs. This small species is nearly related to *Kraussina Lamarckiana*, but it is more pouch-shaped, and differs from it in several exterior and interior details. From the shortness of its peduncle, the beak and umbo are generally much worn from friction. Some specimens are ribbed only on the posterior half of the valves, while on others the surface is regularly ribbed throughout. The interior details have been described under *Kraussina* (*Megerlina*) *Lamarckiana*, and need not therefore be repeated.

75. KRAUSSINA ATKINSONI, Tenison Woods, sp. (Plate XXI. figs. 5, 6.)

Kraussia Atkinsoni, Tenison Woods, Census, with brief descriptions, of the Marine Shells of Tasmania, Proc. Roy. Soc. Tasmania, 1878, p. 57.

Shell small, somewhat subpentagonal, widest about the middle, indented in front. Marginal line flexuous. Dorsal valve gently convex, divided longitudinally into two lobes by a deep, wide, angular sinus; lateral sides of the umbo auriculate. Ventral valve deeper than the dorsal one, with a longitudinal mesial elevation or fold; beak very slightly incurved, pointed, with a rather large incomplete foramen, margined anteriorly by a portion of the umbo of the opposite valve and by narrow elongated lateral deltidial plates; margin-line in front angular. Surface of valves smooth, marked by fine concentric lines of growth. Colour light greyish yellow. Length 3 lines by $2\frac{1}{2}$ in breadth and $1\frac{1}{4}$ in depth. In the interior of the dorsal valve the hinge-plate is excavated along the middle; septum very slightly elevated, extending from the middle of the base of the hinge-plate to about half the length of the valve. From the anterior extremity of the septum rise two deviating folded lamellæ.

Hab. Dredged at Long Bay, South Tasmania, by the Rev. H. D. Atkinson, in 10 fathoms water.

Obs. I am indebted to the Rev. Tenison Woods for my knowledge of this well-marked small species. It can hardly be said to have been described, for all that Woods says is that "This is a shell about the size of the last (*K. Lamarckiana*), but more depressed, with a smooth valve." *Kraussina Atkinsoni* is at once distinguished from its congeners by being the only smooth species of the genus with which we are acquainted, and also by the shape of its shell.

Subfamily ARGIOPINÆ.

In this subfamily we would include the genus *Argiope*, Deslongchamps, 1842 (=*Megathyris*, d'Orbigny, 1847), and the subgenus *Cistella*, Gray, 1853, both being closely related to the Terebratulidæ, of which they form a part, and distinct from the Thecidiidæ, which the larger number of zoologists and palæontologists would form into a separate family.

We are well aware that the name *Argiope* was proposed in 1827 by Savigny and Audouin (Descr. de l'Egypte, ed. 2, xxii. p. 334, pl. ii. fig. 6) for a genus of Egyptian Spiders; but as the name *Argiope* has been very generally adopted for a genus of Brachiopods, I am disposed to retain it for that purpose.

In *Argiope* proper there are three or five prominent submarginal septa, the lamella forming the loop being four-lobed, adhering to the septa, and more or less confluent with the valve.

In *Cistella* there is but one prominent submarginal septum, the loop, or semicircular lamella, being two-lobed. In the first the labial appendages are folded into four lobes, in the second into two.

The animal and its embryology have been carefully studied, described, and illustrated by such excellent observers as W. Dall, Kowalevsky, A. E. Shipley, M. A. Schulgin, and S. P. Woodward, as well as by myself and others, and these investigations will be fully alluded to in the description of the species.

We know with certainty of but one species of *Argiope* in the recent condition, the *Argiope decollata* of Chemnitz. To this section Schulgin would add the *A. Barroisi* and *A. globuliformis*; but as I have never seen those two species or their interiors, I cannot feel certain whether they should be classed with *Argiope* or with *Cistella*.

We are acquainted with the following eight or nine recent species of the genus *Cistella*, viz.:—

1. *Cistella neapolitana*, Scacchi, 1833.
2. —— *Kowalevskii*, Schulgin, 1884.
3. —— *cistellula*, S. Wood, 1840.
4. —— *Woodwardiana*, Davidson, 1866.
5. —— *cuneata*, Risso, 1826.
6. *Cistella Barrettiana*, Davidson, 1866.
7. —— *Schrammi*, Crosse, 1866.
8. —— *lutea*, Dall, 1870.
9. —— *lunifera*, Philippi, 1836.

76. Argiope decollata, Chemnitz, sp. (Plate XXI. figs. 30–35.)

Anomia decollata, Chemnitz, Conch.-Cab. vol. viii. p. 96, pl. lxxviii. fig. 705, 1785.

Anomia detruncata, Gmelin, Syst. Nat. p. 3347, 1788.

Terebratula ungula, Retzius, Nov. Gen. Test. 1788.

Terebratula detruncata, Bruguière, Encycl. Méth. tab. 243, fig. 10, 1789.

Anomia detruncata, Dillwyn, A Descrip. Cat. of Shells, p. 292, 1817.

Terebratula detruncata, Blainville, Dict. Sc. Nat. vol. liii. p. 141, 1828.

Terebratula aperta, Blainville, Dict. Sc. Nat. vol. liii. p. 144, 1828.

Terebratula decollata, Deshayes, Encycl. tab. ccxliii. fig. 10, 1830; Cantraine, Bull. Acad. R. des Sciences de Bruxelles, 1835.

Terebratula dimidiata, Scacchi, Osserv. Zool. p. 17, 1833, and Cat. Conch. Regni Neapolitani, p. 8, 1836.

Terebratula detruncata, Scacchi, Cat. Conch. Regni Neapolitani, p. 8, 1836.

Terebratula urna antiqua and *T. cardita*, Risso, Fauna Europ. Mér. vol. iv. pp. 387, 389, pl. xii. figs. 177, 180, 1826.

Terebratula decollata, Lamarck, An. sans Vert. ed. 2, vol. vii. p. 350, 1836.

Terebratula detruncata, Philippi, En. Moll. Siciliæ, vol. i. p. 96, tab. vi. fig. 14, 1836.

Argiope decollata, E. Deslongchamps, Mém. Soc. Linn. de Normandie, vol. vii. p. 9, 1842.

Orthis detruncata, Philippi, En. Moll. Siciliæ, vol. ii. p. 69, 1844.

Terebratula detruncata, Forbes, Rep. on the Moll. of the Ægean Sea, p. 141, 1844; D. Galvani, Ill. delle Conch. fossili, 1845.

Terebratula decollata, G. B. Sowerby, Thes. Conch. i. p. 355, pl. lxxi. figs. 68–70, 1846.

Megathyris detruncata, A. d'Orbigny, Comptes Rendus Acad. des Sciences, 1847; Annales des Sciences Nat. Zool. 3e sér. vol. viii. p. 341, 1847; Paléontologie Française, Ter. Crét. vol. iv. p. 146.

Orthis detruncata, G. Michelotti, Descr. des Foss. Miocènes, p. 78, 1847; A. Aradas, Descr. delle Conch. Foss. di Gravitelli, p. 14, 1847.

Terebratula pectiniformis, Costa, Mem. Reale Accad. delle Scienze di Nap. vol. v. p. 39, pl. i. fig. 6.

Orthis detruncata, Costa, Fauna del Regno di Napoli, pl. ii. figs. 6–7, 1851.

Argiope decollata, Davidson, Ann. & Mag. Nat. Hist. vol. ix. p. 373, 1852; Woodward & Gray, Cat. of the Brachiopoda in the Brit. Mus. p. 113, 1853; Davidson, Brit. Foss. Brach. vol. i. Introduction, p. 73, figs. 22–23, and pl. vi. figs. 32–33, 1853; S. P. Woodward, A Manual of the Mollusca, p. 220, 1856.

Argiope detruncata and *A. decollata*, Pictet, Traité de Pal. vol. iv. p. 27, 1857.

Argiope decollata, A. Adams. The Genera of Recent Mollusca, vol. ii. pl. cxxxi. fig. 6, 1858; Deslongchamps, Bull. Soc. Linn. de Normandie, vol. iii. p. 122, 1858.

Orthis decollata, Requiem, Coq. de la Corse, p. 35.

Argiope decollata, Gwyn Jeffreys, Ann. & Mag. Nat. Hist. 3rd ser. vol. ii. p. 124, 1858; E. Suess, Ueber die Wohnsitze der Brach. Acad. der Wissensch. Wien, Bd. xxxvii. p. 213, 1859.

Terebratula (*Argiope*) *decollata*, Lovell Reeve, Conch. Icon., Monogr. of *Ter.* pl. x. fig. 13, 1861; and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 185, 1861.

Argiope decollata, Chemnitz, Man. de Conch. ii. p. 209, figs. 1067–1069, 1862; E. Deslongchamps, Recherches sur l'Organisation du Manteau chez les Brachiopodes, p. 291, pl. iii. figs. 8, 9, 1864; Gwyn Jeffreys, Brit. Conch. vol. ii. p. 18, 1863, and vol. v. p. 164, pl. xix. fig. 3, 1869; Davidson, Brachiopoda of the Maltese Islands, Ann. & Mag. Nat. Hist. 3rd ser. vol. xiv. p. 9, pl. i. figs. 11, 12, 1864; Seguenza, Mem. Soc. Ital. di Scienze Nat. vol. i. p. 69, 1865; S. Brusina, Moll. Dalmati, p. 47, 1866; C. Weinkauff, Die Conch. des Mittelmeeres, p. 288, 1867; Davidson, Ital. Tert. Brach., Geol. Mag. vol. vii. pl. xxi. figs. 5–8, 1870.

Megathyris decollata, Dall, Amer. Journ. of Conch. vol. vi. p. 145, 1870, and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 193.

Argiope decollata, P. Fischer, Brachiopodes des Côtes Océaniques de France, Journ. de Conch. vol. viii. p. 377, 1870, and Conchyl. de la Gironde, Soc. Linn. de Bordeaux, p. 172, 1874; Gwyn Jeffreys, Proc. Zool. Soc. 1878, p. 409; Zittel, Handbuch der Paläontologie, p. 697, 1880; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. i. p. 57, pl. iv. figs. 12, 13, 1880.

Megathyris decollata, J. de Morgan, Bull. Soc. Géol. de France, vol. viii. 1883.

Argiope decollata, Schulgin, Zeitschrift für wissensch. Zool. Band xli. pl. viii. figs. 1–11, 1884.

Shell small, variable in shape, generally semioval or obscurely subpentagonal, rounded laterally and in front, obtusely angular posteriorly. Hinge-line nearly straight, as long as the greatest breadth of the shell, with generally acute cardinal extremities. Dorsal valve semicircular, gently convex. Ventral valve rather deeper than the opposite one; beak prominent, nearly straight; foramen large, incomplete, margined anteriorly by a considerable portion of the umbo, laterally by very small rudimentary deltidial plates; beak-ridges sharply defined, leaving between them and the hinge-line a wide triangular, flattened area. Surface of valves ornamented with from ten to fourteen rounded corresponding ribs, the two central ones generally deviating so as to admit one or two shorter ribs between them. Surface of both valves crossed by equidistant, slightly projecting lines. Teeth short, sockets broad and deep. In the interior of the dorsal valve the hinge-plate is long, narrow, and concave, without any defined or prominent cardinal process. Three or five submarginal septa, most elevated anteriorly; the three central ones the largest and most prominent. The loop, composed of a riband-shaped lamella, is first attached to the hinge-plate, then curved to fit into the hollows between the septa, which adhere to the sides of the hinge-plate, and are more or less confluent with the valve. Labial processes folded into four lobes, united by a membrane, forming a brachial disk with long cirri. Mantle extending to the margin of the valves, and closely adherent. A tuberculated flattened margin surrounds the valves. In the interior of the ventral valve a triangular plate occupies the posterior portion of the inside of the fissure, and from under the centre of which extends a short mesial septum. Shell-structure punctate. Colour dull yellow or white. Length 3 lines, width 4 lines, depth 2 lines.

Hab. Mediterranean Sea; Ægean Sea, at a depth of from 27 to 100 fathoms (Forbes); Straits of Samos; Atlantic coast of Spain and of France, off Cape Breton, in upwards of 45 fathoms, two miles east of Guernsey, 18 fathoms; off Madeira in 20 fathoms (M^cAndrew); Canary Islands; Rhodes (Fischer); Guetaria in 80 fathoms (Hidalgo). Costa informs us that *Argiope decollata* occurs plentifully near the islands of Capri, Ischia, Palmieri, and in the Gulf of Taranto. The 'Challenger' Expedition obtained it in great abundance at Gomera, off Teneriffe, in 73 or 75 fathoms.

It is a common fossil in the Upper Tertiaries of Italy, Sicily, Malta, and is found at Nice and elsewhere; also in rocks of Miocene age.

Obs. Dr. S. P. Woodward and myself were able to give the first description and illustrations of the manner in which the loop and brachial appendages are arranged in this important genus and species (Ann. & Mag. Nat. Hist. vol. ix. May 1852). Since then Dr. Gray proposed to separate from the genus *Argiope* all those forms with a single submarginal septum, uniting them into the subgenus *Cistella*. Up to the present time we are acquainted with only a single recent species of *Argiope*, but there are several fossil species referable to the genus.

In his admirable memoir 'Recherches sur l'Organisation du Manteau chez les Brachiopodes articulés,' p. 29, 1864, M. E. Deslongchamps asserts that, properly speaking, no pallial apparatus (of spicula) exists in the genus *Argiope*. The whole of the mantle, which is stretched like the skin of a drum between the arched branches of the dorsal valve, is pervaded merely by an amorphous calcareous substance, the presence of which is indicated by a slight effervescence when the mantle is submitted to the action of dilute acid. The labial appendages and their cirri are equally devoid of definite calcareous structures, although their yellowish aspect in dried specimens might lead at first sight to a contrary supposition. If, however, the raised up portion of the mantle in the larger valve be examined at the place where it forms the walls of the visceral cavity, a concentric line of detached spicula may be seen when sufficiently magnified, elongated perpendicularly to the direction of the front, and nearly similar in aspect to those of *Kraussina*. Some small calcareous particles of an angular and irregular shape may also be seen. The genus *Argiope* thus shows a manifest passage from a mantle entirely destitute of calcareous bodies to one where spicula are more or less numerous, as in *Terebratulina*, *Terebratula*, *Kraussina*, *Megerlia*, and *Morrisia*.

In his "Note sur quelques espèces nouvelles de *Mégathyridés*," Bull. Soc. Zool. de France, vol. viii. 1883, M. J. de Morgan strongly advocates the adoption of A. d'Orbigny's generic name *Megathyris*, 1847, in preference to that of *Argiope*, proposed in 1847 by E. Deslongchamps. He also describes, with considerable detail, the animal and its shell. He gives the following diagnosis of the animal:—"Oval, fixed, provided with a mantle disunited at the edges, thickened and ciliated, cut out into four lobes like clover; gills formed of a ramified vascular net-work. Body small, unprovided with arms; peduncle short, tendinous, issuing from a cardinal foramen in the upper or ventral valve." The peduncle is, indeed, so short that the beak is often much worn from friction, due to its close contact with the objects to which the shell is attached.

The species of *Cistella* are more numerous, both in the recent and fossil conditions, than are those of *Argiope*.

In 1790, Wulfen published some good figures of *A. decollata*, as well as of *T. seminula*.

77. Cistella neapolitana, Scacchi, sp. (Plate XXII. figs. 8–24.)

Terebratula neapolitana, Scacchi, Osserv. Zoologiche, ii. p. 18, 1833, and Cat. Conch. Regni Neap. p. 8, 1836; Küster, New ed. Chemnitz, Conch.-Cab. p. 32, 1843.

Orthis neapolitana, Philippi, En. Moll. Sic. ii. p. 69, 1844; Costa, Fauna del Regno di Napoli, p. 37, pl. iii. figs. 1, 3, 5, 1851.

Argiope neapolitana, Davidson, Proc. Zool. Soc. 1852, p. 81, pl. xiv. figs. 24, 25, and Ann. & Mag. Nat. Hist. 3rd ser. vol. viii. p. 40, 1861.

Argiope Forbesii, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 373, 1852.

Argiope neapolitana, S. P. Woodward, A Manual of the Mollusca, p. 229, fig. 125, 1856; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, p. 213, 1859; Davidson, Brit. Foss. Brachiopoda, Introduction to vol. i. p. 73, fig. 21, 1853.

Terebratula (*Argiope*) *neapolitana*, Lovell Reeve, Conch. Icon. Monogr. *Ter.* pl. x. fig. 15, 1861, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 186, 1861.

Argiope neapolitana, Chemnitz, Man. de Conch. ii. p. 209, figs. 1074, 1075, 1862; H. C. Weinkauff, Conch. des Mittelmeeres, p. 290, 1867.

Cistella neapolitana, Dall, Amer. Journ. of Conch. vol. vi. p. 116, 1870, and Philadelphia Acad. Nat. Sciences, 1873, p. 194.

Argiope neapolitana, Kowalevsky (in Russ. Moscow, 1874), Observations sur le Développement des Brachiopodes, Analyse par MM. Oehlert and Deniker, in Archives de Zool. Expérim. 2^e^ sér. tom. 1. pp. 57–76, 1883; Gwyn Jeffreys, Proc. Zool. Soc. 1878, p. 409; S. Brusina, Molluschi Dalmati, p. 17, 1866.

Argiope biplicata, Seguenza, Rendiconto Accad. delle Scienze Fisiche et Matemat. Napoli, xv. pp. 123, 124, 1876.

Argiope neapolitana, A. E. Shipley, On the Structure and Development of *Argiope*, Mittheil. a. d. Zool. Station zu Neapel, Bd. iv. p. 494, 1883.

Shell small, somewhat triangularly orbicular, broadest anteriorly, obtusely angular posteriorly, plicately indented at the margin and especially in front. Dorsal valve very moderately convex and flattened, with a mesial longitudinal depression commencing at a short distance from the umbo and extending to the front; hinge-line obtusely angular, nearly straight, and rather more than half the length of the breadth of the shell; lateral sides of the umbo auricular. Ventral valve very moderately or tumidly convex, with a longitudinal mesial depression (as in the dorsal valve) commencing near the extremity of the beak and extending to the front. Beak short, slightly incurved and truncated by an incomplete foramen, margined anteriorly by the umbo of the opposite valve, and laterally by two small deltidial plates; beak-ridges sharply defined, leaving between them and the hinge-line a small triangular flattened space. Surface of valves smooth, or with from two to six rounded ribs, more or less defined in different specimens. Shell semitransparent, white or yellowish brown. Shell-structure punctate. Length $2\frac{1}{2}$ lines, breadth 2 lines, depth 1 line. In the interior of the dorsal valve the hinge-plate is long and narrow, without any defined cardinal process. Under its centre a triangular-shaped plate or septum gradually rises, and extends to four fifths of the length of the valve, being most elevated near to its anterior extremity. Loop two-lobed, attached to the base of the hinge-plate and again to the anterior extremity of the submarginal septum, and more or less confluent with the valve. Labial processes folded into two lobes, united by a membrane forming a brachial disk fringed with long cilia. Mantle extending to the margin, closely adherent. In the interior of the ventral valve a small septum extends from under the beak to about half the length of the shell; margins of the valves much thickened within.

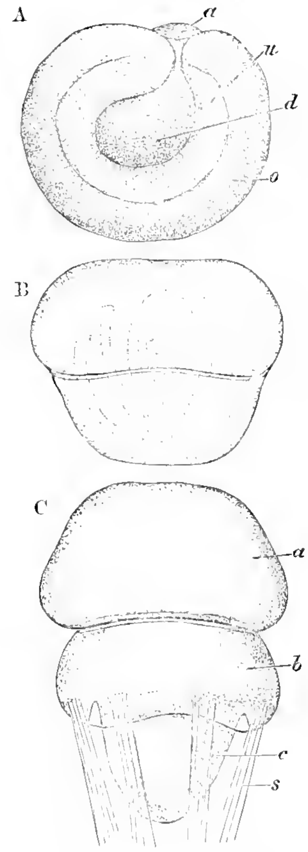
Hab. Mediterranean, at depths of from 60 to 100 fathoms; Bay of Naples, off the islands of Capri and Ponza; Ægean Sea.

Obs. Some malacologists have expressed the opinion that *Terebratula seminula*, Philippi, is a synonym of *C. neapolitana*; but the foraminal umbo of the dorsal valve in the first-named shell would render that view doubtful.

Exteriorly *Cistella neapolitana* is a well-marked species, although it varies a good deal in shape, being also either quite smooth or obscurely ribbed.

Kowalevsky has described and illustrated in great detail the development of *C. neapolitana*. MM. Oehlert and Deniker have published an excellent summary of this memoir, most useful to those who are unable to read the Russian language. Kowalevsky states that the eggs, after they are detached from the ovary, fall into the general cavity of the body, enter the oviducts by the funnel-shaped opening of these organs, and pass into the incubatory pouches, situated on the ventral lobe of the female individual, where they are developed. He is of opinion that fecundation must, without doubt, be accomplished either during the passage of the egg along the oviduct or in the general cavity.

Fig. 10.



Argiope neapolitana (after Kowalevsky).

A. Egg after the invagination of a part of the blastoderm: *d*, cavity formed by the invagination; *a*, orifice of the cavity; *o*, exterior layer (upper); *u*, interior layer.

B. The embryo divided into two segments.

C. Embryo, in which the folding of the mantle already covers a part of the caudal segment: *a*, cephalic segment; *b*, thoracic segment; *c*, caudal segment; *s*, bundles of bristles.

First Period.—*From the Commencement of the Development of the Egg up to the moment when the Larva fixes itself.*

In the least advanced state, as observed by Kowalevsky, the egg presents the aspect of a vesicle, the sides of which are composed of little cylindrical cells surrounding a small cavity. Soon after a portion of a blastoderm becomes invaginated (woodcut, fig. 10, A) the extremities of the gastrula approach each other, and leave between them only the place of an opening. At this moment the embryo presents two layers of small cells; one of them is the outer layer of the blastoderm, the other the inner layer; and it is at the expense of this last that the middle segment, as well as all subsequent modifications, are formed.

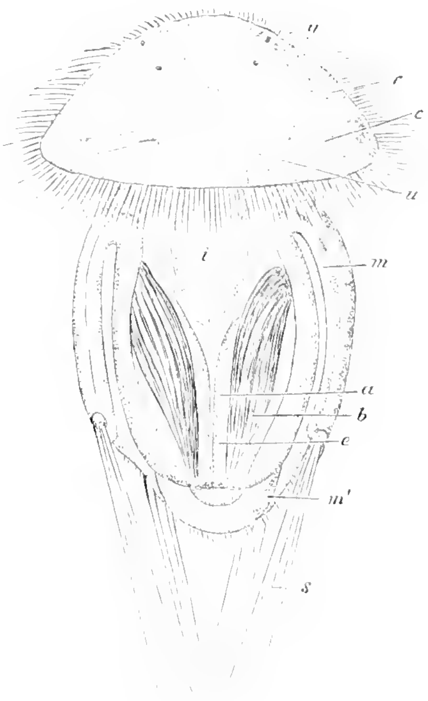
In the next stage the cavity divides itself into three lobes (one median and two lateral), which communicate at the part nearest to the orifice. This orifice is connected with the median lobe by means of a narrow canal, the walls of which present two small prominences formed of small cells distinctly differentiated. Soon after the embryo divides itself transversely into two segments, the one upper and large (cephalic segment), the other narrower and more conical (caudal segment). (Woodcut, fig. 10, B.)

At this period the three lobes of the internal cavity become separated from one another, and form three isolated cavities. The median cavity presents at its posterior portion so great an approximation to its walls that these last appear as partitions. At the lower part the median cavity is surrounded, in addition to its own walls, which are formed of cylindrical cells like the envelopes of the other cavity, by a second layer of small pale-coloured hexagonal cells, which for some distance are in direct relation with the external layer. (Kowalevsky is unable to explain either the origin or the signification of this layer.)

Afterwards the median cavity is transformed into a digestive tube: perhaps these walls form the intestino-glandular layer. The lateral cavities constitute the general cavity of the body; the interior part of their walls produces the mesentery and perhaps some muscular fibres (intestino-muscular layer of the middle layer); the outer part mainly contributes to the principal muscles.

Next follows a stage wherein the embryo is divided into three segments (woodcut, fig. 10, C), the last

Fig. 11.



Adult larva of *Argiope neapolitana* (after Kowalevsky).

Swimming freely. *g*, eyes; *r*, edge of the cephalic segment; *u*, cylindrical part reuniting the cephalic segment to the thoracic segment; *m*, mantle; *i*, rudiment of the intestine; *c*, mesentery (a part of the mantle covering over the caudal segment); *a*, muscles going from the dorsal part to the ventral part of the valve; *b*, abdominal muscles; *c*, muscles of the cephalic segment; *s*, bristles.

segment to appear being the median or thoracic segment, which has probably been formed by a division of the caudal segment.

The thoracic segment carries four bundles of bristles, of which two are median and two lateral; each bundle is composed of four or five immovable cylindrical and blunt bristles (woodcut, fig. 10, C).

At the succeeding stage the mantle commences to appear under the form of two folds covered with cilia, which rise from the ventral and dorsal sides of the thoracic segment.

This folding of the skin (future mantle) soon becomes developed and partly covers the caudal segment. The bristles, which are then situated on this fold, become larger and pass beyond the caudal segment. At the same time two pigmentary spots appear on the dorsal side of the cephalic segment.

The author was not able to observe the intermediate phases between this stage and that where the larva issues from the incubatory pouch and swims freely. At that period of the larval development the mantle covers all the caudal segment, whilst the cephalic segment, which is covered with vibratile cilia, assumes an umbrella-shape, at the summit of which may be distinguished a portion more or less separated from the rest (head), which carries four eyes (woodcut, fig. 11, *y*): this head corresponds to that which M. Lacaze-Duthiers has described in *Thecidium*.

The digestive tube is almost entirely confined to the thoracic segment; its anterior portion, however, pentrates a little into the cephalic segment. This last is connected slightly with the adjoining segment by means of an organ of cylindrical shape. Kowalevsky could not detect any traces of the nervous system.

The muscular system of the larva is represented by delicate fibres, which pass from the posterior portion of the intestine to the lateral walls of the thoracic segment.

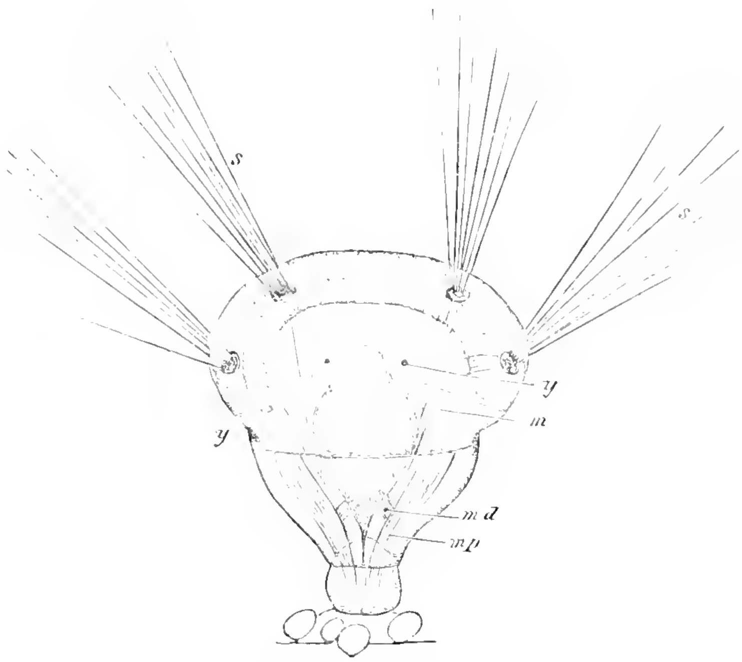
The mantle is composed of two layers—one external, formed of pavement-epithelium, the other internal, and consisting of small cylindrical cells. Between these two layers there are very delicate muscular fibres. The edges of the mantle always carry, on the ventral side, four bundles of bristles, which, already existing in the preceding stages, have grown and increased in length.

At this stage the larva swims freely by the help of its vibratile cilia and by slight movements of the head. At the approach of danger it vigorously contracts itself, and erects its bristles in all directions. The larva, after swimming for some time, fixes itself, and then the second stage of its development commences.

Second Period.

The attachment of the larva is effected by means of a sticky substance exuded by the caudal segment; as soon as fixed, the larva begins to turn up its mantle and to raise it above its head, so that in a little time the mantle envelopes the whole of the cephalic segment. On account of this folding-over of the mantle, the external part of each lobe becomes internal, and the bristles which were on the exterior surface, being thus carried inside, become unnecessary, and drop off in a few days' time. It is thus seen that it is not these bristles which produce those that border the mantle of the adult animal. *Argiope*, it is true, is not provided with marginal bristles or setæ, but in species wherein they occur they are the result of a new formation of a

Fig. 12.



Argiope (*Cistella*) *neapolitana* (after Kowalevsky).

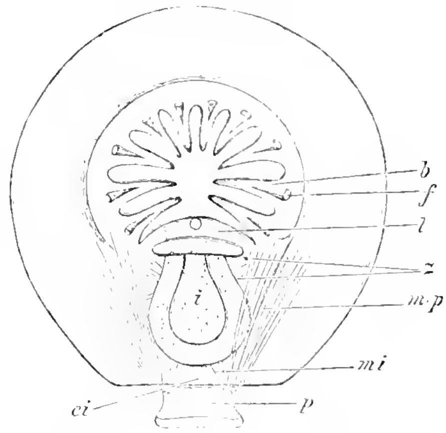
Immediately after it has become fixed. (The thoracic segment has four bundles of bristles, of which two are median, and two lateral.) *s*, bristles; *y*, eyes; *m*, muscles going to the basis of the bristles; *md*, adductor muscles; *mp*, ventral peduncular muscles.

much later period. The lobes of the mantle gradually become invested with a thick and ridged cuticle, which permits them to move only in a vertical direction. At the same time the caudal segment is transformed into a peduncle, and the muscles that proceeded from this last segment to the thoracic segment become ventral peduncular muscles, the middle pair of muscles changing into divaricators. The head assumes a spherical shape, and the eyes remain.

At the next stage the thoracic segment grows smaller in size, the digestive canal becomes round, and a funnel-shaped pit which descends towards the canal is produced on the cephalic segment. This depression is, in all likelihood, the œsophagus (gullet). It should be observed that the characteristic feature of this period consists in the appearance of the branchiæ; these come into existence in the shape of four nipples directed inwardly and situated on the thickening of the dorsal lobe near its border.

The dorsal thickening soon assumes the form of an almost circular swollen ring, and the number of the branchiæ amounts to ten (woodcut, fig. 13, *b*). In the interior of the swollen ring there exists a cutaneous layer which seems to support all the branchia apparatus, and is pierced by a hole opposite each of the branchiæ. The branchiæ, which are only prolongations of the swollen ring, are covered with vibratile cilia, are provided with flexible muscles, and become erected through their own elasticity. The extremities of the branchiæ converge towards the opening of the mouth.

Fig. 13.



Larva of *Argiope neapolitana* (after Kowalevsky).

Condition previous to the formation of the shell. *b*, branchiæ; *f*, muscular bundle of the branchiæ of the inner side; *l*, head of œsophagus; *z*, divaricator muscles; *i*, stomach; *m.p*, ventral muscles of the peduncle; *mi*, muscles going from the ventral valve to the upper part of the dorsal valve; *ci*, internal envelope; *p*, peduncle.

In the following stage twelve tentacles are present, and at the same time the shell is formed; but no tubular perforations are yet seen. Of the following stages Kowalevsky has been able to trace but one, that of the gradual formation of the shell.

In 1876 Signor Seguenza described a small *Cistella* under the name *Argiope biplicata*. Dr. Gwyn Jeffreys considered it to be an abnormal form of *C. cuneata*, but I would be more inclined to refer it to *A. neapolitana*; only one example was collected.

In his valuable paper on the structure and development of *Argiope* or *Cistella neapolitana* and *C. cuneata*, Mr. A. E. Shipley* observes that "The body of Argiope lies almost entirely in the dorsal shell, whose internal skeleton consists of three triangular plates: one median, the other two lateral and paired." I find myself, in the specimens of those species, that there is present in the dorsal valve one prominent submarginal septum only, the loop being two-lobed, adhering to the septum, and more or less confluent with the valve. The shell is sometimes, when fresh, slightly subtransparent, showing the outline of the lophophore and the red colour of the eggs and larvæ. Mr. Shipley describes with much care and detail the minute structure of the shell; he says (p. 496 *et seq.*) that it "consists of a number of very fine calcareous spicules supported by an organic network. . . . . On the outer side of the shell is a layer, in thickness about one eighth of the whole shell, where the proportion of calcareous matter to organic is enormously increased. The spicules are here nearly square, and packed against one another like bricks. . . . . . Outside this is a third layer or periostracum. This is a thick structureless cuticle; it completely covers the whole shell, and in the fresh state adheres very closely to it. . . . . . The shell is pierced by very numerous canals which run completely through the calcareous part, but their outer end is covered by the cuticle. They are of uniform diameter in the first part of their course through the first layer, but when they reach the second layer of King, they expand and end in funnel shaped mouths. . . . . They are, as a rule, single but in the posterior part of the perforate shell, where it is unusually thick, I have seen

* Mittheilungen a. d. Zool. Station zu Neapel, Bd. iv. p. 494. 1883.

branched canals. . . . . . The minute structure of the internal skeleton is like that of the inner layer of the shell, there are no canals present. . . . . . The mantle which lines the internal surface of each shell is formed by two evaginations of the body-wall. . . . . . On the outer surface the mantle is in direct communication with the organic basis of the shell. No setæ occur in the mantle of Argiope. Into each of the canals which pierce the shell, the mantle sends a diverticulum. This is a hollow tube which fits exactly into the calcareous canal, but, unlike that, is closed at its outer end." Mr. Shipley then describes at some length the papillæ and their supposed functions; but space will not allow us to transcribe his account of them, my object being merely to give a few extracts from his valuable paper, which should be read in its entirety.

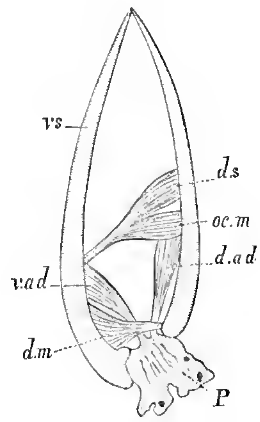
"The lophophore [p. 499] lies entirely in the dorsal shell, it forms a great part of the body wall of the animal. The shape is an oval, the border running parallel with the margin of the shell, except at the anterior median portion where there is a narrow deep indentation dividing the lophophore nearly into two equal halves; this is caused by the triangular septum mentioned above. These halves correspond with the two arms of other Brachiopods. The lophophore [p. 500] is attached anteriorly and anterio-laterally to the mantle lining the shell, postero-laterally it is attached to the free edge of the triangular plates; in the median posterior portion it is continuous with the remaining body wall. In the median line it is attached on each side to the free edge of the septum. The lophophore carries round its margin a number of tentacles; the number increases with the age, but is usually from 70 to 100. Within the bases of the tentacles a lip runs entirely round the lophophore, forming a groove; the mouth lies in the posterior median portion of this groove. The remainder of the lophophore is composed of a membrane which covers some of the viscera; the centre of each half of this membrane is rather thickened and presents in the fresh state an ill defined whitish patch. The tentacles usually lie pointing towards the centre of each half, but they are often curved and sometimes coiled like a cork-screw. . . . . Around the edge of the lophophore, between the base of the tentacles and the origin of the lip, there runs a canal in the substance of the lophophore . . . Thus the cavity in the lophophore communicates with part of the body cavity. . . . The protrusion of the tentacles [p. 501] is probably brought about by forcing in a perivisceral fluid, but their retraction and coiling movements are probably occasioned by the muscular fibres which lie in their interior.

"The mouth [p. 502] is a transverse slit in the median posterior part of the ciliated groove; it leads into a somewhat narrow oesophagus which lies against the posterior curved border of the triangular septum. At the bottom of this border, the oesophagus turns towards the posterior end of the animal and immediately enlarges into the stomach. This is globular in shape and receives upon each side the opening of the liver. The stomach narrows posteriorly and passes into a conical intestine which bends towards the ventral shell between the two brood pouches, and ends between the occlusor muscles. There is no anus.

"The liver [p. 503] consists of two branched glands lying one on each side of the alimentary canal. . . . . The blood is contained in a number of vessels which run irregularly in the tissues of the body, but which chiefly lie in the mantle and that part of the body wall lining the shell."

"The muscles [p. 504] of Argiope (*Cistella*) consist of four pairs; of these two pairs are connected with the movement of the shell upon the stalk, the other two with closing and opening the shell. Each of these last is composed of two parts and is usually considered to represent two distinct muscles, thus making the number six. . . . . Of the two pairs of adjustors, which are both inserted into the peduncle, one pair arises from each shell (valve) (woodcut, fig. 14, *d.ad* and *v.ad*). The pair arising from the dorsal shell has its origin opposite the commencement of the intestine, and the muscles of this pair are close to each other, one on each side of the median line; they pass down and are inserted by a tendinous cord which passes directly into the substance of the stalk. The adjustors of the other shell have their point of origin a little nearer the posterior border of the shell, and are rather larger, they also are inserted into the stalk in a similar manner. The principal function of these muscles is without doubt to raise and lower the animal upon its stalk. . . . . The occlusor muscles [p. 505] have two points of origin upon each side of the median line of the dorsal shell, one in front of the other. They correspond with the two parts of the muscle which were termed by Hancock the occlusor anterior and posterior. Their origin is external to that of the adjustor muscles, and their anterior limit passes far into the two anterior lateral divisions of the body cavity formed by the septum (woodcut, fig. 14, *oc.m*). The muscles of each side which are at first quite distinct soon unite into a common tendon which takes an obliquely downward direction, passing close under the central nervous system; and here it is connected with the homogeneous substance supporting the chief ganglion on each side of the oesophagus, and is inserted by an expanded extremity in the ventral shell just to one side of the median ridge. The insertion is a little anterior to the posterior limit of the intestine which lies between the two tendons. The division into two parts, of the divaricators, is much less marked than is the case with the occlusors. These muscles arise, one upon each side of the median line in the posterior part of the ventral shell, a little behind the insertion of the occlusors, they pass straight across and their tendons are inserted into the most posterior part of the dorsal valve in the middle line (woodcut, fig. 14, *d.m*). The axis upon which the shell turns passes through the teeth and sockets mentioned in the description of the shell, and this lies in front of the insertion of the divaricator muscles; hence a contraction of these muscles has the effect of opening the shell. In Argiope (*Cistella*) all the muscles are unstriated.

Fig. 14.



Diagrammatic view of the muscles of *Argiope* (after A. E. Shipley).

"The peduncle of Argiope [p. 506] appears to be an unusually large development of the homogeneous supporting substance which occurs so frequently in the body of Brachiopoda. . . . . The ovaries of Argiope [p. 507] are of a bright brick red color, resembling the red rays on the shell of Argiope cuneata. . . . . Each ovary [p. 508] appears to be formed of a membrane continuous with the body-wall. . . . . When the eggs are ripe they drop off into the body cavity, the capsule apparently bursting. In the body cavity they are taken by the inner end of the oviduct and thus pass into the brood pouch."

Mr. A. E. Shipley then goes on to describe and illustrate the different stages of embryonic development, and his descriptions agree with those given by Kowalevsky. The few preceding extracts from Shipley's very instructive paper will enable the reader to form a good idea of the character of the shell and the animal of *Cistella neapolitana*.

Subsequently to the publication of Mr. Shipley's researches, another able memoir on a closely allied species was published by M. A. Schulgin, to which we shall shortly refer. As this writer confirms, in all essential points, the details given by Shipley, we may consider the animal of *Cistella* to have been thoroughly and ably worked out.

78. Cistella cistellula, Searles Wood, sp. (Plate XXII. figs. 1–4.)

Terebratula cistellula, Searles Wood, Ann. & Mag. Nat. Hist. 1st ser. vol. vi. p. 253, 1841.

Argiope cistellula, Searles Wood, Suppl. to the Crag Mollusca, Pal. Soc. p. 170, pl. xi. figs. 1 *a–d*, 1874.

Megathyris cistellula, Forbes & Hanley, Brit. Moll. vol. ii. p. 361, pl. lvii. fig. 9, 1850.

Argiope cistellula, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 373, 1852; Proc. Zool. Soc. 1852, pl. xiv. fig. 28; Monogr. Brit. Tert. Brach. i., Pal. Soc. p. 10, pl. i. fig. 13, 1853; Ann. & Mag. Nat. Hist. 3rd ser. vol. viii. p. 40, 1861; Tert. Suppl. Brit. Foss. Brach. vol. iv. p. 6, pl. i. fig. 2, 1874; E. Deslongchamps, Bull. Soc. Linn. Normandie, vol. iii. p. 120, 1858.

Cistella cistellula, Woodward & Gray, Cat. of Brachiopoda in the Brit. Mus. p. 111, 1853; H. & A. Adams, Genera of Recent Mollusca, vol. ii. p. 581, 1858.

Argiope cistellula, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 215, 1859; Gwyn Jeffreys, Brit. Conch. vol. ii. p. 19, pl. i. fig. 2, 1863, and vol. v. p. 161, pl. xix. fig. 1, 1869; Further Gleanings of Brit. Conch., Ann. & Mag. Nat. Hist. 3rd ser. vol. iii. p. 43, pl. ii. fig. 8, 1859; Proc. Zool. Soc. 1878, p. 110.

Cistella cistellula, Dall, Amer. Journ. Conch. vol. vi. p. 146, 1870; Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 191.

Terebratula (Argoipe) cistellula, Lovell Reeve, Conch. Icon., Monogr. *Ter.* pl. x. fig. 46, 1861; Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 186, 1861.

Argiope cistellula, P. Fischer, Brachiopodes des Côtes océaniques de France, Journ. de Conch. vol. xix. p. 101, 1871; and Actes Soc. Linn. Bordeaux, vol. xxix. p. 173, 1874.

Shell very small, variable in shape, often squarely transversely oblong, broader than long, or subpentagonal and as long as wide; hinge-line nearly straight, and often as long as the greatest breadth of the shell; cardinal extremities rounded or more often extended into sharp angular extremities; lateral margins rounded, front gently indented. Dorsal valve semicircular, moderately convex, lateral sides of umbo auricular, longitudinally divided by a mesial depression commencing at a short distance from the umbo and extending to the front. Ventral valve deeper than the dorsal one; beak slightly incurved, often worn by attrition; foramen large, incomplete, margined anteriorly by the umbo of the opposite valve, and laterally by small deltidial plates; beak-ridges sharply defined, leaving between them and the hinge-line a flattened triangular area. Colour dull tawny yellow or light yellowish brown. Surface smooth, marked with fine concentric lines of growth. Shell-perforations rather large. In the interior the teeth are strong, sockets not very deep. Hinge-plate long, not very wide. Septum submarginal, prominent anteriorly; loop formed of two semicircular lamellæ, attached first to the base of the hinge-plate and then to the anterior extremity of the septum, and more or less confluent with the valve. Brachial appendages yellowish brown. Cirri few and thick;

occlusor and retractor muscles very large and powerful. Length 1 line, breadth $1\frac{1}{4}$ line, depth 1 line.

Hab. East Shetland, Skye, County Antrim (Gwyn Jeffreys); Moray Firth (Dawson); Dublin Bay (Walker), Belfast Bay; Exmouth (Barlee and Clark); off Guernsey (where Dr. Leskis found more than 200 specimens on a single stone brought up from a depth of 20 fathoms); off Weymouth (Damon); Sardinia (Vérany); Etretat, Normandy; S.W. coast of France, Cape Breton (Landes), Hendage, Basses-Pyrénées, in 32 to 45 fathoms (P. Fischer).

Fossil. Kirköen, near Christiania (Sars); Coralline Crag, Sutton (Searles Wood), not abundant.

Obs. The discovery of this interesting little Brachiopod is due to Mr. Searles Wood, who mentioned it under the name of *Terebratula cistellula* in his 'Catalogue of the Crag Mollusca' in 1841, and it was dredged in the living state by Dr. Gwyn Jeffreys seven years later. Forbes and Hanley give a good description of this shell as found in the recent state in their valuable work on 'British Mollusca.' It is there stated that a few specimens had been found in 40 fathoms of water by Mr. Jeffreys and Mr. Barlee while dredging off Skye; also in 30 fathoms off Croulin Island, near Skye, by Mr. MacAndrew; and on the Haaf, or deep-water fishing-grounds of Zetland, by Mr. Barlee. Dr. Gwyn Jeffreys observes, in his 'British Conchology,' p. 21, that this shell may be easily distinguished from *Argiope neapolitana* "in being only half the size and more convex, in the foramen being much larger, and in the inside margin of the upper valve being slightly and closely crenulated, instead of having rather strong and distant tooth-like notches, which is the case in *A. neapolitana*."

To this species several malacologists have referred the *Terebratula lunifera* of Philippi, while others have referred that shell to the *Platydia anomioides*. As much uncertainty prevails about the matter, I have preferred, provisionally, to leave *T. lunifera* among the doubtful species of *Platydia* (?). In 1852 I published a figure showing the labial appendages and muscles from a dried specimen, as well as the two-lobed loop.

79. Cistella Woodwardiana, Davidson, sp. (Plate XXII. figs. 7, 7*c*.)

Argiope Woodwardiana, Davidson, Proc. Zool. Soc. 1866, p. 103, pl. xii. fig. 4.

Cistella Woodwardiana, Dall, Amer. Journ. of Conch. vol. vi. p. 146, 1870; and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 195.

Shell very small, somewhat pentagonal, indented in front. Dorsal valve semicircular; hinge-line straight, as long as the width of the shell, moderately convex, but divided into two lobes by a deep median sulcus. Ventral valve deeper and more convex than the opposite one, and with a longitudinal groove along the middle; beak very prominent; area acutely triangular; foramen large and incomplete, margined by the umbo of the opposite valve and laterally by small rudimentary deltidial plates. External surface smooth, whitish yellow, with a few red patches arranged in interrupted lines radiating from the beak. The shell is also marked with numerous concentric lines of growth. In the interior of the dorsal valve the loop is two-lobed, adhering to a central submarginal elevated septum. Shell-structure punctate. Proportions variable; the largest specimen measured—length $2\frac{1}{2}$ lines, breadth 2 lines, depth $1\frac{3}{4}$ lines.

Hab. This species was obtained at a depth of 60 fathoms, off the north-east coast of Jamaica, by Lucas Barrett.

Obs. I published this description in 1866, and have never seen any specimens besides those obtained by Mr. Barrett. *Cistella Woodwardiana* is a stout little shell, and differs from its congeners in shape as well as in its smooth and spotted surface.

80. CISTELLA CUNEATA, Risso, sp. (Plate XXII. figs. 30–34.)

Terebratula cuneata, Risso, Hist. Nat. Europe méridionale, t. iv. p. 388, pl. 1. fig. 179, 1826.

Terebratula Soldaniana, Risso, Hist. Nat. Europe méridionale, t. iv. p. 389, pl. 1. fig. 178, 1826.

Terebratula cuneata, de Blainville, Dict. Sci. Nat. t. liii. p. 143, 1828.

Anomia Pera, Mühlfeld, Verhandl. d. Gesellsch. naturforsch. Freunde, Berlin, i. p. 205, 1829.

Terebratula cuneata, Philippi, Enum. Moll. Siciliæ, vol. i. p. 96, pl. vi. fig. 13, 1836; E. Forbes, Report on the Mollusca of Ægean Sea, Brit. Assoc. Report for 1843, p. 165.

Terebratula pera, Küster, Conch.-Cab. vol. vii. p. 30, pl. 2 *b*. figs. 14–17, 1843.

Orthis Pera, Philippi, Enum. Moll. Siciliæ, vol. ii. p. 69, 1844.

Terebratula cuneata, G. B. Sowerby, Thes. Conch. i. p. 355, pl. lxxi. figs. 83 & 84, 1846.

Orthis Pera, O. G. Costa, Fauna del regno di Napoli, p. 37, pl. iii. bis, fig. 1, 1851.

Argiope cuneata, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 373, 1852; and Proc. Zool. Soc. 1852, pl. xiv. fig. 27; Woodward & Gray, Catalogue of Brachiopoda in Brit. Mus. p. 114, 1853; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, p. 214, 1859.

Terebratula (Argiope) cuneata, Lovell Reeve, Conch. Icon. pl. x. fig. 44, 1861; Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 185, 1861.

Terebratula cuneata, Verany, Zool. des Alpes Maritimes, 1862.

Argiope cuneata, H. C. Weinkauff, Die Conch. des Mittelmeeres, vol. i. p. 288, 1867.

Argiope Pera, S. Brusina, Moll. Dalmati, p. 47, 1866.

Terebratula cuneata and *T. Soldaniana*, Davidson, Notes on some Recent Mediterranean Species, Ann. & Mag. Nat. Hist. 4th ser. vol. iii. p. 374, 1869.

Orthis pera, Terquem, Coquilles de Corse, p. 99.

Argiope cuneata, Monterosato, Cat. delle Coq. Mediterranea, 1875; Gwyn Jeffreys, Proc. Zool. Soc. 1878, p. 410; Schulgin, Zeitschrift für wissensch. Zool. Bd. xli. p. 121, pl. viii. fig. 3, 1885; A. E. Shipley, On the Structure and Development of *Argiope*, Mittheilungen a. d. Zool. Station zu Neapel, Bd. iv. p. 495, 1883.

Shell very small, somewhat transversely semicircular, obtuse posteriorly, slightly indented in front, rounded laterally, wider than long. Hinge-line straight, about as long as the greatest breadth of the shell; cardinal angles gently rounded. Dorsal valve semicircular and very gently convex. Ventral valve deeper and more convex than the dorsal one; beak tumidly produced, slightly incurved and truncated by a very large, broad, incomplete foramen, thickened posteriorly, anteriorly margined by the umbo of the dorsal valve, and laterally by small rudimentary deltidial plates; beak-ridges sharply defined, leaving between them and the hinge-line a widish triangular flattened space. Surface of valves marked with from six to eight simple, rather flat, rounded radiating ribs, with interspaces of nearly equal breadth, three or four on each side of a rather wide median groove; ribs corresponding in both valves. Colour white, or bright yellow, tinted with light-brick or rose-red between the ribs; shell-structure punctate. Length a little over 1 line, breadth 2 lines, and less than 1 line in depth. In the interior of the dorsal valve the hinge-plate is very broad and narrow; from under its centre a long narrow mesial septum proceeds to within a short distance of the front margin, which acquires height as it nears its anterior extremity. The principal lamellæ of the loop, first attached to the base of the hinge-plate by a half-circle, afterwards attach themselves to the sides of the anterior extremity of the septum. Margins of the shell crenulated. In the interior of the ventral valve a short mesial ridge extends to half the length of the valve under the posterior thickened edge of the foramen.

Hab. *Cistella cuneata* occurs in different places in the Mediterranean. In the Bay of Naples; Ægean Sea at a depth of from 28 to 69 fathoms (Forbes); near Villafranca. To a white variety found near the coast of Sicily Dr. Gwyn Jeffreys has given the varietal name of *pentalaria*. It has been found off the Canaries in 28 to 200 fathoms (MacAndrew); off Corsica (Terquem), Sardinia (Cantraine), Dalmatia (Brusina).

Philippi mentions it as fossil at Tarent.

Obs. In the 'Proceedings of the Zoological Society of London' for 1852 I gave an enlarged figure, showing the interior of both valves in a dried specimen given to me by Prof. E. Forbes in 1851. It shows the fringed labial appendages of a yellow colour, the position of the mouth, and of the adductor, cardinal and pedicle muscles.

Cistella cuneata bears some external resemblance to *Argiope decollata*, but differs from it generically, on account of its bilobed loop which is attached to a single submarginal septum. It is also a much smaller shell, with fewer and simple ribs tinted with red in their interspaces.

In his paper on the Mollusca procured during the 'Lightning' and 'Porcupine' Expeditions (Proc. Zool. Soc. of London, 1878, p. 410), Dr. Gwyn Jeffreys says:—"I have been favoured by Prof. Seguenza with an opportunity of examining his unique specimen of *Argiope biplicata* from the Straits of Messina, and of comparing it with an extensive series of *A. cuneata* and its colourless variety. The result of such examination and comparison, as regards both the outside and inside, compels me to consider the specimen an abnormal form of *A. cuneata*."

I would, however, have almost considered it a malformation of *Cistella neapolitana*, for some specimens of the last-named shell sometimes possess four rounded ribs with a wide mesial interspace, as in Seguenza's specimen. *Cistella cuneata* has received three or four specific names, but that of *cuneata* seems to be the oldest. While at Nice, in 1869, I was able to examine Risso's types of *Terebratula cuneata* and *T. Soldaniana*, and found them referable to a single species, and this view was subsequently confirmed by Dr. Gwyn Jeffreys.

81. CISTELLA LUTEA, Dall. (Plate XXIII. figs. 5 & 6.)

Cistella Barrettiana, Dall, Amer. Journ. of Conch. vol. vi. p. 146, 1870.

Cistella (*? Barrettiana* var.) *lutea*, Dall, Report on the Brach. dredged by the United States Coast Survey Exped., Bull. Mus. Comp. Zoöl. vol. iii. p. 20, pl. i. figs. 5 & 6, 1871.

Cistella lutea, Dall, Moll. of the 'Blake' Exped., Bull. Mus. Comp. Zoöl. vol. xii. p. 203, 1886.

Shell small, transversely oval, wider than long; hinge-line straight, rather less than the breadth of the shell, sides and front rounded. Dorsal valve semicircular, very little convex, somewhat flattened. Ventral valve deeper than the dorsal one, with a slightly marked depression extending from the beak to the anterior margin; beak bent backwards and truncated by a large incomplete foramen, usually much eroded, margined anteriorly by the umbo and laterally by very small rudimentary deltidial plates; area triangular, flat, and smooth. Colour light brownish white, with about twelve radiating ribs in each valve, of which five or six are smaller and interpolated between the longer ones. In the interior of the dorsal valve a large, much elevated mesial septum is present, denticulated anteriorly, forming nodules and notches on its upper edge, the whole having a subtriangular form, somewhat resembling an open fan. The loop consists of two bands, or lamellæ, attached to the hinge-margin and afterwards to the septum on each side about its middle and close to the shell. Cardinal plate, or hinge-plate, absent; area behind the muscular disk somewhat excavated. Length 3 lines by $3\frac{1}{2}$ in breadth.

Hab. Tortugas, in a depth of 30 to 43 fathoms (Pourtales). Off Havana, 80 to 127 fathoms (Sigsbee); Barbados, 100 fathoms, 'Blake' Exped. (Dall).

Obs. We are indebted to Mr. William H. Dall for the first description of the animal of *Cistella* (*C. lutea*), which he published in 1871, prior to Kowalevsky's admirable description of the animal of *Cistella Neapolitana* in 1873, and that of *C. Kowalevskii* by Schulgin in 1884. Dall says (*l. c.* p. 20):—"Muscular impressions much thickened, forming two rather concave disks. . . . The anterior portion of the apophyses is more posterior than in *C. Neapolitana*, and the margin is not granulated as in that species. It would seem from Mr. Davidson's figures that the loop of *Cistella Barrettiana*, Dav., is more anterior than in this species; the latter being also unprovided with the posterior extension of the septum seen in the figure of the former, and being, moreover, entirely destitute of the red markings between the ribs . . . . . It is possible that the present species, *C. Antillarum* and *C. Barrettiana*, are forms of one species, in which case the last name has priority."

[*L. c.* p. 22.] "I have not met with much success among these small species in the use of acid in dissolving away the shell from the animal. . . . The brachia in this and the other species of the genus are arranged around the edge of a broad membrane, which covers the concavity of the shell, like a drumhead. The loop of the drum is represented by the apophyses. The brachia differ from the same organs in the *Terebratulinæ* in being arranged in a single series instead of a double one. Of this there can be no doubt, it is very evident upon a casual inspection, and is entirely confirmed by careful dissections. In this species the drumhead membrane is divided into two lobes by the septum. The edges of these lobes are fringed with the brachia. . . . They are usually curled up in front and on each side, while those which are situated behind the mouth are longer than the others, and usually lie smoothly over them, extending forward without any marked curve, pointing towards the anterior margin of the shell, and extending clear over the central membrane, even beyond the posterior edge of the septum. The brachia are covered with an epithelium furnished with cilia, are tubular, and communicate with a series of brachial channels, which did not appear to differ from those of *Waldheimia* as described by Hancock, as far as I was able to discover. The great brachial canal was rendered conspicuous by a band of cartilaginous substance which seemed to form its external covering, or rather beneath which it was situated, and which was longitudinally striated. The external edge of the membranes, between which the apophyses were formed, was directly attached to the pallial lobes at the points where the apophyses are attached to the muscular disks of attachment already described. On either side of this attachment, however, was a kind of pocket, opening externally, where the brachial and pallial membranes did not coalesce; and, there being one on each side of the point of union, there were consequently four in all, two on each side of the septum. The drumhead membrane, covering the space inside of the brachia, was translucent white or opalescent, and quite thick and tough towards the middle of each lobe."

[*L. c.* p. 23.] "I am inclined to think that an error has been perpetuated in regard to the position of the mouth of *Megathyris decollata*. It has been figured and described by Woodward as being of a circular form, and situated in the midst of the drumhead membrane. It is certainly not so situated in *Cistella*; and I do not believe that it is in *Megathyris*, though I have only seen dry specimens. In the present species it is placed, as in all the *Terebratulidæ*, at the back of this membrane, just in front of the posterior junction of the brachia, and at the bottom of a deep transverse groove which is of a stout membranous consistency, and the two sides of which, for convenience' sake, I have called the lips (*labia*). In the present species the oral groove is situated far back and close to the brachia, which are exceptionally long behind it, as already described. It is, in fact, entirely hidden by them until they are laid back. The groove is very long and quite deep, the entrance to the œsophagus being trumpet-shaped and flattened transversely. Were the brachia disposed as in Woodward's figure, the oral groove would be hidden. I am disposed to think that this was really the case in the specimen figured, and that the extraordinary circular mouth there figured was an accidental lesion of the dry tissues, which might easily be taken for a mouth of so small an animal. The labia, in all the Brachiopods I have examined so far, have invariably exhibited a tinge of darker colour than the surrounding tissues. The present case forms no exception. The posterior lip presents a small prominence in the median line, and the anterior lip a small emargination or concavity below this prominence. This structure is also common to all the Brachiopods I have examined.

"The œsophagus is wide, transversely flattened, with thin walls, and of an orange color. It enters the stomach nearly at a right angle, without much dilation. The stomach is oval with thicker and firmer walls; the inner lining appearing slightly villous and rugose. The intestine is not differentiated from the stomach on the lower side, but on the upper side a deep groove occurs at the juncture. The canal is stout and thick at its lower extremity, tapers slightly, and terminates in a somewhat bulbous, but pointed cæcal extremity, attached to the perivisceral membrane. The various membranous bands which support the alimentary system present no differences from the homologous structures in other species of *Terebratulidæ*. The stomach was filled in each case with a yellowish flocculent matter. The hepatic lobules resembled those of other species, entering the stomach by two ducts on each side, of which the anterior were the larger. They did not extend over or cover the sides of the intestine."

[*L. c.* p. 24.] "The heart is extremely small and difficult to find. It is situated lower down than in most species, and between and hidden by the hepatic lobules. It is nearly spherical. No accessory pulsatile vesicles were found, after close scrutiny.

"The ovaries differ in appearance from those of *Waldheimia* and *Terebratulina*. They hang like a frill or puckered ribbon-like lamina from the pallial membranes, and form a simple loop on each side of each valve. Those of the hæmal (dorsal) valve were most developed. The ends of the loops extended into the great pallial sinuses. The rounded granules which studded the frills were of two kinds. Those at or near the extreme edge were of a pellucid deep brown hue, while those closer to the pallial membrane were mostly of a pale yellowish color, and quite opaque. The oviducts are very inconspicuous and not easily found. They are situated in the usual position, but exhibit only a very few short folds, and the external opening directly in the midst of them, instead of being at the end of a rather long duct, as in other forms. There are only two of them. They do not appear to be attached to the intestine or mesenteries, but lie flatly upon the parietes. The pallial sinuses are comparatively insignificant in this species, being very narrow, almost linear, channels with few branches. A few spiculæ were observed in some of them. The margin of the mantle is perfectly plain, without setæ, and adhering closely to the shell. Yet the circumpallial muscular band is much broader than usual, and strongly marked. When torn from the shell, the cæcal prolongations of the mantle were beautifully shown. They were often bifurcate and occasionally had three or even four branches.

"The punctate structure of the shell was very coarse. Even the crura and laminæ of the apophyses were punctate. The nervous system was not traced out; but the œsophageal ganglia presented no special peculiarities.

"The border of the mantle appeared to be ciliated. The peduncle, so wide and short as to resemble a mere muscular disk, was strongly attached to the shell by the peduncular muscle, beside which a broad tendinous band appeared to pass entirely across, in front of the dorsal adjustors (posterior retractors of Owen), giving an additional solidity and firmness to the attachments of the peduncle. The extremities of all the muscles were very much enlarged and thickened, while their median portions were slender and tendinous. No striated fibres were observed."

82. Cistella Barrettiana, Davidson, sp. (Plate XXIII. figs. 1 & 2.)

Argiope Barrettiana, Davidson, Proc. Zool. Soc. 1866, p. 103, pl. xii. fig. 3.

Argiope Antillarum, Crosse & Fischer, Journ. de Conch. vol. xiv. p. 270, pl. viii. fig. 7, 1866.

Cistella Barrettiana, Dall, Amer. Journ. of Conch. vol. vi. p. 146, 1870; and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 193.

Cistella (? *Schrammi*, var.) *rubrotincta*, Dall, Bull. Mus. Comp. Zoöl. vol. iii. p. 19, pl. i. fig. 6, 1871.

Cistella Barrettiana, Davidson, var. *rubrotincta*, Dall, Moll. 'Blake' Exped., Bull. Mus. Comp. Zoöl. vol. xii. p. 203, 1886.

Shell small, somewhat subpentagonal, wider than long; dorsal valve semicircular, slightly indented in front; hinge-line straight, as long as the breadth of the shell, forming acute angles at its junction with the labial margins of the valves. Valves unequally convex. Dorsal valve very gently convex, rather flat, with a shallow longitudinal depression along the middle. Ventral valve convex, with a rather deep mesial sinus, corresponding to the one in the dorsal valve; beak and area sloping backwards, forming an obtuse angle with the plane of the dorsal valve. Foramen very large, incomplete, margined anteriorly by the umbo of the dorsal valve, and laterally by rudimentary deltidial plates. Surface of valves traversed with from eight to twelve rounded ribs, corresponding in both valves, with interspaces between them of almost equal breadth. Colour pale yellow, with scarlet interspaces; surface marked with punctuations clearly visible to the eye in a good light. In the interior of the dorsal valve the apophysary system consists of a bilobed ribbon-shaped lamella, originating at the base of the sockets, which after forming half a circle on each side, adheres to a central prominent submarginal septum, the lamellæ forming the loop being also partly confluent with the valve. Proportions variable. Length 3 lines, by a little more than 4 lines in breadth.

Hab. North-east coast of Jamaica in a depth of 150 fathoms (Barrett). At Guadaloupe in from 200 to 250 fathoms (Crosse). Dredged in 70 fathoms off Rio de Janeiro, Brazil, by the captain of the English steamer 'Norseman,' in lat. 21° 48′ S., long. 40 3′ W. These specimens were obtained attached to corals brought up by the grappling-irons, and sent to me by Mr. R. Rathbun. Dredged also by M. de Pourtales west of Tortugas in 30 to 43 fathoms; Sand Key, 80 fathoms; St. Vincent, 95 fathoms; Tortugas, 43 fathoms; off Grenada, 115 fathoms; Barbados, 100 fathoms; off Havana, 450 fathoms (Sigsbee), Yucatan Strait, 641 fathoms, 'Blake' Exped. (Dall).

Obs. This fine species of *Cistella* approaches most nearly in general appearance to the *Cistella cuneata*, Risso, but is a much larger species and possesses, when full-grown, a greater number of ribs. In external shape it bears likewise some resemblance to *Argiope decollata*, from which, however, it can be at once distinguished by its two-lobed loop and single submarginal septum. It varies somewhat also in shape as well as in the number of its ribs, some specimens being as long as wide when quite young. In a letter dated the 22nd of March, 1870, Mr. Crosse writes me that in all probability his *Argiope antillarum* is a synonym of *Cistella Barrettiana*, but that he considers his *C. Schrammi* to be a distinct species. I have also, through the kindness of Mr. Dall, been able to examine the type of his *C. rubrotincta*, and I believe it to be a synonym of *C. Barrettiana*. From Mr. Dall's description it would seem that it is of a pale yellow colour, with brilliant scarlet interspaces, and agrees in shape and character with typical examples of *C. Barrettiana*. "Septum triangular, extending from the hinge margin to the anterior border of the shell. Most elevated point, forming the apex of the triangle in the middle of the valve, rather bulbous and of a red colour. Anterior slope of the septum to the border of the shell, straight without nodules; this part of the septum is thin and even. Posterior slope of the septum irregularly concave, thick, and nodulous, tapering to a point at the hinge-margin." The size and extent of the transverse plate of the septum varied in different specimens.

Uncertain Species.

83. ARGIOPE GLOBULIFORMIS, Schulgin. (Plate XXII. fig. 28.)

Argiope globuliformis, Schulgin, Zeitschr. f. wiss. Zool. Bd. xli. p. 121, pl. viii. fig. 2, 1884.

Shell small, ellipsoid, globular; valves smooth, inflated, of a yellowish colour; beak not very projecting, wide; foramen incomplete, transversely oval. In the interior of the dorsal valve there are three submarginal septa. In the ventral valve one low median septum. Diameter 7 millim.

Hab. Obtained by Schulgin on stones off Sardinia, and near the islands of Hyères; it was not found at Villafranca.

Obs. I have never seen this shell and have no further knowledge of it than Schulgin's very brief description and figure affords. It is said to have three submarginal septa in the dorsal valve, and must consequently be placed in the genus *Argiope*.

84. ARGIOPE BARROISI, Schulgin. (Plate XXII. fig. 29.)

Argiope Barroisi, Schulgin, Zeitschr. f. wiss. Zool. Bd. xli. p. 122, pl. vii. fig. 4, 1884.

Shell small, squarely transversely oblong, wider than long; hinge-line straight, less than the breadth of the shell. Valves moderately convex, ornamented with from eight to eleven rounded ribs. Colour light yellowish orange; interspaces between ribs bright red. Beak moderately produced; foramen large, circular, incomplete, margined anteriorly by a part of the umbo of the dorsal valve. In the interior of the dorsal valve there are three high submarginal septa, and a single low one in the ventral valve. Breadth 3·6 millim.; length 3 millim.

Hab. It occurs frequently on *Posidonia* and upon stones at Villafranca, along with *Cistella Kowalevskii* at a depth of 30 metres; also off Sardinia, Naples, and the islands of Hyères.

Obs. I have never seen this shell, and know nothing more of it than is contained in Schulgin's brief description. His figure does not quite satisfy me. As it is said that three septa exist in the dorsal valve, it is an *Argiope*.

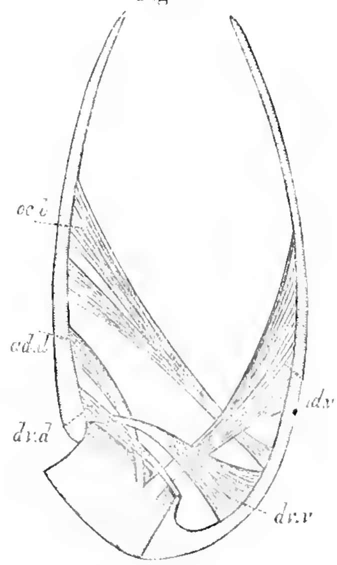
85. CISTELLA KOWALEVSKII, Schulgin, sp. (Plate XXII. figs. 26 & 27.)

Argiope Kowalevskii, Schulgin, Zeitschr. f. wiss. Zool. Bd. xli. p. 122, pl. viii. figs. 5–9 & 12, pl. ix. figs. 11–18, 1884.

Shell very small, from 3 to 8 millim. in length by 3 millim. in breadth, heart-shaped, broadest and rounded anteriorly, tapering somewhat posteriorly. Valves gently convex, thin, shining, and sharp at their edges, marked with a few concentric lines of growth and widely separated punctures; beak short, triangular, both it and the umbone of the opposite valve excavated for the passage of the cylindrical-shaped peduncle. In the interior of the dorsal valve one short thick submarginal septum; in the ventral valve a thin, low, long septum. Colour yellow.

Hab. Found by Herr M. A. Schulgin alone or in groups on *Posidonia*; off Sardinia, Villafranca, and off the islands of Hyères.

Fig. 15.



Muscular arrangement in *Cistella Kowalevskii* (after Schulgin).

ad.v, adjuvator ventralis; *dv.v*, divaricator ventralis; *oc.b*, occlusor biceps; *ad.d*, adjuvator dorsalis; *dv.d*, divaricator dorsalis.

Obs. I have never seen this small shell. Schulgin gives two figures which seem to me rather dissimilar; we will, however, take the illustration in his pl. viii. fig. 5 as his type, as it differs in several particulars from *Cistella neapolitana*. Schulgin describes and illustrates the shell and its animal with much care and minuteness in the memoir above quoted; but his description agrees so nearly with that of *Cistella neapolitana*, published one year before by Mr. Shipley, that I must refer the reader to Herr Schulgin's memoir, and content myself by reproducing in Pl. XXII. fig. 26 one of the author's most instructive illustrations. Schulgin seems to have discovered the presence of some sense-organs situated in the body-wall just behind the chief or subœsophageal nerve-ganglion; but this requires confirmation, for A. E. Shipley saw nothing of them in the allied species he studied in Naples. The arrangement of the muscles in *C. Kowalevskii* is quite similar, as might be expected, to that described by Mr. Shipley in *Cistella neapolitana*.

86. Cistella Schrammi, Crosse, sp. (Plate XXIII. figs. 3 & 4.)

Argiope Schrammi, Crosse & Fischer, Journal de Conch. vol. xiv. p. 269, pl. viii. fig. 6, 1866.

Cistella Schrammi, Dall, Amer. Journ. of Conch. vol. vi. p. 146, 1871, and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 194.

Shell very small, transversely subpentagonal, wider than long, indented in front; hinge-line straight, as long as the greatest breadth of the shell, cardinal extremity prolonged and acutely angular. Dorsal valve very gently convex, with eight rounded ribs, and a very broad median depression between the two central pairs. Ventral valve rather deeper than the dorsal valve, with a similar number of corresponding ribs, and wide depressions between the central ones; beak bent backwards, almost straight, area triangular, foramen large and incomplete, margined anteriorly by the umbo, and by two small lateral deltidial plates. Colour yellowish or pale orange, sometimes tinted with red. Length 1 line, breadth $1\frac{1}{2}$ line.

Hab. Dredged, associated with *Cistella Barrettiana* (*C. antillarum*, Crosse), off Guadaloupe, at a depth of from 200 to 250 metres, by the Italian brig 'Icilia.'

Obs. Thanks to the kindness of M. Crosse, I have been able to examine and draw his type. I have also a rather larger specimen from Tortugas. The material at hand has, however, been so small that I can say nothing positive with respect to the specific claims of *Cistella Schrammi*.

87. CISTELLA (?) LUNIFERA, Philippi, sp. (Plate XXII. figs. 5 & 6.)

Terebratula lunifera, Philippi, Enum. Mollusc. Siciliæ, vol. i. p. 97, tab. vi. figs. 16 *a–f*, 1836.

Orthis lunifera, Costa, Fauna del regno di Napoli, p. 10, tav. iii. *bis*, figs. 3 A, B, & 4, 1851.

Morrisia lunifera, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 212, 1859.

Argiope (*Terebratula*) *lunifera* = *T. cistellula*, Monterosato, Nuova Revista delle Conchy. Med., Atti del Accad. Palermitana di Scienze, 1875.

Terebratula (*Morrisia*) *lunifera*, L. Reeve, Conch. Icon. pl. x. fig. 11, 1861.

Morrisia lunifera, Weinkauff, Die Conch. des Mittelmeeres, vol. i. p. 288, 1867.

Argiope lunifera, Gwyn Jeffreys, Mediterranean Mollusca (= *A. cistellula*), Ann. & Mag. Nat. Hist. 4th ser. vol. vi. p. 67, 1870.

Shell small, length and breadth half a line, thin, hyaline, somewhat orbicular, broadest anteriorly. Dorsal valve very gently and uniformly convex, somewhat compressed, very slightly indented at the umbo and at the frontal margin. Ventral valve gently convex; beak short, slightly incurved and truncated by a rather large incomplete foramen; beak-ridges sharply defined, leaving between them and the hinge-line a narrow triangular space. Surface smooth, puckered near the margin, and traversed by fine concentric lines of growth. Colour light yellowish white. A small submarginal septum rises in the interior of the dorsal valve. On each side of the mouth the labial appendages form a half-circle and do not apparently occupy much more than a third of the interior of the shell.

Hab. Mediterranean Sea, off the African coast.

Obs. Much uncertainty has prevailed with respect to the genus to which this so-termed species should be referred. It was described and figured in 1836 by Philippi as follows:—

"T. testa minima; subcordata, compressa, punctata, margine frontali subemarginato, foramine incompleto, sceleto interno e lamella semilunata obliqua versus frontem aperta constante. Specimina duo zoophytis inhaerentia inveni. Testa minima $\frac{5}{4}'''$ longa, 1''' lata, $\frac{1}{2}'''$ alta, cordata subpentagona, margine frontali emarginata, parum convexa, convexitate maxima in cardinis regione, v. fig. e. Sub lente fortiori superficies punctis minutis elevatis per series radiantes dispositis, aliisque minimis, impressis, densissimis obsita. Area angusta satis elevata, foramen magnum incompletum. Deltidium distinguere non potui. Sceleton internum lamina obliqua semilunaris ad frontem prona et aperta, v. fig. 16 *a* et *e*. Color testae albidus." Philippi gives six figures of his little shell; in fig. *a* he draws a submarginal single septum as in *Cistella*, and he speaks of a loop in the shape of a half-circular lamella.

The form is, therefore, as the Marquis of Monterosato and Dr. Gwyn Jeffreys suggest, more nearly related to *Cistella* than to *Platydia*. Costa, in his 'Fauna del regno di Napoli,' describes and figures some of the soft parts of the animal, from a specimen which he says belonged to Philippi's species, which occurs off the shore of Trapani, as well as near the coast of Africa. He points out the differences between it and *Platydia anomioides*. The hinge-line in the dorsal valve is entire and not scooped out, as in the last-named species, for the passage of the peduncle, and its interior is quite different from that of *Platydia*.

The Marquis of Monterosato and Dr. Gwyn Jeffreys would consider the *Cistella cistellula* of Wood to be a synonym of *C. tunifera*; but this identification seems to be uncertain, and new material must be examined and compared before the matter can be regarded as definitely settled.

Uncertain Genus and Species, 1859.

(The characters of the genus are given under *Gwynia capsula*. One species only known.)

88. GWYNIA CAPSULA, Gwyn Jeffreys, sp. (Plate XXI. figs. 28 *a*, *b*, *c*, & 29.)

Terebratula capsula, Jeffreys, Ann. & Mag. Nat. Hist. 3rd ser. vol. iii. p. 43, pl. ii. figs. 7*a*, *b*, 1859.

Gwynia capsula, King, Proc. of the Dublin University Zool. & Bot. Assoc. vol. i. p. 258, woodcuts, figs. 1–5, 1859.

Argiope capsula, Gwyn Jeffreys, Brit. Conch. vol. ii. p. 21, 1863, and vol. v. p. 164, pl. xix. fig. 5, 1869.

Gwynia capsula, M. Sars, Om de i Norge forekommende fossile Dyrlevninger fra Quartaerperioden, Christiania, p. 96, pl. iv. figs. 121, 122, 1865; Davidson, Br. Foss. Brach. vol. iv. p. 5, pl. i. figs. 3–4, 1874; H. Friele, Archiv for Mathematik og Naturvidenskab, Bd. ii. p. 385, pl. iii. figs. 7 *a* & *b*, 1877.

Argiope capsula, Terquem, 'Essai sur le classement des animaux qui vivent sur la plage dans les environs de Dunkerque,' 1879; Gwyn Jeffreys, Ann. & Mag. Nat. Hist. 5th ser. vol. vi. p. 106, 1880, and Proc. Zool. Soc. 1881, p. 949.

Shell thin, minute, pouch-shaped, or slightly elongated oval, nearly equivalved, longer than wide, broadest anteriorly, rounded in front; hinge-line nearly straight or very obtusely angular, margins rounded at the sides. Dorsal valve convex, most so at the umbo, slightly depressed anteriorly. Ventral valve uniformly convex; beak slightly prominent and incurved; foramen incomplete, margined anteriorly by the umbo, and by small rudimentary deltidial plates. Interior without loop or septa (?). Surface of valves smooth; shell-perforations rather large and far apart. Lines of growth slightly marked. Colour nearly white, glossy. Length two thirds of a line by half a line in breath.

Hab. Off Plymouth, in 18–25 fathoms (Norman, from Webster). On stones near Guernsey, 8 to 20 fathoms (Lukis and Duprey). Dublin Bay and off Portsmouth (Waller). Belfast Bay, Larne, County Antrim (Hyndman and Gwyn Jeffreys). It occurs with *C. cistellula*, nestling in hollows of old shells, *Pectunculus glycymeris*, and other bivalves. Off Etretat, in Normandy, on stones which had been taken up in trawl-nets at a distance of about four leagues from land (Gwyn Jeffreys). Off Dunkerque (Terquem). M. Colbeau obtained the shell from Sluys-Kill, Zeeland, near the Belgian frontier. Off Jersey, low water (Duprey), where it adheres by its short stout peduncle in an upright position to the undersides of large stones which are sunk and partly buried in the sandy mud (Gwyn Jeffreys).

It also occurs fossil in the Post-tertiary clays at Kirköen, near Christiania (Sars).

Obs. I have specimens of this minute shell, from the size of a microscopic dot up to little more than half a line in length. I cannot, however, arrive at any other conclusion than that it is the fry or young stage of some species not at present determined. The shell has already been referred to *Terebratula*, *Argiope*, and *Gwynia*. Dr. Gwyn Jeffreys and Herr Herman Friele believe it to be referable to *Argiope* or *Cistella*, and in vol. ii. p. 22 of his 'British Conchology,' Gwyn Jeffreys writes, "It may be the young of *Argiope Neapoli-*

tana (probably *T. cordata* of Risso); and I feel pretty confident that the last-named species will be found on our own as well as the Mediterranean coasts." In 1859, Dr. S. P. Woodward and myself spent a whole day at the British Museum in endeavouring, with the aid of a good microscope, to find some kind of calcareous support, or septum, but could find none; nor has any other naturalist who has studied the shell been more successful. In 1859, Prof. W. King proposed the generic name of *Gwynia* for this form, stating at the same time that "the principal generic character of Gwynia is in the labial appendages being attached directly to the shell (first observed by Mr. Jeffreys), and not to a loop, as in other genera of the family. The prominency of the umbone of the small or receiving valve, the form, position, and (considering the size of the species) the unusual development of its teeth, also the large size of the perforations of its shell-tissue, form other good distinguishing characters." We must, however, for the present, assume that no calcareous support in reality exists.

In a note published in the 'Ann. and Mag. Nat. Hist.' for Nov. 1880 (p. 406), Dr. Gwyn Jeffreys again returns to the subject, in referring to what he terms *Argiope capsula*, and says:—"The specimens kindly sent me by Mr. Duprey are larger than any I had previously seen; and I was enabled to examine the inside of the shell by soaking them for some days in dilute potash water, together with *Argiope cistellula* of the same size. *A. capsula* has a thick hinge; and the smaller (though scarcely smaller) valve has a sharp-edged and wavy crest or ridge lying a little within the margin, which is heart-shaped and continuous in front. The shell is strong for its size, and is nearly spherical and equivalve, the beaks of both valves being excavated to contain the byssus. There is no trace of a septum in either valve. The caecal tubercles are numerous, twice as many as in *A. cistellula* of the same size. The latter species is transversely oblong; there is a distinct and prominent septum in each valve; and the laminar ridge in the smaller valve is much slighter, and is interrupted by the septum to which it is attached. Both species occur together on the English and Irish coasts, and at Etretat in Normandy."

In his paper on the development of the skeleton in the genus *Waldheimia*, Herman Friele says (p. 385), "Dr. Jeffreys has had the great kindness to send me his type-specimens of *Gwynia* (*Argiope*) *capsula*, Jeffr., for comparison. My first glance at them sufficed to convince me that there can be no question as to their [not *] being the fry of *Waldheimia cranium*, for not only are both valves of very nearly the same size, but the form, the foramen, and the structure of the shell are essentially different."

Mr. Lovell Reeve writes, in his 'Geographical Distribution of the Terebratulæ' †, "Is this very minute form, it has been asked, an adult shell, or the fry of *Argiope cistellulum* or of some other *Terebratula*? An *Argiope* it certainly is not; and I am unable, after a most tedious examination of specimens, to add anything to what is known on the subject." The question being still involved in considerable uncertainty, it will be better, I think, at any rate provisionally, to leave it under *Gwynia*, from which it may be hereafter removed, if anything definite should be ascertained concerning it.

* [Herr Friele writes April 19th, 1886, that "by a printer's error the word 'not' was omitted here:" and this is evident from the rest of the passage quoted.—A. C.]

† Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 183.

Mr. W. H. Dall, in his Index to the names which have been applied to the subdivisions of the class Brachiopoda (Smithsonian Miscell. Coll. vol. xiii., Bull. U. S. Nat. Mus. vol. i. no. 8, p. 30, Washington, 1877), states, as many zoologists have done, that the so-termed *Gwynia capsula* is an immature form, and perhaps that of *Waldheimia cranium*.

Genus PLATYDIA, Costa.

The subfamily into which the genus *Platydia* should be placed has not yet been satisfactorily determined. It is thus characterized by Dall:—"Shell with the loop attached, not reflected; animal with sigmoid brachia meeting behind the mouth, without any spiral median lobe or lateral loops. Cardinal process absent."

The genus *Platydia* was proposed by Costa in January 1852, and by myself, entirely independently, in May of the same year, under the name of *Morrisia*, which must now be placed among the synonyms.

The animal of *Platydia* has not yet been anatomically examined.

89. Platydia anomioides (Scacchi), Philippi, sp. (Plate XXI. figs. 15–19.)

Terebratula Seminulum, Philippi, Enum. Moll. Siciliæ, vol. i. p. 97, pl. vi. fig. 15 *a–g*, 1836.

Orthis anomioides (Scacchi, MS.), Philippi, Fauna Moll. Regni utriusque Siciliæ, vol. ii. p. 69, pl. xviii. fig. 9, 1844.

Terebratula appressa, E. Forbes, Report of the Mollusca of the Ægean Sea, Report Brit. Assoc. for 1843, pp. 141, 167, 193, 1844.

Platidia anomioides, Costa, Fauna del regno di Napoli, p. 48, pl. iii. fig. 4, and pl. iii. *bis*. fig. 6, 1852.

Morrisia seminulum, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 371, 1852.

Morrisia anomioides, Davidson, Proc. Zool. Soc. 1852, pl. xiv. fig. 29; Intr. to vol. i. Brit. Foss. Brach. p. 71, pl. vi. figs. 30, 31, 1853; Woodward & Gray, Catalogue of Brachiopoda in the Brit. Mus. p. 108, figs. 17, 18, 1853; S. P. Woodward, A Manual of the Mollusca, p. 218, 1856; H. & A. Adams, The Genera of Recent Mollusca, vol. ii. p. 579, pl. cxxxi. figs. 5 *a, b*, 1858; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, p. 212, 1859.

Terebratula (*Morrisia*) *anomioides*, L. Reeve, Conch. Icon. pl. x. fig. 40, 1861, Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 184, 1861; Chemnitz, Man. de Conch. p. 208, fig. 1064, 1862.

Morrisia anomioides, E. Deslongchamps, Recherches sur l'Organisation du Manteau chez les Brachiopodes articulés, Caen, p. 28, pl. iii. figs. 6, 7, 1864; Seguenza, Cat. Mal., Mem. Soc. Ital. Sci. Nat. p. 66, pl. viii. fig. 6, 1865; H. C. Weinkauff, Die Conch. des Mittelmeeres, vol. i. p. 288, 1867.

Platidia (*Morrisia*) *anomioides*, Davidson, On Italian Tert. Brach., Geol. Mag. vol. vii. p. 405, pl. xxi. figs. 15, 15 *a*, 1870; Dall, Amer. Journ. of Conch. vol. vi. p. 143, 1870, and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 192; P. Fischer, Brachiopodes des côtes océaniques de France, Journ. de Conch. vol. xx. p. 162, 1872; Monterosato, Poche note sulla Conch. Mediterranea, 1875.

Platidia seminulum, Monterosato, Journ. de Conch. vol. xxvii. p. 307, pl. 13. fig. 3, 1879.

Platidia anomioides, Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 55, pl. iv. figs. 10, 11, 1880; Zittel, Handbuch der Pal. Bd. ii. p. 708, 1880; E. Deslongchamps, Études critiques sur les Brachiopodes, p. 160, pl. xiii. fig. 19, 1884.

Shell small, transversely oval, or nearly circular, semitransparent, yellowish white, conspicuously perforated by minute canals; foramen large, encroaching nearly equally on both valves. Dorsal valve almost flat, and mesially depressed; umbo notched by a semicircular foramen. Ventral valve convex, of moderate depth, hinge-line straight, area small. Beak very slightly incurved, foramen situated under its angular extremity, margined by narrow deltidial plates. Surface smooth, marked with concentric lines of growth. In the interior of the dorsal valve the loop is not reflected. The converging principal lamellæ are found attached first to the hinge-plate, and then to a small pillar-shaped median vertical septum. Peduncle very short; animal possessed of sigmoid vertical labial appendages. Length 2 lines, breadth 2 lines.

Hab. Dredged in the Ægean Sea by Prof. E. Forbes, under the names of *Terebratula seminulum*, Philippi, and *T. appressa*, Forbes, at depths varying from 15 to 105 fathoms; in the Bay of Naples (Costa); off the Portuguese coast, near the mouth of the Tagus, attached to corals (W. S. Kent); Bay of Biscay and Sahara ('Travailleur' Expedition), in 178 to 347 fathoms; North of Stornoway ('Knight Errant' cruise); off Cuba and West Indies ('Blake' Expedition), 88 to 645 fathoms; off Marion Island in 500 fathoms, and off Prince Edward's Island close to Marion Island ('Challenger' Expedition). Mr. W. H. Dall records it from San Diego, California, and from Lodos, Santos Bay, south of the United-States boundary in Lower California (Mexico).

It occurs in the fossil state in the Upper Pliocene rocks of Sicily.

Obs. As the specific name *anomioides* is now in general use, I do not feel inclined to disturb it, although those of *seminulum* and of *appressa*, Forbes, seem to have priority. Forbes neither described nor figured his species, and therefore it cannot be said to have been published. The name *anomioides* is attributed to Scacchi, but he has neither named, described, nor published it. It was a MS. name known to Philippi and to Costa, and they both described and figured a shell in 1844 and 1852 under the name of *Orthis anomioides*. As the *Terebratula seminulum*, Philippi, is evidently identical with the so-termed *Orthis anomioides*, and was described and figured in 1836, the specific name *seminulum* should in reality obtain priority over that given to the shell in MS. by Scacchi. In May 1852 I proposed for *T. seminulum* and similar shells the generic name of *Morrisia*, not being aware at the time that Costa on the 27th of January of the *same year* had proposed that of *Platydia* for the same shell.

The animal of this interesting and well-marked genus and species has not yet been anatomically examined. The arrangements of its labial appendages are very remarkable. They were briefly described and figured by Costa and by myself in 1852, but more particularly by E. Deslongchamps in 1861, in his valuable memoir, 'Recherches sur l'Organisation du Manteau chez les Brachiopodes articulés.' His observations were, however, like my own, unfortunately founded on dried specimens. He states that the brachial appendages are much more simple than in other genera of the Brachiopoda, and that the two principal branches which lie close to each other at their origin and deviate by a curve towards the centre of the shell, and, having made almost a complete circle, return close to their origin, without forming a spiral. His most important observations, however, relate to the mantle, which he states to be so thickly coated with spicula that it is impossible to separate it from the brachial appendages without injuring them; that they are small, but exceedingly numerous, and yet so blended together that it becomes at last very difficult to define their shape; and that they appear to be a white spongeous mass formed of an innumerable number of short lamellæ, crossing each other in every direction. In his paper "Brachiopodes des côtes océaniques de France" ('Journal de Conchyliologie,' vol. xx. p. 160, pl. vi. figs. 3–9, 1872), M. P. Fischer describes at great length *Platydia anomioides*, and the characters that distinguish it from *Platydia Davidsoni*. He gives an enlarged sketch of the brachial appendages, which he likewise states to be extremely simple. "De chaque côté de la bouche part une portion horizontale qui se coude ensuite et forme une première anse ou boucle buccale. Elle est continuée de chaque côté par la portion currente dirigée du crochet de la valve vers le bord frontal et en rapport avec la valve inférieure ou dorsale; cette portion currente se coude, décrit un cercle complet (anse ou boucle latérale) et revient au-dessus de la portion currente en étant en rapport avec la valve dorsale; elle se termine enfin par une sinuosité dirigée vers la bouche. C'est là le rudiment de la portion spirale, qui est assez développée chez les *Megerlia* et beaucoup plus marquée chez les Terebratula. L'appareil brachial ressemble donc à celui du Platidia anomioides; mais la boucle est moins large, par rapport aux boucles latérales. Les cirrhes des bras sont assez longs et disposés par paires, ou plutôt chaque cirrhe semble se diviser en deux filaments égaux. Ce caractère a été représenté, chez le Platidia anomioides par M. Davidson."

Owing to the extreme shortness of the peduncle, the ventral valve is kept so close to the object to which it is attached that the asperities or irregularities of the rock or shell are often reproduced upon it. This peculiarity is especially observable on the smaller valve of *Platydia anomioides*.

90. PLATYDIA DAVIDSONI, E. Deslongchamps, sp. (Plate XXI. figs. 23–27.)

Morrisia Davidsoni, E. Deslongchamps, Ann. & Mag. Nat. Hist. 2nd ser. vol. xvi. p. 443, pl. x. figs. 20 *a–d*, 1855; Seguenza, Mem. Soc. Ital. Sci. Nat. vol. i. p. 67, pl. viii. fig. 5, 1865; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, p. 212, 1859.

Terebratula (*Morrisia*) *Davidsoni*, L. Reeve, Conch. Icon. pl. x. fig. 42, 1861, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 184, 1861.

Platidia Davidsoni, Dall, Amer. Journ. of Conch. vol. vi. p. 143, 1870, and Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 192; P. Fischer, Brach. des côtes océaniques de France, Journ. de Conch. vol. xx. p. 163, pl. viii. figs. 3–9, 1872, and Etudes Conch. Marines du Dép. de la Gironde, Soc. Linn. Bordeaux, t. xxix. p. 170, 1874; Monterosato, Poche note sulla Conch. Mediterr. 1875, and Note sur les espèces du genre *Platidia*, Journ. de Conch. vol. xvii. p. 306, 1879.

Shell small, semicircular or transversely oval, often irregular in shape and unequilateral, wider than long, subpellucid, yellowish white. Dorsal valve flat and irregular, assuming the shape of the objects upon which it lies in close contiguity; concentrically striated, and perforated by rather large canals; deeply notched at the umbo by a large, wide, semicircular aperture, which constitutes almost the entire foramen. Hinge-line straight, a little shorter than the breadth of the shell. Ventral valve uniformly convex, cardinal angles rounded; beak short, slightly incurved, beak-ridges sharply defined, with a very narrow area or flattened space between them and the hinge-line, in the middle a very wide, rudimentary, obtusely angular fissure represents the foramen, on each side of which are two very narrow rudimentary deltidial plates. Shell irregularly concentrically striated, with numerous small asperities rising from its surface. Shell perforated by canals visible under feeble magnifying-power. Length 3 lines, breadth 5 lines. Valves articulating by means of teeth and sockets. Interior of the dorsal valve not completely known. Short cylindrical processes project into the interior of the shell from a little under each angle of the wide semicircular foramen, and from about the middle of the bottom of the valve arises a thickened pillar-shaped process or septum, curved towards the hinge, and forked at its extremity.

Hab. Found attached to large specimens of *Caryophyllia ramosa* from the coral-fisheries near Tunis, and at other places in the Mediterranean (E. Deslongchamps and Fischer); it was also dredged by the Marquis de Folin at Cap Breton (Landes) in 25-70 fathoms.

Obs. In exterior aspect this species quite resembles an *Anomia*. It is the largest form of the genus *Platydia* with which we are at present acquainted. It was well described in 1855 by M. E. Deslongchamps, and subsequently with greater detail by Dr. Paul Fischer in two memoirs already referred to. In his paper, M. E. Deslongchamps says:—The dorsal valve is at times very irregular, owing chiefly to the shortness of the peduncle. From a superficial examination of the animal in a dried condition my father and myself were enabled to convince ourselves that the labial appendages seem connected with the apophysary system by a kind of very delicate network, reminding one of the descending apparatus in *Thecidium*, which in some species is formed in its upper portion by a calcareous network freely suspended above the visceral cavity.

In his memoir on *Platydia*, published in the 'Journal de Conchyliologie,' vol. xii. p. 160, 1872, Dr. Paul Fischer describes and figures some good examples of *Platydia Davidsoni* dredged by the Marquis de Folin from the Fosse du Cap Breton, which I have also been able to examine through the liberality of the Marquis. In another paper, issued in the Actes Soc. Linn. Bordeaux, t. xxix. 1874, Dr. P. Fischer says (p. 171):—The brachial apparatus is supported by a little calcareous forked pillar rising from the middle of the dorsal valve. . . . The forked pillar is proportionally much longer than in individuals of similar dimensions of *Megerlia truncata*. *Megerlia truncata* can be so modified that the valves become moulded on their substratum; this is occasioned by the shortness of the peduncle, and therefore the peduncular aperture is found almost completely transferred to the dorsal valve—a malformation raised to the rank of a species by the name of *Megerlia monstruosa*, Scacchi; but even in this case we recognize the characters of the species at all ages, and at no stage do we find the rudimentary apophysis of *Platydia Davidsoni*. Dr. Fischer proceeds (*l. c.*):—The general arrangement of the brachial appendage, in *P. Davidsoni*, is extremely simple. On each side of the mouth proceeds a horizontal portion, which afterwards bends and forms an incurvature (boucle). It is continued on each side by the running portion directed from the beak of the valve towards the frontal margin, and connected with the dorsal valve; this part (portion currente) bends, describes a complete circle, and returns above the running portion, being in relation to the dorsal valve; it ends at last by a sinuosity directed towards the mouth. This is the rudiment of the spiral portion which is moderately developed in *Megerlia*, and much more marked in *Terebratula*. The brachial appendages (in *Platydia Davidsoni*) resemble therefore those of *Platydia anomioides*. The cirri of the arms are rather long, ... disposed in pairs, or rather each cirrus seems to be divided into equal filaments. This character has been represented by Mr. Davidson in *Platydia anomioides*.

The characters of *Platydia Davidsoni* are very remarkable. In *Megerlia* the peduncular opening encroaches a little on the dorsal valve, more especially in the variety *monstruosa*. In *Platydia anomioides* the foramen is almost entirely on the dorsal valve, and finally in *Platydia Davidsoni* the ventral valve is devoid of fissure, and its beak forms a median projection. This remark, however, is scarcely correct, for there exists under the beak an indication of a shallow fissure. There are, continues Dr. Fischer, important exceptions among the articulated Brachiopoda, since the perforated valve is not foraminated in *Platydia Davidsoni*. All these changes are produced by the shortening of the peduncle, which obliges the Brachiopod to live in close contiguity with a rock, and to reproduce the irregularity of the object upon which it is fixed. Since the above was written, M. E. Deslongchamps has described the different stages in the development of the loop in *Megerlia truncata*, and points out that at one stage the dissimilarity between it and *Platydia*, although apparent, is not so very great.

In *Platydia anomioides* the principal stems of the loop, after having become attached to the base of the hinge-plate, become fixed to the central pillar-shaped process arising from the bottom of the dorsal valve; but in *Platydia Davidsoni* these principal stems, in the specimens examined by M. E. Deslongchamps, Dr. Fischer, and myself, were either broken or absent; so that to ascertain their real condition more specimens will have to be examined hereafter.

Family THECIDIDÆ.

Genus THECIDIUM, Defrance, 1828.

We are acquainted with but two recent species of this genus, viz. *Thecidium mediterraneum*, Risso, 1826, and *Thecidium Barretti*, Woodward, 1864. The generic characters have been fully described under *Thecidium mediterraneum*. The animal and embryology of the last-named species have been admirably described and illustrated by Lacaze-Duthiers and others.

91. Thecidium mediterraneum, Risso. (Plate XXIII. figs. 12–22.)

Thecidea mediterranea, Risso, Hist. Nat. des Principales Prod. de l'Europe méridionale, t. iv. p. 394, pl. xii. fig. 183, 1826; Blainville, Dict. Sc. Nat. t. liii. p. 434, 1828; Deshayes, Encycl. Méth., Vers, t. iii. p. 135, 1830; Philippi, Enum. Moll. Siciliæ, vol. i. p. 99, pl. vi. fig. 17, 1836, and vol. ii. p. 70, 1844.

Thecidea? spondylea, Scacchi, Cat. Conch. Regni Neapolitani, p. 8, pl. ?, figs. 8–10, 1836.

Thecidea mediterranea, Desh. ed. Lamarck's An. sans Vert. vol. vii. p. 346, 1836; Anton, Verzeichniss Conch. p. 21, 1839; Küster, nov. ed. Chemnitz's Conch.-Cab. pl. 2 *c*. figs. 22–25, 1843; G. B. Sowerby, Thes. Conch. p. 371, pl. lxxiii. figs. 30–32, 1846.

Thecidea testudinaria, Michelotti, Desc. des Foss. Miocènes de l'Italie Sept. p. 79, pl. ii. fig. 26, 1847.

Thecidea mediterranea, O. G. Costa, Fauna del Regno di Napoli, p. 19, pl. ix. figs. 1–3, 1852; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 371, 1852; A. Adams, The Genera of Recent Mollusca, p. 581, pl. cxxxii. fig. 1, 1858.

Thecidium mediterraneum, Davidson, Brit. Foss. Brach. vol. i. Introduction, p. 77, fig. 29, 1853; Woodward and Gray, Catalogue of the Brachiopoda in the British Museum, p. 118, 1853; S. P. Woodward, A Manual of the Mollusca, p. 221, fig. 128, 1856; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, Bd. xxxvii. p. 216, 1859; Lacaze-Duthiers, Histoire de la Thécidie mediterraneum, Ann. des Sciences Nat. 4e sér. Zool. vol. xv. p. 259, pls. 1–5, 1861.

Terebratula (*Thecidea*) *mediterranea*, L. Reeve, Conch. Icon. pl. xi. fig. 18, 1861, and Ann. & Mag. Nat. Hist. 3rd ser. vol. vii. p. 186, 1861.

Thecidea mediterranea, Vérani, Zool. des Alpes Maritimes, Nice, 1862; Chenu, Manuel de Conch. vol. ii. p. 212, figs. 1087–1089, 1862.

Thecidium mediterraneum, Davidson, Geol. Mag. vol. i. p. 14, pl. i. figs. 1–3, pl. ii. figs. 5–10, 1864; E. Deslongchamps, Recherches sur l'organisation du Manteau chez les Brachiopodes Articulés, p. 31, pl. iii. figs. 10–12, Caen, 1864; H. C. Weinkauff, Die Conch. des Mittelmeeres, p. 291, 1867; Dall, Amer. Journ. of Conch. vol. vi. p. 151, 1870, and Proc. Acad. Nat. Sci. Philadelphia, p. 195, 1873; Gwyn Jeffreys, Proc. Zool. Soc. 1878, p. 412, & 1881, p. 919.

Shell small, somewhat pyriformly ovate, variable in shape, thick, attached to marine objects by a portion of the beak of the ventral valve. Colour dead white. Dorsal valve thin, semicircular, slightly truncated in front; hinge-line straight, shorter than the breadth of the shell, gently convex, most so at the umbo, flattened near the margin. Ventral valve more or less regularly pyriform, very convex, thickened, longitudinally depressed along the middle; beak callous, much produced, irregular on account of the position and extent of its attached surface; area large, triangular, flat, with a slightly raised, flattened, triangular pseudo-deltidium; no foramen; shell-structure punctate. Surface of valves smooth, marked with concentric lines of growth. In the interior of the dorsal valve the hinge-plate is large, squarely oblong, prominent, and concave. There exists outside each of the socket-depressions an oval muscular scar, attributed by Lacaze-Duthiers to his "lateral adductor muscles" (adjustors of Hancock). A broad, thickened, sloping, granulated margin encircles the valve, and forms a bridge (Plate XXIII. fig. 16, *h*) over the small deep visceral cavity, and close to the basis of the hinge-plate, or cardinal process. The granulations are larger and most prominent as they recede from the outer margin. This inner denticulated or granulated margin follows in a parallel manner the margin of the shell from the bridge-shaped process (*h*) until it nearly reaches the middle of the frontal (*e*), where it suddenly stops and becomes inflected upwards. At the point (*c*) the margin is again directed upwards, producing a second parallel curve, when at (*e*) by another downward curve it forms a third short parallel concave curve, until it reaches the point (*f*) near the centre of the valve, where it combines with the similar inflections of the other half of the shell, so as to produce on the median line an upwardly produced tongue-shaped process (*g*), the angular extremity of which is directed towards the middle of the bridge-shaped process (*h*). These four symmetrically bent ridges or lobes constitute M. E. Deslongchamps's "ascending apparatus," the central portions (*f* and *g*) are more elevated than the other parts, and overlie a portion of the visceral cavity. The parallel grooves or spaces left between the ridges above described are partially occupied by a lamella in the shape of a double crescent (*i* and *k*), of which the larger branches (*i*) partly occupy the large cavities left between the first and second ridges, these being on their inner sides intimately united with the sides of the grooves; while the shorter branches (*k*) are freely suspended over the visceral cavity, and occupy the spaces left between the third and fourth ridges of the ascending apparatus. To these crescent-shaped lamellæ M. Deslongchamps has given the name of "descending apparatus." The interior of the ventral valve is concave and deep, with a small longitudinal, rounded, mesial elevation; the hinge-line is straight, and on each side at the base of the deltidium strong hinge-teeth for the articulation of the valves are situated. The beak is hollow; but there exists on the median line, and far back in the cavity, a small elevated septum, to each side of which is attached a very small thin concave plate (Plate XXIII. fig. 15, *b*), to which, according to M. Lacaze-Duthiers, the adductor muscle, or "occlusor" of Hancock, was attached. On the bottom of the valve, a little lower down, and on each side of the mesial elevation, and partly under the cavity of the beak, a large pyriform scar is observable, to which the "divaricator muscles" of Hancock were attached (*c*); and, lastly, external to these, on the bottom of the valve, and near the angles of the hinge-line, there exists a small oval scar (*a*), which is believed to have been produced by the "ventral adjustor" of Hancock. The remaining surface of the shell is closely covered with numerous granulations or asperities. Length 3 lines, breadth $2\frac{3}{4}$, depth 2 lines.

Hab. Mediterranean, especially on the African coast, in from 30 to 300 fathoms. Bay of Naples; off the coast of Sicily. Algerian coast, from Bône to near Cape Rosa. Off Jamaica, 60 to 150 fathoms (L. Barrett). In the Gulf of Mexico ('Blake' Expedition), 163 fathoms. It is also stated by Sir H. Barkly to occur off Mauritius; but this statement must be taken with reserve.

Thecidium mediterraneum occurs fossil in the Miocene and Pliocene rocks of Italy.

Obs. The animal and its embryology have been admirably described and illustrated by M. Lacaze-Duthiers. We extract the following notes from his important paper:—

Relative to the muscles, M. Lacaze-Duthiers states that there are three pairs, six in all, possessing distinct directions and functions. Of these muscles, two (woodcuts, figs. 16, 17, 18, *a*) are lateral, short, wide, easily observable, and serve without doubt for the occlusion of the shell. These are M. Lacaze-Duthiers's "muscles adducteurs latéraux ou externes," which, Mr. Hancock informs me, would represent his "adjustors," but that the function of this pair of muscles does not appear to be exactly similar to the "adjustors" of *Waldheimia*, in which they move the shell upon the pedicle; in *Thecidium* they assist in closing the valves suddenly, and in preventing any irregular or lateral movements which, from the central position of the occlusors, might be liable to take place. In fact, he believes that the function of the "adjustors" in *Thecidium* is modified much as it is in the same muscles of *Lingula*; and he is therefore inclined to conjecture that the two valves of the former are not so firmly hinged as they are in the other articulated forms. The second pair of muscles (*b* of woodcuts) are those nearest to the median line; these are termed "muscles adducteurs internes" by M. Lacaze-Duthiers, and correspond, or are equivalent to, Mr. Hancock's anterior or posterior occlusors. In the *ventral valve* these muscles would be fixed to the bottom of the valve, nearly under the extremity of the tongue-shaped "ascending shelly process" already described (Plate XXIII. fig. 16, *g*), and be again attached to the two thin shelly processes (Plate XXIII. fig. 15, *b*) which we have described

Fig. 16.

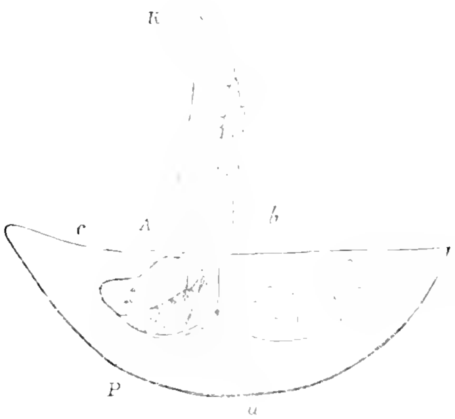


Fig. 17.

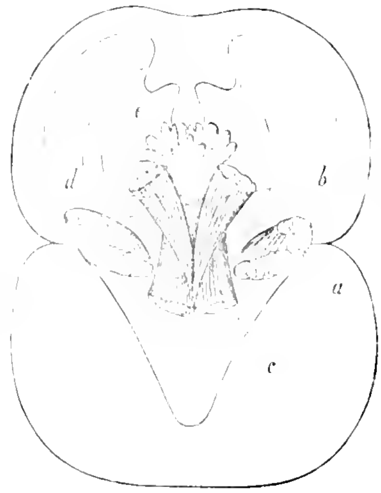
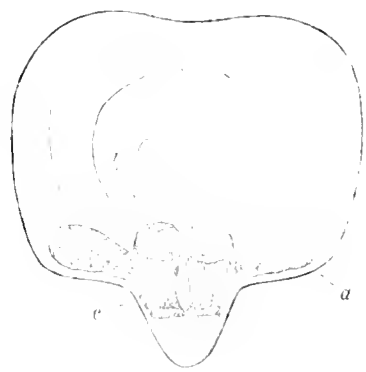


Fig. 18.



After Lacaze-Duthiers, 'Annales des Sciences Naturelles,' Zool. t. xv. pl. i. figs. 7, 8, 9.

Fig. 16. Longitudinal section of *Thecidium*, to give an idea of the manner in which the median muscles act: *a*, curved lamellæ, which are supported by and attached to a small septum under the beak in the ventral valve; *b*, median adductor muscle of Lacaze-Duthiers (= occlusor of Hancock); *c*, adductor muscle of Lacaze-Duthiers, which is attached by one extremity to the bottom of the ventral valve, and by the other end to the extremity of the quadrilateral cardinal process of the dorsal valve. M. Lacaze-Duthiers states that the mechanism of the opening and occlusion of the shell can be thus formulated: when the animal wishes to open its shell, the power, P, is represented by the muscle (*c*), its point of application being at the extremity of the cardinal process of the ventral valve; the resistance, R, is the weight of the valve which has to be raised; the point of support is found at A: we have, thus represented, a lever of the first kind. When the shell has to be closed, the same analysis would be applied to the lateral muscles, reversing, however, the power and the resistance, the point of support being always at the articulation A.

Fig. 17. Animal, with the lobes of the mantle spread out, viewed from the side of the shell so as to exhibit M. Lacaze-Duthiers's (*a*) muscles adducteurs latéraux (Hancock's adjustors); *b*, Lacaze-Duthiers's "muscles abducteurs médians" (Hancock's occlusors), of which one extremity passes between the "muscles abducteurs" (*c*), and the other is directed outwardly to make room for the intestine (*d*) which is the continuation of the lobes of the liver (*e*); *c* is Hancock's divaricator.

Fig. 18. Animal, separated from the shell, and seen on the face which corresponds to the concave valve: *a*, lateral adductor muscle of Lacaze-Duthiers; *b*, median adductor muscle, of which the extremity only can be seen, which attaches itself to the bottom of the lamellæ under the beak of the ventral valve; *c*, adductor muscle slightly curved, of which the two extremities can be seen.

as existing in the cavity of the beak. The function of these muscles (as stated by M. Lacaze-Duthiers) would also be to effect a closing of the valves, but less efficaciously than the preceding pair. The third pair, designated "muscles abducteurs" by the same author (woodcuts, figs. 16, 17, 18, *c*), are Mr. Hancock's "divaricators," and their function would be to open the valves. They form large impressions on the bottom of the ventral valve, on each side of the central septum (Plate XXIII. fig. 15, *c*) and have their outer end attached to the extremity of the cardinal process of the dorsal valve. M. Lacaze-Duthiers has had the opportunity of studying a vast number of individuals of this species of *Thecidium* in the living state; and he mentions that, contrary to what we find to be the case in *Terebratula*, the animal opens its shell very widely—the dorsal valve rising on its hinge at right angles to the ventral valve, like the lid of a snuff-box (woodcut, fig. 16, *c*). The animal is also sensible to light and darkness; and it draws down its smaller valve with the rapidity of lightning on the approach of danger.

M. Lacaze-Duthiers further observes that the *mantle* is exceedingly thin, and is not furnished round the margin with any of the long setæ which exist in *Terebratula* and *Lingula*, and that the genital lobe (the one which corresponds to the concave or ventral valve) differs much from the other, and is characterized in its thickest lobe, or central portion (that is to say, towards the deep and concave portion of the valve), by very thick calcareous plates, the analogues of the plates and spicula occurring in the mantle of *Terebratula*. These plates in *Thecidium* participate in the character of the shell itself, being smooth on the under surface, and covered on the upperside with asperities similar to those which cover the entire surface of the bottom of the valve. The plates are very thick, and form a ceiling or vault over the cavity which contains the organs of reproduction. They have been carefully described and figured by M. J. Bosquet, M. E. Deslongchamps, and myself, as seen in several fossil species, and in particular in *Thecidium vermiculare*, from the Upper Cretaceous beds of the Duchy of Limbourg.

M. E. Deslongchamps says, at pp. 30, 31 of his memoir on the Organization of the Mantle in the Articulate Brachiopoda:—In short, the Thecidiidæ possess an altogether peculiar organization of the mantle. Calcareous spicules crowding the external laminæ are no longer present, but true calcareous plates which obliterate almost the whole interior, and form, as it were, a second shell, line the interior of the valves, and give them a most strange and elegant appearance. We will not now repeat the details of the conformation of these curious laminæ constituting the pallial apparatus, which can, it would seem, be better studied in the fossil than in the recent species, and of which a large number of authors have given excellent descriptions. We will only mention that this apparatus undergoes very great modifications in different species, being sometimes excessively complicated, as in *T. recurvirostris*, ... whilst in others this apparatus is reduced to an indistinctly marked single lamella, as in *T. Perrieri*. . . . . .

Another very striking peculiarity is revealed to us in the organization of the tissues of *Thecidea mediterranea*. We have seen hitherto, except in *Argiope*, which formed the exception, that it was in the arms and their cirri that the calcareous spicula were especially developed, and that it was in these organs that they began to appear in the earliest stages of the shells, extending progressively on the two laminæ of the mantle. We note that precisely the contrary occurs among the Thecididæ. The mantle is no longer, so to say, merely a calcareous mass, and the arms and their cirri do not show the smallest trace of spicula or even of calcareous granulations. . . . . It is apparent that the arms constitute a simple diaphanous membrane, which is rather difficult to distinguish even by a feeble magnifying-power, as the walls are so delicate; whilst the calcified portion of the mantle is very thick, of a dull white colour, apparently of a spongy nature, and under the same enlargement seems to us much more compact than even the walls of the shell. In order to realize the diverse condition of the mantle thus calcified, we must call to our aid high magnifying-power.

M. Lacaze-Duthiers states, in the work previously quoted, that the so-termed "oral arms" or labial appendages of *Thecidium* resemble those of other Brachiopoda, except that they are not free, but adhere throughout their extent; that the swollen basis certainly presents a canal similar to that which exists in the other animals of the same group, and that this longitudinal canal is present throughout their length, being almost confounded with the mantle, or with the margin of the body, and is even located in the insertion of the arms. These "arms" are inserted by their basis, not on the intermediate or lateral lamella, or external lamella ("descending crescent-shaped processes"), but on the edge of the "ascending apparatus." Their direction is that of the lamina on which they are supported; and they reach, after having described the inflections already indicated, the median point of the tongue-shaped process, where their two extremities are located. This arrangement is shown in Pl. XXIII. fig. 16, which is copied from one I published first in the 'Annals and Magazine of Nat. Hist.' for May 1852, and afterwards reproduced in Dr. Woodward's 'Manual of the Mollusca.' The cirri of the arms are long and flexible.

Space will not permit us to follow M. Lacaze-Duthiers in his admirable observations in connection with the anatomy of the animal, further than to say that he minutely describes the position of the animal in the shell, the mantle, muscles, the organs of nutrition, the arms and their cirri, the mouth and its lips, the liver, stomach, intestines, circulation, respiration, the special glands, nervous system, the male and female organs of reproduction, &c. He adds, that French zoologists consider, with some other naturalists, that respiration is probably effected partly by the labial appendages, which bear a great analogy to the gills of other Mollusca, and that he has not been able to discover any anal aperture—a fact strongly urged by Messrs. Huxley, Hancock, Gratiolet, and others for *Terebratula* and *Rhynchonella*. M. Lacaze-Duthiers is of opinion that the sexes are distinct, or, in other words, that there is a male and female animal; but Mr. Hancock considers this to be uncertain, and is disposed to hold the opinion that the sexes are combined in the same animal.

M. Lacaze-Duthiers concludes his elaborate series of anatomical observations with many important details in connection with the embryonic condition of *Thecidium mediterraneum*, but states that it was not possible for him to follow out in a complete manner every successive stage of its development. The youngest egg that he was able to observe had already acquired a rather elongated pyriform shape, and what attracted most notice was the large size of the cells of which it was composed, which also contained a large quantity of granulations, of a comparatively enormous size. The egg at this stage is very similar, at least in general appearance, to a mass of vegetable cells full of feculæ. Towards one of the extremities of the egg the connection with the bourlet or cap of the suspensory filaments may be found, and however little the glass slides are shaken between which the embryos are placed they become ruptured, and the cells and granulations that they contain escape.

In the next stage which M. Lacaze-Duthiers found in the same group of young, the embryo no longer presented a uniform mass, but was divided into two halves, one of which, more voluminous than the other, was in every case found attached to the upper filament.

After many details which I have not space to reproduce, M. Lacaze-Duthiers concludes by saying (p. 324) :—On the lower face, an embryo in the more advanced state shows four eye-shaped spots, visible in the thickness of its anterior intermediary lobe. A distribution of yellowish matter recalls tolerably well the origin of the liver in the Acephala or the Gasteropoda; it is probably in the middle of these small agglomerations of yellowish matter that the stomach is excavated, and one may already recognize in these series of little bundles the lobules and secretory glands of the liver of the adult *Thecidium*. We have reproduced on Plate XXIII. a few of M. Lacaze-Duthiers's admirable illustrations of the embryo with two and four lobes.

92. THECIDIUM BARRETTI, Woodward, MS. (Plate XXIII. figs. 9–11.)

Thecidium Barretti, Davidson, Geol. Mag. vol. i. p. 17, pl. ii. figs. 1, 2, 3, 1864; Crosse, Journ. de Conch. 3e sér. t. vi. p. 272, 1866; Dall, Amer. Journ. of Conch. vol. vi. p. 151, 1870, Bull. Mus. Comp. Zoöl., Harvard, vol. iii. p. 42, 1871.

Shell small, somewhat pyriformly ovate, attached to marine objects by a portion of the back of its beak. Dorsal valve semicircular, flattened, and slightly convex at the umbo. Ventral valve somewhat pyriform, very convex, deep, and thickened; beak moderately produced; area triangular, but more or less irregular on account of the position and extent of the attached surface. The interior of the dorsal valve is slightly concave, with an oblong, square-shaped, prominent, cardinal process between the dental sockets. A broad, thickened, raised, granulated margin encircles the valve, and forms a bridge over the small, deep, visceral cavity, close to the basis of the cardinal process; the granulations are larger and more prominent on the inner margin. On reaching the front, near the middle, the margin suddenly curves upwards on each side, and unites so as to form a central Λ-shaped ascending process (*g*), the attenuated extremity of which is directed towards the middle of the bridge-shaped process (*h*) already described in *Thecidium mediterraneum* (see Pl. XXIII. fig. 16). The descending apparatus (*i*, *k*) is united close to the extremity of the central angular ascending process, and follows at a little distance the curves of the inner margin of the same ascending process. Length and breadth about 2 lines. Colour white.

Hab. This small and well-characterized species was obtained by Lucas Barrett at 60 fathoms off the north-east coast of Jamaica, and was found fossil by him in the newest Pliocene beds of that island.

Obs. In external shape *Thecidium Barretti* cannot be distinguished from the Mediterranean species; but its interior is very different, and resembles, in its simple arrangement, that of several Jurassic forms, such as *Thecidium Moorii*, *T. triangulare*, &c.

Family RHYNCHONELLIDÆ.

The genus *Rhynchonella*, Fischer, 1809, and the genus *Atretia*, Gwyn Jeffreys, are the only representatives of this family found in the recent state.

The genus *Rhynchonella* is one of the oldest types of life, and has been largely represented since Silurian times. Six species are still living in the present seas, viz.:—

1. *Rhynchonella psittacea*, Chemnitz, 1780.
2. —— *nigricans*, Sowerby, 1846.
3. —— *lucida*, Gould, 1860.
4. *Rhynchonella cornea*, Fischer, 1885.
5. —— *Grayi*, Woodward, 1855.
6. —— *Döderleini*, Davidson, 1885.

The first two species are very abundant, the others much less so. Of the spiny *Rhynchonella Döderleini* four specimens have been dredged, and we are only acquainted with a single example of *Rhynchonella Grayi*. The shell in all is fibrous and impunctate. The genus *Rhynchonella* is characterized by a very insignificant development of internal septa. In the ventral valve generally only dental plates are present, which do not unite in the middle line, and in the dorsal valve an inconspicuous median septum is developed. The hinge-plate is deeply divided, supporting two slender curved lamellæ. The animal has elongated spiral labial appendages, directed inward towards the concavity of the dorsal valve. Mantle not adhering, its margin fringed with a few short setæ.

93. RHYNCHONELLA PSITTACEA, Chemnitz, sp. (Plate XXIV. figs. 1–11.)

Anomia, Lister, Hist. sive Syn. methodicæ Conchyliorum, tab. 211. fig. 46, 1685.

Bec de perroquet. Davila, Cat. Syst. vol. i. pl. xx., 1767.

Anomia ——?, Lister, Conch. tab. ccxi. fig. 46, 1768; Favanne de Montcervelle, La Conchyliologie, pl. xli. fig. 24, 1780.

Anomia rostrum psittacea, Chemnitz, Neues syst. Conch.-Cab. vol. viii. pl. lxxviii. fig. 713, 1785.

Anomia aquilina, Solander, MS. no. 14, 1757.

Lampas psittacei, Calonne, Catalogue of the various articles which compose the Coll. of M. de Calonne, 1797.

Anomia psittacea, Gmelin, Linn. Syst. Nat. p. 3349, 1788.

Anomia ——, d'Argenville, Hist. Nat. Conchyliologie, etc. tab. 23.

Terebratula psittacea, Bruguière, Encyclop. Méth. pl. ccxliv. figs. 3*a*, 3*b*, 1789; Klein, Tentamen Methodi Ostracologicæ, pl. xii. fig. 84, 1753.

Anomia psittacea, Dillwyn, Descriptive Catalogue of Recent Shells, p. 293, 1817.

Terebratula psittacea, Lamarck, An. sans Vert. vol. vi. p. 248, 1819.

Anomia psittacea, Turton, A Conch. Dictionary of the British Islands, p. 5, figs. 42–44, 1819.

Terebratula psittacea, Fleming, Hist. of Br. An. vol. i. p. 368, 1828.

Gypidia psittacea, Menke, Syn. Meth. Moll. p. 96, 1828–30.

Terebratula psittacea, Blainville, Dict. Sci. Nat. t. liii. p. 140, 1828; Möller, Index Moll. Grönlandiæ, Nat. Tidsskr. iv. p. 76; Owen, On the Anatomy of *Terebratula*, Trans. Zool. Soc. vol. i. p. 146, pl. xxii., 1833; Quenstedt, Ueber das Oeffnen und Schliessen der Brachiopoden, Wiegmann's Archiv, Bd. ii. p. 220, pl. iv. figs. 5 & 6, 1835; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. xvi. p. 436, 1855; Lamarck, An. sans Vert. vol. vii. p. 333, 1836; Anton, Verzeichniss der Conchylien, p. 23, 1839; G. B. Sowerby, A Conch. Manual, p. 203, 1842; Küster, Chemnitz's Conch.-Cab. vol. vii. pl. ii. figs. 18–20, 1843; Sowerby, Thes. Conch. p. 342, pl. lxxi. figs. 78–80, 1846.

Hypothyris psittacea, King, Ann. & Mag. Nat. Hist. vol. xviii. p. 238, 1846.

Hemithyris psittacea, d'Orbigny, Considérations Zool. sur les Brachiopodes, Comptes Rendus, t. xxv. p. 268, 1847.

Hypothyris psittacea, Forbes & Hanley, A History of British Mollusca, vol. ii. p. 346, pl. lvii. figs. 1–3, 1849.

Rhynchonella psittacea, Quenstedt, Handbuch der Petrefaktenkunde, pl. 35. fig. 44, 1851; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 374, 1852; L. Barrett, Ann. & Mag. Nat. Hist. 2nd ser. vol. xvi. p. 259, 1855; S. P. Woodward, A Manual of the Mollusca, p. 225, figs. 138 & 139, 1856; A. Adams, The Genera of Recent Mollusca, vol. ii. p. 582, pl. cxxxii. fig. 2, 1858; A. Hancock, On the Organization of the Brachiopoda, Phil. Trans. vol. cxlviii., 1858; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, p. 218, 1859; L. Reeve, Monogr. of Rhynchonella, pl. i. fig. 2, 1861.

Hemithyris psittacea, M'Coy, Synopsis of a Classification of the British Palæozoic Fossils, p. 199, 1865.

Rhynchonella psittacea, Gwyn Jeffreys, British Conchology, vol. v. p. 164, 1869, and Proc. Zool. Soc. 1878, p. 413; Gould, Report on the *Terebratulæ* of Massachusetts, p. 210, fig. 501, 1870.

Hemithyris psittacea, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 196.

Rhynchonella psittacea, Davidson, Brit. Foss. Brach. vol. iv. pp. 8 & 16, pl. ii. fig. 5, 1874; G. O. Sars, Moll. Regionis Arcticæ Norvegiæ, p. 9, t. i. fig. 1, 1878; Whiteaves, Canadian Naturalist, vol. viii. no. 8, 1878; G. Dunker, Index Mollusc. maris Japonici, p. 253, 1882; Davidson, Brit. Fossil Brach. vol. v. p. 331 etc., 1884.

Shell somewhat triangular, globose, broadest anteriorly, tapering posteriorly, lateral margins rounded. Dorsal valve inflated, especially at the umbo, more or less divided into three lobes, of which the central one forms a mesial fold, scarcely defined in some specimens, much more so in others; front line nearly straight or three-lobed. Ventral valve much less convex than the dorsal one, rather flattened, with a broad, channelled, flattened, longitudinal mesial sinus; beak sharply pointed, incurved, under which is situated an incomplete elongated foramen, margined anteriorly by the umbo, and laterally by triangular deltidial plates; beak-ridges not sharply defined; lateral margins of the valves sinuous, curved in front. Surface of valves radiately and finely striated. Shell-structure fibrous. Valves strongly articulated by curved teeth in the ventral valve, fitting into sockets in the dorsal one. Hinge-plate in the dorsal valve deeply divided, supporting two short, flattened, grooved and curved lamellæ. At the bottom of the dorsal valve are seen the quadruple muscular impressions left by the adductor or occlusor muscles, each pair being separated by a short medio-longitudinal ridge. In the interior of the ventral valve the teeth are supported by dental plates extending to the bottom of the valve, and at their base a semicircular ridge on either side encloses a saucer-shaped depression in which are situated the muscular scars. Close under the beak the peduncular muscles leave a small scar; lower down and towards the centre of the valve is situated a divided heart-shaped scar due to the adductor or occlusor muscles; and on each side of these are situated, one above the other, the divaricator and ventral adjustor muscular impressions. The animal is provided with elongated spiral arms, directed inwards, towards the concavity of the dorsal valve; alimentary canal terminates behind the insertions of the adductor in the ventral valve; mantle not adhering, its margin fringed with a few short setæ. Colour bluish or a brown-black. Length 1 inch 3 lines, width 1 inch 1 line, depth 9 lines.

Hab. Rhynchonella psittacea is circumpolar in its distribution. It was dredged in Franklin-Pierce Bay, lat. 79° 25′ N., in 15 fathoms, and at Cape Napoleon in 15 fathoms, by Nares's Arctic Expedition in 1875, being in fact the only Brachiopod obtained by the 'Alert' and 'Discovery' in those polar regions. *R. psittacea* abounds in the

Norwegian Seas, from Drontheim to the North Cape; off Shetland; Grand Grève, Gaspay Bay, Canada East; Unalashka to Shumagins in the Aleutian Chain (Dall); Banks of St. Margaret Bay; Russian Lapland to Sitka; from Behring Strait to Japan in North Pacific; in the Gulf of St. Lawrence, Canada, and in several other places.

Fossil. It occurs in the Upper Tertiaries of Great Britain, Ireland, Scandinavia, Canada, Sicily, south of Spain, &c.

Obs. Until 1809, when Fischer de Waldheim proposed his excellent genus *Rhynchonella*, the shell under description had been described under the fancy and generic names of "*Bec de perroquet*," *Anomia* and *Terebratula*; since then sometimes by those of *Hemithyris*, *Hypothyris*, *Lampas*, and *Gypidea*; but Fischer's name *Rhynchonella* is the generic designation by which the shell has been generally known, and that which should hold priority over all others.

Rhynchonella psittacea does not vary very much in external shape; young specimens are, however, more triangular, less convex, and with a more elongated triangularly shaped beak. The dorsal valve in some adult examples is uniformly convex, while others show a well-defined mesial fold. The intimate structure of the shell of *Rhynchonella* has been carefully studied, described, and illustrated by Dr. W. B. Carpenter in various papers. He says:—"No one who examines the shells of the Recent *Rhynchonella psittacea* and *Rh. nigricans*, even in the most superficial manner, can have any hesitation in recognizing the entire absence of the superficial 'punctuations' which mark the orifices of the shell-canals in the recent species of *Terebratulidæ*; and the most careful microscopic examination of these sections of the shell, taken from any part and in any direction, does but confirm this conclusion. . . . In all other respects the intimate structure of the shell corresponds precisely with that of *Terebratulidæ*; but it may be mentioned that the prismatic laminæ are less adherent to each other than in the perforated shells, so that they are readily split asunder." ('On the Intimate Structure of the Shells of Brachiopoda,' Palæontological Society, p. 35, 1851.)

The animal of *R. psittacea* and its anatomical characters were carefully described by Richard Owen in 1833, and especially by Albany Hancock, in his admirable memoir "On the Organization of the Brachiopoda," in the Philosophical Transactions of the Royal Society for 1858. We are likewise indebted to Prof. T. H. Huxley for several valuable anatomical details published in vol. vii. of the Proceedings of the Royal Society for 1854, as well as to several other distinguished zoologists. In 1835 Quenstedt, in Wiegmann's Archiv, Bd. ii. p. 220, founding his views on very precise reasons derived from the mode of attachment of the valves in *Rhynchonella psittacea*, pointed out the two orders of muscles, of which one closed, while the other opened the valves.

Mr. Lucas Barrett informs us that he found *Rhynchonella psittacea* very difficult to examine, the animal being extremely timid and closed its valves on the slightest movement; the coiled arms are extended, so that the cirri come as far as the margin of the shell, but it never protruded its arms *.

In *Rhynchonella psittacea*, as well as in other species of the genus, the elongated spiral appendages are supported at their origin only by two short, curved, projecting calcareous

* Annals & Mag. Nat. Hist. 2nd ser. vol. xvi. p. 259, 1855.

processes; they can be unrolled at the will of the animal and protruded to some distance beyond the margins of the valves, contrary to the statement made by Barrett. When forcibly stretched out they are said to be more than four times the length of the shell, and support some 3000 cirri. In a note on the extension of the coiled arms in *Rhynchonella psittacea*, published in the 'Amer. Journ. Sci. & Arts,' 3rd ser. vol. xvii. 1879, p. 257, Prof. Morse says:—"Years ago von Buch recorded that Otto Frederic Müller had observed *Rhynchonella psittacea* protrude its arms beyond the anterior borders of the shell. This single observation was not widely accepted, and many doubted the possibility of the arms being exerted in this manner. In the year 1872, while studying living Rhynchonella in the St. Lawrence, I observed a specimen protrude its arms to a distance of four centimeters beyond the anterior borders of the shell, a distance nearly equaling twice the length of the shell. This year I again had an opportunity of studying Rhynchonella in Hakodate, Yesso, and again observed the same features. Specimens lying on the bottom of a glass dish protruded their arms a short distance, and remained in this position for hours. .... The movements of the arms were very sluggish, though the cirri were constantly in motion. Sometimes the shells closed upon the arms before they were retracted."

In 1833 Owen (*l. c.*) gave a figure in illustration of the arms, one of which has been artificially unfolded. Space will unfortunately not admit of my reproducing all the admirable details in connection with the anatomy of *R. psittacea* so well described and illustrated by A. Hancock; we will, however, refer to the most important features.

"In *Rhynchonella psittacea* (p. 799, *l. c.*) the general disposition of the muscles is the same as in *W. australis*, only they are longer and more slender, particularly the occlusors, which, with the exception of their extremities, are thin and tendinous. The surfaces of attachment also vary a little in form, as can be readily seen on removing the shell. The extremities of the muscles are then observed, as usual, at the ventral surface of the animal, clustered together, a little in advance of the umbonal region. The occlusors are almost colourless, narrow and elongated, and have their anterior margins united on the median line; posteriorly they diverge, leaving a space between them, in which the terminal extremity of the intestine is seen. The divaricators are very large, and are placed external to, and in contact with, the occlusors; they are broad and fan-like in front, exhibiting radiating divisions, and meet on the median line, in advance of the occlusors. Behind they are produced and pointed. The ventral adjustor muscles have their extremities narrow and much elongated; they rest against the external margin of the divaricators, are enlarged a little, and converge posteriorly. Unlike *Waldheimia*, there is here *a pair* of peduncular muscles seen at the sides of the umbo, having between them the accessory divaricators, which are of a somewhat triangular form. The dorsal terminations of the occlusors present nothing remarkable in their appearance. All the extremities of the muscles seen at the surface of the animal are of a yellowish-red colour, except those of the peduncular muscles and the ventral terminations of the occlusors . . . The muscles (*l. c.* p. 805) in the *Terebratulidæ* and *Rhynchonellidæ* are peculiar for their enlarged, fleshy extremities, and for the attenuated, tendinous character of their intermediate portions . . .

"The arms [p. 802] of *R. psittacea* are totally deprived of calcareous support except at their origin, where they are sustained by the two hinge-processes, or oral laminæ, the points of which reach as far forward as their external margins. They fill up the greater portion of the pallial chamber; and in their arrangement accurately resemble the calcareous spirals of *Atrypa reticularis*, a Silurian fossil, only their approximate sides are not flattened. The arm throughout is composed of a slightly depressed tube or canal, carrying along its outer margin the semi-cartilaginous grooved edge, bearing the fringe of cirri as in *W. australis*. The brachial fold in front of the groove is largely developed, and completely overlaps it. The tube or the great brachial canal terminates at the side of the œsophagus in a delicate membranous sac of no great extent, which projects into the perivisceral chamber, as first noticed by Prof. Huxley . . .

"The parietes of the great canal are somewhat stouter than in *W. australis*; the muscular fibres, however, are arranged in the same manner as in it, but are more numerous, particularly the longitudinal ones, which form a well-defined band towards the proximal extremity of the arm . . . . A large development of the brachial apparatus seems necessary in the economy of the animal, and the various ways in which it is folded up and disposed within the pallial chamber are only so many methods of arranging within a limited space the requisite extent of organ."

Mr. Hancock seems to doubt the unrolling and projection of the arms in *Rhynchonella* or that the arms are in any way instrumental in opening the valves.

"In *R. psittacea* [p. 814] the disposition of the alimentary canal is the same as in the *Terebratulidæ*. The œsophagus is, however, considerably longer than in *Waldheimia*, the mouth approaching much nearer to the ventral valve. The liver is larger than usual, and the biliary secretion is conveyed through the lateral walls of the cardiac extremity of the stomach by four short ducts, two at each side, one being placed a little in advance of the other.

"The intestine is rather long and gradually tapers downwards. On reaching the ventral valve, directly behind the extremities of the occlusor muscles, it turns backwards and upwards, and, detaching itself from the mesentery, advances a little, and terminates in a much enlarged, rounded extremity, which inclines to the right or left, varying in this respect in different individuals. The termination projects freely into the centre of the perivisceral chamber, and here, as in the *Terebratulidæ*, there is no anus; the bulbous enlargement is entire, exhibiting no opening whatever. . . . In *Rhynchonella* the gastro-parietal and ilio-parietal bands, particularly the latter, are longer than in *Waldheimia* . . . . The reproductive organs [p. 818] have much the same disposition in *Rhynchonella psittacea* [as in the other *Terebratulidæ*], but the dorsal genital sinuses are not connected with the so-called vascular trunks, while the ventral are. The genital band, too, which is yellow, is much more closely convoluted, having sometimes almost the appearance of being fused into one mass, the interstices being just sufficient to permit the passage of the muscular ties, which are stout, and are arranged in imperfect longitudinal and diagonal lines. These ties give a granulated or pitted appearance to the ovarian impression in the shell, and are worthy of the attention of the palæontologist. . . .

"There are two of these oviducts in all the Brachiopods that have come under my observation, except in *Rhynchonella*, in which there are four, as first pointed out by Prof. Huxley, ... two [p. 821] within the ventral, and two within the dorsal valve; both pairs are precisely similar, and are of a yellowish colour . . . . The central portion of the blood-system in *Rhynchonella* is arranged much as in the *Terebratulidæ* . . . . In *R. psittacea* [p. 829] the setæ are slender, short, and finely pointed; they vary in length, as they do indeed in all the species, and occasionally three or four issue out of one follicle . . . . The great cavity [of the perivisceral chamber], placed close to the hinge of the valves, in which the viscera are lodged, is limited above and below by the dorsal and ventral walls of the body, and in front by the inflections of the inner laminæ of the pallial lobes." In conclusion, Mr. Hancock describes at great length the nervous system, to which we cannot refer.

RHYNCHONELLA PSITTACEA, var. WOODWARDI, A. Adams. (Plate XXIV. figs. 12–13.)

Rhynchonella Woodwardii, A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 100, 1863.
Rhynchonella psittacea, var. *Woodwardi*, Davidson, Proc. Zool. Soc. 1871, p. 309, pl. xxxi. fig. 12.

Mr. Adams states in his paper that "this species differs from *R. psittacea* in being concentrically striolate instead of radiately grooved; the beak, moreover, is smaller and less curved; the foramen is more broadly triangular, and the ventral margin rounded and produced in the middle. The young possess the same characters seen in more adult specimens."

Hab. Gotto, 48 fathoms; also off Rifunsiri Islands, four miles from the shore, in 35 fathoms, from a bottom of coral, broken shells, and stones.

I have been able to examine two examples of this shell, given to me by Mr. Adams, and could distinctly perceive faintly radiating striæ, similar to those that cover the surface of *R. psittacea*. I cannot help thinking, and am confirmed in this opinion by Dr. Gwyn Jeffreys, that the *R. Woodwardi* of Adams is no more than a local variety of *R. psittacea*.

The specimens obtained by Mr. Adams are of a less bluish tint than we find usually in the shell last named, but some examples from the Northern European seas have also assumed that colour.

94. RHYNCHONELLA LUCIDA, Gould. (Plate XXIV. figs. 14–15 *b*.)

Rhynchonella lucida, Gould, Proc. Boston Soc. Nat. Hist. p. 323, 1860; Otia Conch. p. 120; and Proc. Boston Soc. Nat. Hist. vol. vii. p. 323, 1871; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, p. 219, 1859; A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 100, 1863; Dall, Amer. Journ. of Conch. vol. vi. p. 153, 1870; Davidson, Proc. Zool. Soc. p. 309, pl. xxxi. figs. 13–14, 1871.
Hemithyris lucida, Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 196, 1873.
Rhynchonella lucida, G. Dunker, Index Moll. maris Japonici, p. 253, 1882.

Shell small, obtusely subrhomboidal or ovate, rather longer than wide. Dorsal valve convex, almost gibbous; mesial fold wide, commencing to rise at about half the length of the valve. Ventral valve rather less convex, or deeper than the opposite one, and scooped out near the front in the form of a rather deep sinus. Beak acute, sharply incurved; foramen beneath the angular extremity of the beak, completed by a deltidium. Surface smooth; shell-structure fibrous. Colour light glassy grey. Length 6 lines, width 5 lines, depth 3 lines.

Hab. Dr. Gould's specimens were dredged off the coast of Japan, lat. 30° 35′ N., long. 130° 40′ E., in 100 fathoms, sand, by Capt. Stevens of the 'Hancock,' and by A. Adams at Satanomosaki in 55 fathoms, and at Gotto in 48 fathoms.

Obs. This very interesting species was first discovered by Dr. Gould, but he does not appear to have figured it. I did so, however, in 1871, from specimens given to me by Mr. Adams. In his description, Dr. Gould observes that his shell, which might be taken for a small *Terebratula vitrea*, is very thin and delicate, and further distinguished by the absence of punctures.

95. RHYNCHONELLA GRAYI, Woodward. (Plate XXV. figs. 1–1 *c*.)

Rhynchonella Grayii, S. P. Woodward, Ann. & Mag. Nat. Hist. 2nd ser. vol. xvi. p. 444, pl. x. figs. 16–16 *c*, 1855; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 219, 1859; L. Reeve, Conch. Icon., Monogr. of *Rhynchonella*, pl. xi. fig. 3, 1861; Dall. Amer. Journ. of Conch. vol. vi. p. 153, 1870.

Hemithyris Grayi, Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 196, 1873.

"Shell light horn-colour, dull, trigonal, depressed; sides rounded, front truncated; beak small, acute; valves smooth, obscurely marked by lines of growth, and strongly plaited near the margin with four central plaits and three or four on each side, the furrows obscurely striated; margins of valves sinuated in front and strongly toothed; foramen minute, completely tubular. Length nearly 8 lines, by 6½ in breadth and 4 in depth.

"This interesting and at present unique shell was sent, with other natural-history objects, from the Feejee Islands by J. M'Gillivray, Esq., Naturalist to the Surveying Expedition under Capt. Denham, of H.M.S. 'Herald.' No particulars as to its habitat have been received. It differs from the known species of living *Rhynchonella* in its lightness of colour, the others being black; in the plication of the borders of its valves, which reminds us of the fossil *Rh. subplicata* (Mantell), and *Rh. lineata*, Philippi, and especially it differs in having a foramen quite separate from the hinge-line, by the development and union of the two elements of the deltidium, in this respect agreeing with the ordinary adult condition of the fossil *Rhynchonellæ*. Were it not for the remains of the pedicle and traces of the mantle in its interior, we might have taken it for a pliocene fossil, being exactly similar in its colour and dull transparency to the specimens of *Rh. psittacea* found in the Crag at Norwich. The muscular impressions are like those of the type, and the interior has traces of unsymmetrical vascular markings."

The above description was sent to me for publication in 1855 by my valued and eminent friend Dr. S. P. Woodward; and I added figures of the shell to my paper "On Brachiopoda" published in the Ann. & Mag. Nat. Hist. for 1855. Singularly enough, no other example of the species has been discovered. The type forms part of the collection of shells in the Zoological Department of the British Museum.

96. RHYNCHONELLA NIGRICANS, Sowerby. (Plate XXIV. figs. 16–19.)

Rhynchonella nigricans, G. B. Sowerby, Proc. Zool. Soc. 1846, p. 91, and Thesaurus Conchyliorum, i. p. 342, pl. lxxi. figs. 81, 82, 1846; Davidson, Proc. Zool. Soc. 1852, p. 81, pl. xiv. figs. 30, 31, and Ann. & Mag. Nat. Hist. 2nd ser. vol. xvi. p. 445, pl. x. fig. 18, 1855; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. der Wissensch. Wien, p. 220, 1859; L. Reeve, Conch. Icon., Monogr. of

Rhynchonella, pl. i. fig. 1, 1861; E. Suess, Fossile Mollusken aus Neu-Sieland, Novara Exped. Geol. Theil, Bd. i. Abth. 2, p. 60, pl. xiv. fig. 6, 1864; Dall, Amer. Journ. of Conch. vol. vi. p. 152, 1870; Hutton, Catalogue of the Marine Mollusca of New Zealand, 1873, p. 87.

Hemithyris nigricans, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 196.

Rhynchonella nigricans, T. W. Kirk, List of Marine Mollusca found in the neighbourhood of Wellington, Transactions New Zealand Institute, vol. xii. p. 303, 1880.

Shell somewhat tetrahedral, wider than long. Hinge-line obtusely angular. Dorsal valve convex, divided into three lobes, of which the central one forms a broad, slightly raised mesial fold. Ventral valve rather less deep or convex than the dorsal one, with a broad mesial sinus commencing at about a third of the length of the valve and extending to the front; beak pointed and slightly incurved; foramen longitudinally oval, incomplete, and situated under the extremity of the beak, margined anteriorly by a small portion of the umbo and laterally by narrow deltidial plates; beak-ridges tolerably well defined, leaving between them and the hinge-line a narrow triangular flattened space. Surface of valves ornamented by a variable number of angular ribs, from twenty to twenty-five on each valve, a few of which are due to interpolation, while from five to six occupy the fold and sinus. Surface of valves crossed by numerous concentric lines, or projecting ridges, of growth. Colour bluish or brownish black; shell-structure fibrous. impunctate. The apophysary system consists of two short curved lamellæ. Length 11 lines, breadth 13 lines, depth 7 lines.

Hab. Five miles east of Ruapuke Island, New Zealand; dredged by Mr. F. J. Evans, R.N., in 19 fathoms, on rock and coral. Abundant at Faveau Strait, and not uncommon off the south Chatham Islands (Hutton).

Fossil shells referred to this species have been found in New Zealand.

Obs. Our first knowledge of this most interesting species is due to G. B. Sowerby, who says that, at the time he was describing the shell, only one small young specimen, without indication of locality, was known, which was found in the collection of the late G. Humphrey. Since then a number of specimens of all ages have been dredged and may be seen in many collections. In 1882 I received from New Zealand several examples, and redescribed and figured the species.

When quite young, and up to a certain age, the shell is triangular and somewhat compressed, and many adult examples are unsymmetrical, from the fold and sinus being moved more to one side than the other. The young shells are often found attached in groups to an adult example, or to a sponge or rock.

The striking resemblance presented to more than one Jurassic or Cretaceous species of *Rhynchonella* is very remarkable. Some fossil specimens of *R. nigricans* described by Prof. Suess from Kohuron in New Zealand measured 13 lines in length by 14 in breadth.

97. Rhynchonella nigricans, var. pyxidata, R. B. Watson, MS. (Plate XXIV. fig. 20.)

Rhynchonella nigricans, var. *pixydata*, Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 59, pl. iv. fig. 14, 1880.

Var. *pyxidata*. Shell transversely oval, widest anteriorly, tapering posteriorly, wider than long. Dorsal valve uniformly convex to about half its length, where a broad mesial fold, scarcely raised above the general convexity of the valve, occupies the anterior half of the valve. Ventral valve rather less deep and convex than the opposite one, with a broad well-defined mesial sinus, commencing at a short distance from the extremity of the beak and extending to the front; beak rather small, acute, and incurved; foramen incomplete, situated under its pointed extremity, laterally margined by narrow deltidial plates; surface of both valves ornamented with about forty to forty-six small, angular, radiating ribs, closely intersected by equidistant, squamose, concentric ridges of growth, giving an imbricated appearance to the surface. Colour whitish, sometimes brownish, especially at the beaks. Length 9 lines, breadth 10 lines, depth 6 lines.

Hab. Six examples were dredged by the 'Challenger' Expedition south of Kerguelen Island, associated with numerous specimens of *Waldheimia kerguelenensis*; at a depth of 150 fathoms.

Obs. Nearly all the specimens of the typical form from Faveau Strait were of a blue-black or brownish colour, while the six examples of the variety *pyxidata* dredged by the 'Challenger' Expedition were of a light yellowish-white colour; but as one showed at the beaks the brown tint of the New-Zealand type, it is probable that some specimens of the variety were also of a light brown colour. The ribs in the latter are likewise more numerous and smaller. These differences, no doubt, led the Rev. R. Boog Watson to distinguish it as a distinct species under the MS. name of *pyxidata*, from πυξίον, as he thought it like a box in form. After careful study and comparison with an extensive series of New-Zealand types, I am led to the conclusion that *Rhynchonella pyxidata* is merely a local variety of *R. nigricans*. A species of *Rhynchonella* recently found by the Rev. J. E. Tenison Woods in the Tertiary rocks of Table Cape, Tasmania, seems absolutely undistinguishable. It has received the MS. name *Rhynchonella cœlata* from Prof. M'Coy, and was described under that name by the Rev. Tenison Woods in a paper on the Tertiary deposits of Australia, published in the 'Proceedings of the Royal Society of New South Wales' in 1877.

98. RHYNCHONELLA CORNEA, P. Fischer, MS. (Plate XXV. figs. 2–4.)

? *Rhynchonella sicula*, Gwyn Jeffreys, Proc. Zool. Soc. 1878, p. 413, pl. xxiii. figs. 5, 6.

Shell thin, ovately triangular, broadest anteriorly, tapering posteriorly, rounded laterally, very slightly so in front. Dorsal valve moderately convex, without either fold or sinus, slightly depressed along the middle. Ventral valve rather deeper and more convex than the opposite one, and slightly depressed from the middle of the valve to the front; beak short, incurved, with a small circular incomplete foramen under its angular extremity, and laterally margined by narrow deltidial plates; margins gently flexuous, and slightly curved in front. Surface of valves covered with numerous close-set very fine longitudinally radiating striæ, and crossed by a few fine concentric lines of growth; shell-structure fibrous. Colour pale brownish yellow. Valves articulating by means of small teeth and sockets. In the interior of the dorsal valve the hinge-plate is divided along the middle, with a median groove along each of its parts, from which extend two thin curved lamellæ denticulated at their extremity; under the hinge-plate a narrow ridge-like septum of small elevation extends to about one third of the length of the valve, and on each side of the septum on the bottom of the valve are situated the quadruple impressions of the adductor muscle. Length 1 inch 1 line, breadth 1 inch, depth 7 lines.

Hab. English Channel, depth 690 fathoms (Gwyn Jeffreys); off Cape St. Vincent ('Talisman' Expedition), depth 57½ fathoms.

Obs. In 1870, during the 'Porcupine' Expedition, Dr. Gwyn Jeffreys obtained, in the chops of the English Channel, one perfect living specimen and two incomplete valves of a *Rhynchonella* which he thought might be the living representative of the fossil Pliocene *Rhynchonella sicula* of Seguenza, and he asked me to figure it for his paper published in the 'Proceedings of the Zoological Society' for 1878. He says:—"The shape of the Sicilian fossil is rather more broadly triangular, and is uniformly convex; but it agrees with the recent specimen in its peculiar structure, want of flexuosity in the front margin, short beak, and small foramen. The fibrous texture of the shell is much softer and looser than that of *R. psittacea*." He adds that the "body is whitish, gelatinous; mantle not furnished at its edge with setæ or bristles, as is the case in the Terebratulidæ; arms fringed with short cirri, which are unequal in length and curl inwards at their extremities; byssal plug (peduncle) small, cylindrical, and slender; its outer case or sheath is chitinous, and resists the action of liquor potassæ."

I have seen only three examples of the recent shell; they are, however, much larger than the specimens of *R. sicula* that have been forwarded by Signor Seguenza for my examination. Dr. P. Fischer has also written to me that he thinks the identification of the recent form with the fossil one is so uncertain that he proposes to give it the distinctive name of *cornea*, which I have therefore provisionally adopted. The specimens dredged off Cape St. Vincent by the 'Talisman' Expedition are larger than those obtained by Dr. Gwyn Jeffreys in 1870.

99. Rhynchonella Döderleini, Davidson. (Plate XXV. figs. 14, 15.)

Rhynchonella Döderleini, Davidson, Ann. & Mag. Nat. Hist. 5th ser. vol. xvii. p. 1, 1886.

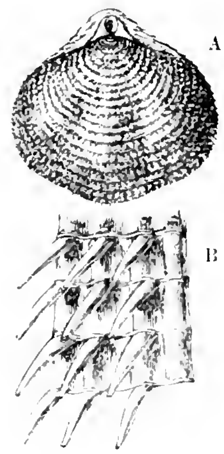
Shell transversely subpentagonal, wider than long; hinge-line obtusely angular. Dorsal valve deep, posteriorly uniformly convex, anteriorly divided into three lobes, the central one forming a broad rounded mesial fold varying in elevation according to the age of the individual. Ventral valve much less deep than the dorsal one, with a broad mesial sinus of greater or less depth, commencing at a third of the length of the shell and extending to the front. Beak moderately produced, almost erect, with an oval-shaped foramen situated under its gently incurved angular extremity, and margined by narrow deltidial plates. Lateral margins of the valves slightly sinuated, and forming in front a more or less elevated curve. Surface of valves marked with numerous delicate radiating ribs, with interspaces between them of almost equal width, and increasing in number at variable distances from the beaks by the interpolation of shorter riblets. Ribs numbering, in full-grown specimens, sixty, close to the margin. Valves closely crossed by numerous equidistant, concentric, raised or foliated lines of growth, giving rise at the margin on each riblet to short sloping or erect hollow spinules. Shell-structure fibrous. Colour light yellowish grey. In the interior of the dorsal valve are two short, curved lamellæ for the support of the labial appendages. Length 12 lines, breadth 13, depth 7 lines.

Hab. Dredged by Dr. L. Döderlein, in about 160 fathoms, in Sagami Bay, Japan.

Obs. We are indebted to Dr. L. Döderlein for the discovery of this very remarkable recent form of *Rhynchonella*, and he kindly forwarded for my inspection and description the four examples he procured during his dredgings in Japanese waters. When young the shell is flattish, neither fold nor sinus being yet developed; the ribs are also few in number, and the spines have not yet been formed. In external appearance and size it bears some resemblance to the Jurassic *Rhynchonella spinosa*; but in this last-named species the spines are very much longer and irregularly implanted on the ribs, while in *R. Döderleini* they are arranged in rows.

It is with much pleasure that I name this very interesting species after its discoverer.

Fig. 19.



A. Adult *R. Döderleini*, Davidson.
B. Portion of external surface, enlarged, to show ribs, interspaces, concentric lines, and spines.

Genus ATRETIA, Gwyn Jeffreys, 1870.

Type *Atretia gnomon*, Gwyn Jeffreys.

Only two species of this genus have been discovered. The characters of the type, *A. gnomon*, are fully given in the description of the species.

100. Atretia gnomon, Gwyn Jeffreys. (Plate XXV. figs. 6–13.)

Cryptopora gnomon, Gywn Jeffreys, Nature, vol. i. p. 136, 1869.

Atretia gnomon, Gywn Jeffreys, Preliminary Report of the Scientific Exploration of the Deep Sea in H.M.S. Surveying Vessel 'Porcupine,' Proc. Roy. Soc. vol. xviii. p. 421, 1869; Ann. & Mag. Nat. Hist. 4th ser. vol. xviii. p. 251, 1876, and Proc. Zool. Soc. 1878, pp. 412, 413, pl. xxiii. figs. 4, 4 *a*, 4 *b*.

Dimerella gnomon, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 197.

Atretia gnomon, Davidson, Suppl. to the Recent and Tertiary Brachiopoda. Brit. Foss. Brachiopoda, vol. iv. p. 7, 1874.

Shell very small, triangularly oval or pear-shaped, widest and rounded anteriorly, tapering posteriorly, somewhat compressed, thin, white, semitransparent, and glossy. Dorsal valve slightly convex, with a shallow longitudinal depression commencing at about half the length of the valve and extending to the front. Ventral valve slightly deeper than the dorsal one, with a wide slightly raised mesial fold commencing at about half the length of the valve, and extending to the front; beak moderately produced, angular at its extremity, moderately incurved, with a triangular incomplete foramen commencing under the extremity of the beak, margined anteriorly by the umbo of the dorsal valve, and laterally by narrow rudimentary deltidial plates. Surface smooth, marked only by some fine concentric lines of growth. Shell-structure composed of numerous close-set microscopic imbricated scales. There is a small cardinal process seen in the interior of the dorsal valve, from the base of which extends, to about half the length of the valve, a mesial septum or large vertical blade-like plate. This rises gently by an upward curve until it attains its highest elevation, then presents a short horizontal line, to be again abruptly curved inwards until it reaches the bottom of the valve. On each side of the cardinal process a narrow, small hinge-plate is seen, from which extend two short, slender, curved lamellæ denticulated at their extremities; and at the bottom of the valve on each side of the septum well-defined muscular scars are situated. In the interior of the ventral valve two short but strong, diverging dental plates are present. The valves are feebly articulated by means of small teeth in the ventral valve and sockets in the dorsal one. Length $2\frac{1}{2}$ lines, breadth 2, depth 1 line.

Hab. This species was dredged by Dr. Gwyn Jeffreys in Davis Strait, during the 'Valorous' Expedition, at depths between 1100 and 1750 fathoms, and during the 'Porcupine' Expedition, in from 1380 to 1443 fathoms; and during the Norwegian North-Atlantic Expedition, at about thirty miles west of Tromsö, on the slope of the banks in the cold area in 650 fathoms (Friele).

A single living specimen occurred in lat. 63° 9′ N., long. 56° 43′ W., at a depth of 1100 fathoms. Valves and fragments were also found in lat. 59° 10′ N., long. 50° 25′ W., and in lat. 56° 11′ N., long. 37° 41′ W., at depths of 1750 and 1450 fathoms. Imperfect specimens had been dredged by Dr. Jeffreys during the 'Porcupine' Expedition of 1869, at Stations 20 and 30, at depths of 1443 and 1380 fathoms, off the west coast of Ireland. *Atretia gnomon* was also obtained by the 'Talisman' French Expedition off Morocco and the Canaries, at depths of from 50 to 65 fathoms.

Obs. Since publishing my restored figures of this small species in the Palæontographical Society's volume for 1874, from ten to fifteen * complete examples have been obtained by Dr. Gwyn Jeffreys and by the Marquis de Folin, and I have been able to ascertain that my figures, restored as it were, were quite correct. None of the examples exceeded the dimensions given. The presence of the internal septum is indicated on the exterior of the dorsal valve by a dark line. Dr. Gwyn Jeffreys observes in his paper published in 1878:—"According to Mr. Dall, *Atretia* is a synonym of Zittel's genus *Dimerella* (Dunker and v. Meyer, Palæont. 1870, p. 220), which is a Jurassic Brachiopod; but, although it belongs to the same family, the internal apparatus is different, and the beak is prominent in *Atretia* and incurved in *Dimerella*. The septum in *Atretia* is short, gnomon-shaped, and central; in *Dimerella* it extends from below the beak to the front of the lower or smaller valve. The genus *Mannia* of Dewalque (Soc. Malac. Belgique, 1874), from the 'sable noir,' or Upper Miocene of the Antwerp Crag, is also a Rhynchonellidan; but the internal apparatus is likewise different from that of *Atretia*."

* [About fifty specimens of *Atretia gnomon* were dredged by Dr. Herman Friele during the Norwegian North-Atlantic Expedition, but no species of *Rhynchonella* occurred at the same station or in corresponding depths.—A. C.]

APPENDIX.

ATRETIA BRAZIERI, Davidson. (Plate XXV, figs. 16–17 *a*.)

Atretia Brazieri, Davidson MS.; Agnes Crane, Proc. Zool. Soc. 1886, p. 183.

[NOTE.—This species was received by Dr. Davidson, and named in manuscript shortly before his death. A short description was published by me to secure priority for the name *Atretia Brazieri*, which Dr. Davidson had given it, after Mr. John Brazier of Sydney, who dredged eleven specimens in the harbour of Port Stephens, New South Wales.—A. C.]

This pretty little Brachiopod presents all the well-marked characteristics of the genus *Atretia*. Two short, curved, slender processes, denticulated at their extremities, descend from the small narrow hinge-plate of the smaller dorsal valve, and an elevated wedge-shaped projection rises abruptly from the central mesial septum of the same valve: the presence of this septum is indicated by a dark line visible from the exterior of the shell. The shell is small, generally longer than wide, triangular in shape, especially in the younger specimens. Dorsal valve rounder than, and not so large as, the ventral one, slightly convex, flexuous towards the centre at the margins of the valves. The ventral valve, owing to the prolongation of the beak-area, is longer and more triangular than the dorsal one, raised towards the beak, which is somewhat produced and incurved, with a triangular foramen commencing beneath its pointed extremity. Two elevated ridges extend from the shoulder of the shell nearly to the margins of the valves, and there seems to be a slight elevation corresponding to the well-marked external depression, and surrounded by muscular scars, in the interior of the two specimens I have examined under the microscope. The shell is shallow towards the margins, but rounded and deeper near the beak. Shell-substance imperforate. Surface smooth, glossy, and gleaming, marked with fine concentric lines of growth, semitransparent, horn-coloured, or light grey. Length $2\frac{1}{4}$ lines, width $1\frac{1}{2}$, depth 1 line. Another specimen measured 2 lines in length by $2\frac{1}{4}$ lines in width; this was more flattened and depressed, and the external mesial sinus in the ventral valve was less marked. Other specimens were about 1 line in length.

When examined under microscopic power the scaly structure of the shell is very apparent; there are no perforations. The circular and elongated sac-like aggregations apparently result from the partial overlapping of the cycloidal shell-scales. The presence of parallel rows of spicular projections was revealed in the interior of the shell; these recur at regular distances from each other, running from the beak to the margins of the valves.

Hab. Eleven specimens and odd valves were obtained by Mr. John Brazier off Cabbage-Tree Island, Port Stephens, New South Wales, in 25 fathoms, on sandy mud.

Obs. Five of these specimens Mr. Brazier forwarded to Dr. Davidson in July 1885. Dr. Davidson examined them, made drawings, and named the species after Mr. Brazier, to whom he was indebted for much information concerning the recent Australian Brachiopoda, as he has frequently stated in this monograph.

DESCRIPTION OF THE PLATES.

Plate XIII.

Figs. 3–9 *a*. *Terebratella coreanica*, Adams and Reeve, sp. 3. Type specimen figured by Reeve. 4–4 *c*. A fine and large specimen. 5, 5 *a*. A still larger example (*Terebratula miniata*, Gould), dredged by L. V. Schrenk, from Hakodadi, Japan. 6, 6 *a*. An elongate globose variety, dredged by Capt. St. John in Tsuga Strait. 7. Interior of dorsal valve, to show loop. 8, 8 *a*. Elongate variety (*T. Bouchardi*, Davidson). 9, 9 *a*. Var. *Bouchardi*, Davidson. Specimens 1, 5, 6, 7, and 8, in the Davidson Collection, Geol. Dept., British Museum; 9, in the Zool. Dept., British Museum.

Plate XIV.

Figs. 1–8. *Terebratella cruenta*, Dillwyn, sp., of different forms and ages; from Cook's and Faveau Straits, New Zealand. All in the Davidson Collection, Geol. Dept., British Museum. 1, 1 *a*, 1 *b*. A very large and fine example. 2. An elongated form. 4. Interior of dorsal valve, showing the loop. 8. A young specimen, showing a modification in the loop. Another modification is represented in figs. 5 *a*, 5 *b*, which was described under the name of *Terebratella Evansii*, but it is really a young form of *Terebratella cruenta*.

Figs. 9–19. *Terebratella dorsata*, Gmelin, sp. Different forms and ages; chiefly from Magellan Straits. 9, 9 *a*, 9 *b*. A large specimen (*T. magellanica*, Chemnitz). Figs. 11, 11 *a*. *Terebratella chilensis*, Broderip. 14. Represents the *Terebratella Sowerbyi*, King. 17. Full-grown condition of the loop. 18, 19. Young form, showing one of the early stages of the development of the loop.

Figs. 20–21 *a*. *Terebratella lupinus*, Philippi, sp. Probably a young stage of *Terebratella dorsata*, with *Magasella*-shaped loop. Magellan Straits; type in Berlin Museum (no. 7979).

Plate XV.

Figs. 1–8 *a*. *Terebratella frontalis*, Middendorff, sp. 1–2 *b*. Dredged by W. Dall at Atka Island off the Aleutian Chain, Alaska; 2. A large example. 3, 4, 5, 5 *a*. Dredged by Capt. St. John, off East Yeso, North Japan. 6. Interior of the dorsal valve to show the loop. 7. Interior of same valve, with the loop removed to show the occlusor muscular scars. All in the Davidson Collection, Geol. Dept., British Museum. 8, 8 *a*. Shell-structure after Middendorff.

Figs. 9–12. *Terebratella Blanfordi*, Dunker, sp. 9 and 11. Types after Dunker, from Wakayama, Japan. 10. A specimen from the same locality (Davidson Collection, Geol. Dept., British Museum). 12. Interior of the dorsal valve to show the loop.

Figs. 13–14. *Terebratella Mariæ*, A. Adams. Dredged by A. Adams at Satanomosaki, Japan. 13. Natural size. 14. Interior seen in profile to show the loop (Davidson Collection, Geol. Dept., British Museum).

Figs. 15–29. *Terebratella rubicunda*, Sowerby. Faveau and Cook's Straits, New Zealand. 15–24. A variety of forms and ages in the Davidson Collection, Geol. Dept., British Museum. 22, 23. Modifications of the loop. 24. Adult condition of loop. 25. Vertical section of the ventral valve near the extremity, considerably enlarged, so as to show the ordinary trumpet-like form of the vertical passages, and the remarkable contraction which they exhibit in the inner and (probably) later formed layer; magnified 100 diameters (after Carpenter). 26. Another portion considerably enlarged, showing the occasional bifurcation of the vertical passages; magnified 100 diameters (after Carpenter). 27 *a*, 27 *b*. Young *T. inconspicua*, Sowerby, from his figures in the Thes. Conch. pl. xxxi. figs. 102, 103, 104. 28, 29. *Terebratella rubicunda*, Sowerby, sp.; young elongated form from Chatham Islands, S. of New Zealand.

Plate XVI.

Figs. 1–5. *Terebratella spitzbergensis*, Davidson. 1, 1 *a*, *b*, *c*. Type dredged by Torrell near Spitzbergen (Davidson Collection, Geol. Dept., British Museum). 2, 2 *a*. From off Satanomosaki, Japan (Adams). 3, 3 *a*. From the Gulf of St. Lawrence (J. F. Whiteaves). 4, 5. Interior of dorsal valve enlarged to show the loop.

Figs. 6–9. *Terebratella transversa*, Sowerby, sp.; figs. 6, 6 *a*, the type after Sowerby. 7, 8, 9. Specimens from off Vancouver Island 9. Interior of dorsal valve to show the loop. (Davidson Collection, Geol. Dept., British Museum.)

Figs. 10–12. *Terebratella transversa*, var. *caurina*, Gould. From off Sitka and Vancouver Island. 12. Interior of the dorsal valve to show the loop (Davidson Collection, Geol. Dept., British Museum).

Figs. 13, 14 *a*. *Terebratella transversa*, var. *occidentalis*, Dall. Coast of California. 13. Dall's figured specimen. 14. From the Davidson Collection, Geol. Dept., British Museum.

Fig. 15. *Terebratella? pulvinata*, Gould. Puget Sound, Oregon. After Gould; type in Washington Museum, D.C., U.S.A.

Figs. 16–17 *b*. *Terebratella? Frielii*, Davidson. 16, 16 *a*. Dredged by the 'Challenger' Expedition off Halifax, in 1340 fathoms. 17–17 *b*. From the Philippine Islands, opposite coast of the island of Manilla, in 82 to 102 fathoms, 'Challenger' Expedition. Specimens in the Zool. Dept., British Museum.

Figs. 18, 18 *a*. *Magasella? labradorensis*, Sowerby. After Sowerby's fig. Thes. Conch. pl. lxxi. figs. 89, 90. Labrador. (Genus and species very uncertain.)

Fig. 19. *Terebratella? rubiginosa*, Dall, sp. From the type in the Smithsonian Cabinet, Washington, D.C. Locality uncertain.

Plate XVII.

Figs. 1–5. *Magasella flexuosa*, P. King, sp. 1, 2. Exterior of valves dredged by the 'Challenger' Expedition in the Gulf of Patagonia. 3, 4. Interior of dorsal valve, to show the loop. 5. Profile of another specimen, to show the enormously developed mesial septum.

Figs. 6–8 *a*. *Magasella flexuosa?* This is the type of the *Terebratula rhombea*, Philippi, from Magellan Strait. In the Berlin Museum. I am indebted for these drawings to the liberality of Prof. E. von Martens.

Figs. 9–11. *Magasella crenulata*, Sowerby, sp., from Santa Cruz, Canaries. 9, 9 *a*. A specimen dredged by H. Cuming (in the Zool. Dept., British Museum). 10, 10 *a*, 10 *b*. After Sowerby's figs. in Thes. Conch. pl. lxxi. figs. 96–98. 11. From a fig. in Reeve's Conch. Icon. Monogr. of *Terebratula*, pl. viii. fig. 32.

Figs. 12–13 *a*. *Magasella patagonica*, Gould, sp. 12. Gould's original type from United States Expedition to Patagonia; National Collection, Washington, D.C. 13, 13 *a*. Another specimen from the same locality and collection given to me by Mr. Dall.

Figs. 14–15. *Magasella suffusa*, L. Reeve, sp. 14–14 *b*. The type, given to me by Mr. Reeve in 1860. 15. Interior of the dorsal valve of the same specimen to show the loop and the largely developed septum.

Figs. 16–17 *b*. *Magasella aleutica*. 16. Type in the Washington Museum; from Unalaska. 17, 17 *a*. Another specimen given to me by Mr. Dall, from Popoff Strait, Shumagin Island. 17 *b*. Enlarged.

Figs. 18–19. *Magasella Adamsi*, Davidson. Type specimen; from off the Island of Kuro-puma, Japan. 19. Interior of the dorsal valve to show the small loop.

Figs. 20–22. *Magasella Gouldi*, Dall. Hakodadi, Japan; type in the National Collection, Washington, D.C. 21, 22. Loop.

Figs. 23–32. *Magasella Cumingi*, Davidson, sp. 23, 24. Two living specimens of a light pink colour: dredged by Mr. J. Brazier at South Reef, Port Jackson Heads, S. Australia. 25, 26, 27. From

Pigs Rock, South Australia. 28. Interior of ventral valve. 29. Interior of dorsal valve, showing the loop. 30, 31. Interior of both valves, much enlarged. 32. Loop of a young specimen.

Figs. 33, 33 *a*. *Magasella fibula*, Reeve, sp. From the type in the Zool. Dept. of the British Museum; said to have been dredged in Bass Strait, South Australia; probably a large example of *Magasella Cumingi*.

Plate XVIII.

Fig. 1. *Magasella* (?) *radiata*, Dall. Popoff's Strait, north-west of Alaska. Dall's type, in the National Collection, Washington, D.C. This enlarged drawing was sent to me by Mr. Dall.

Figs. 2–3 *a*. *Magasella* (?) *incerta*, Davidson. 2. Exterior of the shell. 3, 3 *a*. Interior of dorsal valve, enlarged. Dredged by the 'Challenger' Expedition west of St. Thomas, Danish West Indies. In the Zool. Dept., British Museum.

Fig. 4. *Magasella* (?) *lævis*, Dall. From Orange Harbour, Patagonia. Smithsonian Museum, Washington, D.C.

Figs. 5, 5 *a*. *Magasella* (?) *Malvinæ*, d'Orbigny. After figs. in Voyage Amér. Mér. vol. v. pl. 85. figs. 27–29. Malvines.

Figs. 6–9. *Laqueus californicus*, Koch, sp. 6. A very large example (Davidson Collection, Geol. Dept., British Museum). 7. A specimen in the National Collection, Washington, D.C. 8, 8 *a*. Interior of dorsal valve, showing the loop. 9. Küster's fig. of his *T. Kochii*, Chemn. Conch.-Cab. vol. vii. tab. 2 *a*. fig. 9. All from off the Californian coast.

Figs. 10–13 *b*. *Laqueus californicus*, var. *vancouveriensis*. A series of specimens of different forms and ages. Off Vancouver Island. 12. Interior of dorsal valve. (Davidson Collection, Geol. Dept., British Museum).

Figs. 14–18. *Laqueus pictus*, Chemnitz, sp. A series of specimens of different ages from Japanese waters. 14, 15, 17, 18. (Davidson Collection, Geol. Dept., British Museum.) 18. Interior of dorsal valve, showing the loop. 16. Specimen figured by L. Reeve (Mus. de Burgh).

Plate XIX.

Figs. 1–5. *Laqueus rubellus*, Sowerby, sp. From Japanese waters. 1, 2, and 5. Large examples (Davidson Collection, Geol. Dept., British Museum). 3–3 *b*. In Zool. Dept. of the British Museum. 4, 4 *a*. Sowerby's figured type.

Figs. 6–7 *b*. *Laqueus suffusus*, Dall. From the Wharf at Yokohama, Japan. 6. Type in Smithsonian Cabinet, Washington, D.C. 7–7 *b*. Davidson Collection, Geol. Dept., British Museum. This is the shell which was erroneously referred by Adams to *T. cranium*.

Figs. 8–10 *a*. *Megerlia Jeffreysi*, Dall, = young of *Laqueus californicus*. From Port Etches, Alaska Territory. Types in the National Museum, Washington, D.C. 10, 10 *a*. Interior of the dorsal valve, much enlarged.

Figs. 11–20. *Megerlia truncata*, Linné, sp. 11–14. Different forms and ages. 11–11 *b*. Off Teneriffe, dredged by the 'Challenger' Expedition. 12, 13, 14. Mediterranean forms, all in the Davidson Collection, Geol. Dept., British Museum. 15, 16. Interior of the dorsal valve of *Megerlia truncata*, showing loop. 17. Interior of the same valve to show the labial appendages. 18. Interior of the ventral valve of *Megerlia truncata*, after E. Deslongchamps, showing the entire mantle; *vc.*, visceral cavity; *ap.*, calcified portion of the mantle forming the anterior wall of the visceral cavity; *sv.*, calcified portion of the mantle on the course or direction of the large sinus; R, branch and smaller branches or subdivisions of the sinus on which the brachial apparatus does not extend, enlarged four diameters.

Fig. 19. Interior of the dorsal valve of *Megerlia truncata*, also after Deslongchamps, showing the complete mantle (the right branch of the brachial apparatus or loop has been removed in order to show better the bearing of the different portions of the pallial apparatus); *cv.*, visceral

cavity; *ab*, brachial apparatus; *e*, shield; *ap*, raised portion of the mantle forming the wall of the visceral cavity; *svl*, lateral vein sinus; *svm*, median vein sinus.

Fig. 20. Portion of the internal surface of the shell of the same species, showing the usual imbricated arrangement and the internal orifices of the vertical perforations: magnified 100 diameters (after Carpenter).

Figs. 21–22. *Megerlia truncata*, var. *monstruosa*, Scacchi. 22. Enlarged. From the Mediterranean. (Davidson Collection, Geol. Dept., British Museum.)

Figs. 23–26. *Megerlia? Willemoesi*, Davidson. From Twofold Bay, South Australia; 'Challenger' Expedition (in the Zool. Dept., British Museum). 26. Interior of the dorsal valve.

Plate XX.

Figs. 1–8. *Megerlia sanguinea*, Chemnitz, sp. 1, 2. From Honolulu, Sandwich Islands (Davidson Collection, Geol. Dept., British Museum). 4–8. Different modifications in the loop according to age (after E. Deslongchamps). 4. Simplest stage. 5. Second stage. 6. A third stage. 7. Full-grown condition: *b c*, running section of loop; *e*, peripheral section; *i*, median section; *p*, point of attachment of recurrent lamellæ; *a*, supplementary lamella. 8. Adult in profile.

Figs. 9–11. *Megerlia pulchella*, Sowerby, sp. After figures in Thes. Conch. pl. lxxi. figs. 105–107. Probably a variation of *Megerlia sanguinea*? 11. *Megerlia sanguinea*, var. *pulchella*, Sowerby, adhering to fucus. Dredged by Mr. John Brazier from the Bottle and Glass Rocks, Port Jackson. 10–10 *b*. From off Shark's Point, Port Jackson, N.S.W. (Davidson Collection, Geol. Dept., British Museum.)

Figs. 12–12 *b*. *Megerlia Reevei*, Davidson, = *Ismenia Reevei*, Adams. From Gotto, Japan. Probably a bleached form of *Megerlia sanguinea*.

Figs. 13–18. *Bouchardia rosea*, Mawe, sp. From Rio de Janeiro, Brazil. 13–14. Exterior of shell. 15. Profile view of interior of shell. 16. Interior of ventral valve. 17. Interior of dorsal valve. 18. Profile view of dorsal valve. (Davidson Collection, Geol. Dept., British Museum.)

Figs. 19–23. *Kraussina rubra*, Pallas, sp. 19–20. From South Africa. 21–22. Interior of dorsal valve to show forked process. 23. Interior of same valve to show the small labial appendages. (All in the Davidson Collection, Geol. Dept., British Museum.)

Figs. 24–26. *Kraussina cognata*, Sowerby, sp. 24. After Sowerby's fig. in the Thes. Conch. pl. lxviii. figs. 12, 13; from South Africa (Zool. Dept. British Museum). 25. After Reeve's fig. Conch. Icon., Monogr. of *Terebratula*, pl. ix. fig. 38[a]. 26. Interior of dorsal valve.

Figs. 27–30. *Kraussina cognata*? A series of specimens dredged near the Cape of Good Hope. 29. Interior of ventral valve. 30. Interior of dorsal valve. (All in the Davidson Collection, Geol. Dept., British Museum.)

Figs. 31, 31 *a, b*. *Kraussina Deshayesi*, Davidson. Off Cape of Good Hope. (In the Davidson Collection, Geol. Dept., British Museum.)

Plate XXI.

Figs. 1–4. *Kraussina pisum*, Lamarck, sp. Specimens dredged by the 'Challenger' Expedition off the Cape of Good Hope. 2. In Zool. Dept., British Museum. 4. Interior of dorsal valve. 1 & 3. In Davidson Collection, Geol. Dept., British Museum.

Figs. 5, 6. *Kraussina Atkinsoni*, T.-Woods. From Long Bay, South Tasmania (Davidson Collection, Geol. Dept., British Museum). 6. Interior of dorsal valve.

Figs. 7–11. *Kraussina* (*Megerlina*) *Lamarckiana*, Davidson. From Sydney Harbour, New South Wales (Davidson Collection, Geol. Dept., British Museum). 11. Interior of dorsal valve of the same species.

Figs. 12–14. *Kraussina* (*Megerlina*) *Davidsoni*, Vélain. From the shores of the Volcanic Island of St. Paul. Collected by M. Vélain in 1874 (Davidson Collection, Geol. Dept., British Museum). 14. Interior of the dorsal valve, enlarged.

Figs. 15–19. *Platydia anomioides,* Scacchi, sp. 15. Specimen dredged by E. Forbes in the Ægean Sea. 16. Dredged by the 'Challenger' Expedition off Marion Island (Zool. Dept., British Museum). 17. Dredged by W. S. Kent off Setubal, coast of Portugal, near the Tagus (Davidson Collection, Geol. Dept., British Museum). 18. Interior of dorsal valve. 19. Interior of dorsal valve, enlarged to show labial appendages (after E. Deslongchamps).

Figs. 20–22. *Terebratula seminulum,* Philippi (a synonym of *Platydia anomioides).* From the Mediterranean. After Philippi's figures.

Figs. 23–27. *Platydia Davidsoni,* E. Deslongchamps, sp. From the Mediterranean. 23. Type. 23 *a, b.* Enlarged. 24. Spiny surface of ventral valve, much enlarged. 25. Fragment to show the foramen. 26, 27. Interior of dorsal valve (after drawings by E. Deslongchamps). (Davidson Collection, Geol. Dept., British Museum.)

Figs. 28, 29. *Gwynia capsula,* Gwyn Jeffreys, sp. Specimen, much enlarged, from Belfast Bay (Davidson Collection, Geol. Dept., British Museum). 29. A very young shell, much enlarged (after Gwyn Jeffreys).

Figs. 30–35. *Argiope decollata,* Chemnitz, sp. From the Mediterranean. 30. Natural size (Davidson Collection, Geol. Dept., British Museum). 31. Dredged by the 'Challenger' Expedition off Gomera, Teneriffe (in the Zool. Dept., British Museum). 32. A very young shell dredged at Cape Breton (Marquis de Folin's Collection). 33. Interior of dorsal valve, enlarged. 34 *a.* Interior of ventral valve, much enlarged (after E. Deslongchamps). 35. Interior of dorsal valve, much enlarged, showing the labial appendages.

Plate XXII.

Figs. 1–4. *Cistella cistellula,* Searles Wood, sp. 1. Natural size. 1 *a, b.* The same, enlarged; from off Shetland Island. 3. Interior of dorsal valve; enlarged. (1, 3. Davidson Collection, Geol. Dept., British Museum.) 2. A young specimen, enlarged (after Gwyn Jeffreys). 4. Interior of both valves of the same species, showing the powerful muscles on the ventral valve and the labial appendages on the dorsal one.

Figs. 5, 6. *Cistella? lunifera,* Philippi, sp. 5–5 *c.* Figures after Philippi. 6. A perfect specimen, enlarged, from the Mediterranean; sent to me by the Marquis of Monterosato.

Figs. 7–7 *c.* *Cistella Woodwardiana,* Davidson, sp. 7. Natural size; dredged by Lucas Barrett on the N.E. coast of Jamaica (from the type, in the Cambridge Museum). 7 *a, b, c,* enlarged.

Figs. 8–24. *Cistella neapolitana,* Scacchi, sp. 8, 9, 10. Three examples from the Mediterranean (Davidson Collection, Geol. Dept., British Museum). 11. Interior of dorsal valve. 12. Interior of ventral valve. 13–24. After A. E. Shipley:—13. Ovum. 14. Ovum with two segments. 15. Ovum with three segments. 16. Gastrula. 17. Larva with two segments, showing the stalk attaching it to the walls of the brood-pouch. 18. Larva showing traces of three segments, with eyespot *e* and commencing bristles: the outline of the alimentary canal is seen faintly. 19. Slightly older larva. 20. Larva with two kinds of cilia on the first segment: the second segment has already begun to grow down over the third, which has constricted slightly into two parts. 21. Free-swimming larva seen from the ventral side. 22. Free-swimming larva seen laterally. 23. Young Argiope, the lophophore still circular, with twelve tentacles: the liver is growing out as two lateral diverticula of the stomach. 24. View of the ventral shell of the same.

Figs. 25, 25 *a.* *Cistella biplicata,* Seguenza, sp. (probably *Cistella neapolitana*). From off Messina. (Type from Seguenza's Collection.)

Figs. 26, 27. *Cistella Kowalevskii,* Schulgin, sp. After Schulgin's figures. Enlarged. On *Posidonia* off Sardinia. 27. Shell-structure. (Schulgin's Collection.)

Fig. 28. *Cistella globuliformis,* Schulgin, sp.; after his figure. On stones off Sardinia. (Schulgin's Collection.)

Fig. 29. *Cistella? Barroisi,* Schulgin, sp.; after his figure. On stones at Villafranca; much enlarged. (Schulgin's Collection.)

Figs. 30–34. *Cistella cuneata,* Risso, sp. 30–31 *b.* Exterior of two examples from the Mediterranean (Davidson Collection, Geol. Dept., British Museum). 32. Interior of dorsal valve. 33. Interior of ventral valve. 34. Interior of both valves, showing the muscles and labial appendages; from a specimen dredged by E. Forbes in the Mediterranean.

Figs. 35–36. *Cistella Barrettiana*, Davidson, sp. 35. Exterior of shell of natural size. 35 *a*. Enlarged. 36. Interior of dorsal valve, enlarged. Dredged by Lucas Barrett on the N.E. coast of Jamaica. (In the Cambridge Museum.)

Plate XXIII.

Figs. 1, 2. *Cistella Barrettiana*, Davidson, sp. This is the type of Dall's *Cistella rubrotincta*, from Tortugas (National Museum, Washington, D.C.). 1 *a*. Enlarged. 2. Longitudinal section, to show the large submarginal septum on the dorsal valve.

Figs. 3, 4. *Cistella Schrammi*, Crosse, sp. 3. After Crosse's figures, enlarged. 4 is an enlarged drawing of fig. 3 *b*.

Figs. 5, 6. *Cistella lutea*, Dall. 5 *a*. Enlarged. 6. Longitudinal view of the dorsal valve, to show the elevated grooved submarginal septum. From Tortugas. (National Museum, Washington, D.C.)

Figs. 7, 8 *a*. *Cistella antillarum*, Crosse, sp. 7. After Crosse. 8 *a*. Drawn by myself and enlarged, after Crosse's figure. From Guadeloupe. (Crosse's Collection.)

Figs. 9–11. *Thecidium Barretti*, S. P. Woodward, sp. Dredged by Lucas Barrett, north-east coast of Jamaica. 9. Exterior of shell. 9 *a*. Enlarged. 10. Interior of ventral valve, enlarged. 11. Interior of dorsal valve, enlarged. (In the Cambridge Museum).

Figs. 12–22. *Thecidium mediterraneum*, Risso, sp. 12. Natural size. 12 *a*, *b*. Enlarged. 13. Shell with both valves open. 14. Interior of ventral valve much enlarged, after E. Deslongchamps, showing the pallial apparatus in its integrity, of which only a small portion has been removed to show the cavity wherein are lodged the sinuses and the organs of reproduction. 15. Interior of ventral valve of *Thecidium mediterraneum*, to show the position of the ventral adjustor muscles (*a*) of the small concave plates, "coques" (*b*) of Lacaze-Duthiers, to which the extremities of the adductor muscles (Hancock's occlusors) are attached; and the oval scars (*c*) left by the divaricator muscles of Hancock (the "muscles abducteurs" of Lacaze-Duthiers). 16. Interior of dorsal valve, much enlarged: *a*, *c*, *e*, *f*, and *g*, ascending process; *h*, bridge-shaped process; *i*, *k*, half-crescent or descending process; *m*, cardinal process; *w*, scar formed by Hancock's adjustor muscles (= the "muscles adducteurs latéraux ou externes" of Lacaze-Duthiers). 17. Interior of dorsal valve (after Lacaze-Duthiers), to show the labial appendages, much enlarged. 18. The least-advanced embryo hitherto examined; it resembles an agglomeration of small cells. 19. Two embryos, a little more developed and suspended from cirri. 20. An embryo with four lobes. 21. An embryo still more developed, enlarged. 22. Median portion of a gaping female *Thecidium*, showing the embryo-pouch partly broken, and the posterior median cirri at the mouth, each bearing a bundle of embryos. (Figs. 17–22 after Lacaze-Duthiers.)

Plate XXIV.

Figs. 1–11. *Rhynchonella psittacea*, Gmelin, sp. 1. A large example dredged by McAndrew and Barrett in Norwegian seas. 2. Dredged near Baffin's Bay by Gwyn Jeffreys during the 'Valorous' Arctic Expedition, 1875. 3. Dredged by Capt. Nares at Franklin Pierce Bay, 1875, lat. 70° 25′ N., in 15 fathoms. 4, 5. Young specimens from Sitka, dredged by Dall. (All in the Davidson Collection, Geol. Dept., British Museum.) 6. Interior of dorsal valve. 7. Interior of ventral valve. 8. Profile view of same.

Fig. 9. General side view of the viscera of *Rhynchonella psittacea*, after Hancock's figure (Phil. Trans. vol. cxlviii, pl. lxi. fig. 2, 1858):—"*a*, anterior wall of perivisceral chamber; *bb*, brachial organs; *c*, ventral terminations of occlusor muscles; *c* c**, dorsal terminations of anterior and posterior occlusors; *dd*, divaricators, the left one cut through; *d**, ventral wall of perivisceral chamber; *e*, peduncle; *e**, capsule of ditto; *f*, peduncular muscle; *g*, one of the dorsal adjustors; *h*, one of the ventral ditto; *i*, œsophagus; *j*, stomach, exhibiting the two openings of the left hepatic ducts, the liver having been removed from this side; *k*, right lobes of the liver; *k**, posterior lobe; *k***, anterior ditto; *l*, dorsal mesenteric membrane; *mm*, ventral ditto;

n, lateral gastro-parietal band; *o*, central ditto; *pp*, ilio-parietal bands; *q*, heart; *r*, branchio-systemic vein; *s*, aorta; *tt*, dorsal and ventral, pallial or genital arteries; *u*, right ventral oviduct; *u**, portion of left ditto cut through, *v*, œsophageal ganglia; *w*, sheath of crural process or oral lamina; *x*, orifice leading into ditto; *y*, portion of ditto of the opposite side; *z*, terminal sac of the left great brachial canal; *z**, ditto of the right or opposite arm, seen through the mesenteric membrane."

Fig. 10. Portion of shell of *Rhynchonella psittacea* (after Carpenter), showing at *aa* the internal surface, with the imbricated arrangement of the extremities of the component prisms, and at *b* the aspect of the prismatic substance, as displayed by a fracture nearly in the direction of the length of the prisms, showing also the entire absence of the least trace of perforations; magnified 100 diameters. 11. Portion of the shell-surface of the same (after Carpenter), more highly magnified, showing the imbricated arrangement and the entire absence of perforations.

Figs. 12–13 *c*. *Rhynchonella psittacea*, var. *Woodwardi*, A. Adams. From Japanese waters. (Both in the Davidson Collection, Geol. Dept., British Museum.)

Figs. 14–15 *b*. *Rhynchonella lucida*, Gould. From Japanese waters (Davidson Collection, Geol. Dept., British Museum). 15, 15 *a*, 15 *b* enlarged.

Figs. 16–19. *Rhynchonella nigricans*, Sowerby. A series of specimens from Faveau Strait, New Zealand. (Davidson Collection, Geol. Dept., British Museum.)

Fig. 20. *Rhynchonella nigricans*, var. *pyxidata*, Boog Watson. From off Kerguelen Island, 'Challenger' Expedition. (Zool. Dept., British Museum.)

Plate XXV.

Figs. 1, 1 *c*. *Rhynchonella Grayi*, S. P. Woodward. 1 *c*. Enlarged. Habitat not quite certain. (Zool. Dept., British Museum.)

Figs. 2–4. *Rhynchonella cornea*, Fischer, MS. Dredged off Cape St. Vincent, 'Talisman' Expedition (Muséum d'Histoire Naturelle, Paris). 3. Obtained by Dr. Gwyn Jeffreys, chops of the English channel (Dr. Gwyn Jeffreys's Collection, now in Boston Museum, U. S. A.). 4. Portion of the interior of the dorsal valve, enlarged, to show the hinge-plate, curved lamellæ, and muscular interior impressions.

Fig. 5. *Rhynchonella sicula*, Seguenza. Fossil in the Pliocene limestone of Messina, and supposed by Dr. Gwyn Jeffreys to occur in the recent condition.

Figs. 6–13. *Atretia gnomon*, Gwyn Jeffreys. 6, 7. Natural size. 7, 8 *a*. Enlarged. Dredged by Dr. Gwyn Jeffreys during the Norwegian Arctic Expedition, about thirty miles west of Tromsö, on slopes of the banks. 9. Dredged by Herman Friele off the coast of Finmarken, about thirty miles west of Tromsö. 10. Interior of the dorsal valve of a specimen dredged by the 'Talisman' Expedition off Morocco (Marquis de Folin's Collection). 10 *a*. Showing the largely developed mesial septum. 11 and 13. The dorsal valve, from specimens dredged by Dr. Gwyn Jeffreys. 12. Fragment of the interior of the ventral valve, to show the developed dental plates.

Figs. 14, 15. *Rhynchonella Döderleini*, Davidson, MS. From Sagami Bay, Japan. In the collection of Dr. Döderlein.

Figs. 16–17 *a*. *Atretia Brazieri*, Davidson, MS. Dredged by Mr. John Brazier off Port Stephens, New South Wales. 17. Interior of dorsal valve. (Davidson Collection, Geol. Dept., British Museum.)

Tretenterata.

Figs. 18–23. *Discina striata*, Schumacher, sp. 18. A typical specimen, after Sowerby. 19, 19 *a*. A malformation. 20, 20 *a*. An enormously thickened upper valve. 21. Interior of the same valve, much enlarged (Davidson Collection, Geol. Dept., British Museum). 22, 22 *b*. Type of *Discina Evansi*, Davidson; from Bodegas (Cuming Collection, Zool. Dept., British Museum). 23, 24. Type of Gould's *Crania radiosa*, from Cape Palmas (National Museum, Washington, D.C.). 25. Exterior of the upper valve, much enlarged. 25. Exterior of the lower or foraminated valve. 24. Interior of the same valve, much enlarged. 26. Section of the valve, to show the position of the foramen.

III. *A Monograph of Recent Brachiopoda.*—Part III. *By* Thomas Davidson, *LL.D., F.R.S., F.L.S., F.G.S., &c.*

Read 17th June, 1886.

(Plates XXVI.–XXX.)

LYOPOMATA, Owen=TRETENTERATA, King.

Family CRANIIDÆ.

Genus CRANIA, Retzius, 1781.

In the recent condition this family is represented by the genus *Crania* only, of which the following four or five species have been determined * :—

1. *Crania anomala*, Müller, sp., 1776.
2. —— *Pourtalesii*, Dall. (Uncertain sp.)
3. —— *turbinata*, Poli, sp., 1795.
4. *Crania Suessii*, Reeve, 1862.
5. —— *japonica*, Adams, 1863.

In an interesting revision of this family, published by Mr. W. H. Dall in the 'Bulletin of the Museum of Comparative Zoology,' vol. iii. 1871, the author seems disposed to regard *Crania turbinata* as a variety of the northern *C. anomala*. Some uncertainty also prevails with respect to the *Crania Pourtalesii*, Dall, 1871, which the author says may possibly be a strongly marked variety of *C. anomala*.

101. Crania anomala, Müller, sp. (Plate XXVII. figs. 1–9 *b*.)

Patella anomala, Müller, Prodr. Zool. Dan. p. 237, 1776; Zool. Dan. i. p. 4, tab. 5. figs. 1–8, 1788; Gmelin, Linn. Syst. Nat. ed. xiii. p. 3721. no. 151, 1788.

Orbicula anomala, Cuvier, Tab. Elém. de l'Hist. Nat. p. 435, 1799; Règne Animal, ii. p. 501, 1817.

Patella distorta, Montagu, Trans. Linn. Soc. vol. xi. p. 195, pl. xiii. fig. 5, 1808.

Orbicula norvegica, Lamarck, Syst. p. 140, 1801 (not Sowerby); An. sans Vert. vol. vi. p. 242, 1819.

Anomia turbinata, Dillwyn, Descrip. Cat. Recent Shells, vol. i. p. 285, 1817 (not Poli).

Orbicula norvegica, Schumacher, Essai d'un Nouv. Syst. Hab. Vers Test. p. 176, pl. xxi. fig. 2, 1817.

Crania personata (part.), Defrance, Dict. Sci. Nat. xi. p. 312, 1818.

Discina ostreoides, Turton, Conchol. Dict. Brit. Islands, p. 238, 1819 (not Lamarck).

Crania personata, Sowerby (part.), On the Genera of *Orbicularia* and *Crania* of Lamarck, Trans. Linn. Soc. vol. xiii. pl. 26. fig. 3 *a* (not 3 *c*), 1822.

Criopus anomalus, Fleming, Phil. Zool. ii. p. 199, 1822; and Brit. Animals, p. 377, 1828.

Orbicula norvegica, Anton, Verzeich. der Conchylien, p. 21, 1839.

Orbicula norvegica, Deshayes, Encycl. Méth. iii. p. 668, 1832 (partly, + *turbinata*, Poli); Potiez et Michaud, Galerie des Mollusques du Musée de Douai, vol. ii. pl. 43. fig. 1?, 1844.

* A single dead valve of a small *Crania*, too imperfect to warrant specific identification, was dredged by H.M.S. 'Challenger' at Station 33, off Bermuda, at a depth of 435 fathoms. Sea-bottom, mud. (Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool., vol. i. p. 65.)

Crania anomala, Lovén, Index Moll. Scand. p. 29, 1846.

Crania norregica, Sowerby, Thes. Conch. i. p. 368, pl. 73. figs. 15–17, 1847.

Criopus orcadensis, Leach, Moll. Great Brit. p. 358, pl. xiii. figs. 6–8, 1852.

Crania anomala, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 376, 1852; Brit. Foss. Brach. Introduction to vol. iii. p. 123, figs. 44–46, 1853; and Mém. Soc. Linn. Normandie, vol. x. pl. 13. figs. 14–36, 1856; Forbes and Hanley, Brit. Moll. ii. p. 366, pl. lxi. figs. 7 & 8, 1853.

Crania norregica, Carpenter, in Davidson, Br. Foss. Brach. Intr. to vol. i., 1853.

Crania anomala, L. Barrett, Ann. & Mag. Nat. Hist. 2nd ser. vol. xvi. p. 259, 1855.

Crania turbinata, Woods, Index Test. ed. Hanley, pl. xi. fig. 2 (not Poli), 1856.

Crania anomala, S. P. Woodward, A Manual of Mollusca, pp. 235, 236, figs. 157, 158, 1856; A. Adams, The Genera of Recent Mollusca, p. 583, pl. cxxxii. fig. 3, 1858; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 220, 1859; Chemnitz, Man. de Conch. ii. p. 230. fig. 1178, 1862; L. Reeve, Conch. Icon., Monogr. of *Crania*, pl. 1. fig. 4, 1862; Gwyn Jeffreys, Br. Conch. vol. ii. p. 24, 1863; and vol. v. pl. xix. fig. 6, 1869; W. King, Trans. Roy. Irish Academy, vol. xxiv. 1869; Dall, Revision of the Craniidæ and Discinidæ, Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 32, 1871; and Proc. Acad. Nat. Sci. Philadelphia, p. 198, 1873; G. O. Sars, Moll. Regionis Arcticæ Norvegiæ, p. 8, 1878.

Crania anomala, var. *alba*, Gwyn Jeffreys, Brit. Conch. vol. v. p. 165, 1869.

Shell hingeless, marginally rounded or somewhat squarely orbicular or subquadrate, with rounded angles; generally wider than long; posterior border straight or slightly indented, shorter than the breadth of the shell, lateral and front margins gently rounded outwards. Upper valve conical, flattened posteriorly and anteriorly from the apex to the margin. Apex or vertex sometimes sharply hooked and pointed, more or less subcentral or submarginal, surface wrinkled by concentric lines of growth. Colour reddish chocolate-brown or pale or dark liver-colour. Lower valve attached to and moulding itself upon stones or shells by the whole of its exterior surface. In the interior of the ventral or lower valve there exists a wide, flattened, granulated border, sloping upwards and inwards from the margin of the shell with a sharp inclination. At each angle of the posterior inner margin are situated two oblique, widely separated, oval-shaped impressions, left (according to Hancock) by the divaricator muscles; and near the centre of the bottom of the valve are two contiguous, larger, obliquely placed scars, due to the adductor muscles; between these last and a little higher up are two other smaller impressions attributed to the dorsal adjustors. In the interior of the upper or dorsal valve there exists a thin, sharp-edged, granulated margin all round the valve, which fits closely to the sloping margin of the ventral valve and is inwardly limited by a narrow convex ridge which surrounds the interior of the valve. At its inner angles are two almost circular projecting scars, due, according to Hancock, to the divaricator muscles, these scars being widely separated by a concave space; under these and lower down are two oval-shaped adductor muscular scars, widely separated by a blunt, rounded ridge, which extends a little distance towards the front. On each side of its anterior extremity are two small oval-shaped scars, referred by Hancock to the brachial muscles. On the surface of the anterior half of the bottom of the valves are seen digitate vascular impressions. The animal is of a white colour, tinged with yellow and brown. Mantle very thin, extending to the edges of the valve and closely adhering. Labial appendages free, thick, and fleshy, spiral at their extremities, directed towards the concavity of the dorsal valve, and supported by a nose-like prominence in the middle of the lower or ventral valve. Cirri numerous, long and stiff. On the under valve the ovaries are of a tawny hue, as figured by Müller. Length 9 lines, breadth 11 lines.

Hab. North Atlantic seaboard from Spitzbergen to Vigo Bay*; in 18–90 fathoms on almost every part of the Scotch and Irish coasts as well as in the seas of Shetland and the Orkneys (Jeffreys); Isle of Man (Forbes); Greenland. Prof. E. Forbes says, in his 'History of British Mollusca,' that "this curious bivalve was first added to the British lists by Dr. Fleming, who found it adhering to stones, from deep waters in Zetland; since then it has been taken abundantly in several localities, chiefly on the west coast of Scotland; off Arran, in 20 fathoms (Smith); Loch Fyne in 30–80 fathoms, plentiful on stones; off Mull in 20 to 90 fathoms; off Lismore in from 20 to 30 fathoms; off Armadale in 18 fathoms; off Copenhaw Head, Skye, in 40 fathoms; on the Ling Bank off Zetland in 50 fathoms (M'Andrew and E. Forbes); Loch Alsh, Loch Carron, Ullapool, East of Lerwick, in 40 fathoms (Jeffreys). In Ireland it has been taken off Youghal by R. Ball, and off Cork by Humphreys."

Obs. Specimens of *C. anomala* vary much in shape, which is to a great extent dependent on the nature of the object to which they are attached. At times a number are clustered together so closely on the same stone that they necessarily become distorted during growth. The position of the vertex and the elevation of the upper valve vary also a good deal, as well as the circular wrinkles that cover its surface. Interiorly the muscular impressions also vary to some extent, and, as remarked by Dr. Gwyn Jeffreys, "sometimes the shell is ribbed across or obliquely, having taken the impression of an *Astarte* or *Pecten* on which it has been moulded. Being often affixed to rugged stones or small pebbles, its shape is adapted to the angles and extent of the basal surface. When it has bare standing-room only, it increases in height and becomes regularly conical. The under valve of specimens attached to a smooth shell of a *Pinna* is usually a mere film." To small bleached specimens dredged by Jeffreys and Barlee off Shetland in 170–530 fathoms, Dr. Gwyn Jeffreys in 1869 applied the varietal name of *alba*. Two of these specimens were kindly forwarded for my examination by Dr. Jeffreys, but I could not discover any valid grounds for separating them from Müller's species. The lower or attached valve is entirely concealed by the upper one. (See Plate XXVII. figs. 9–9 *b*.)

The intimate structure of the shell of *Crania anomala* has been described by Dr. Carpenter in chapter 2 of the Introduction to vol. i. of my 'Monograph on British Fossil Brachiopoda,' and by Prof. W. King in his memoir "On the Histology of the Test of the Class Palliobranchiata," in vol. xxiv. of the Trans. of the Royal Irish Academy. Dr. Carpenter says, *loc. cit.* p. 37, that in *Crania norvegica* "the shell-structure is widely different from that of Brachiopoda generally. Instead of a series of flattened prisms arranged with great uniformity, we only meet with a substance which does not present any regularity or distinctness in the arrangement of its components, but which is not at all unlike that of which many Lamellibranchiate shells are composed, and may probably, like it, be regarded as having been originally formed of the coalescence of cells, which were destitute of any consistency in size, shape, or general arrangement. But

* Specimens of *Crania* (*C. anomala* or *C. turbinata*?) were obtained by the 'Porcupine' Expedition in the Mediterranean in from 207–266 fathoms; in 1869 at Station 2 in 808 fathoms, and Station 12 in 670 fathoms; in 1870 at Station 1 in 567 fathoms, and at Station 3 in 690 fathoms (Jeffreys).

whilst departing from the general Brachiopodous type in this respect, the shell of *Crania* is quite conformable to it, in being penetrated by canals which are prolonged from the lining membrane of the shell, and which pass towards its external surface. These differ from those of *Terebratula*, however, in not arriving at that surface, and in breaking up into minute subdivisions as they approach it. They usually open near the internal margin of the valves, by orifices so large as to be apparent to the naked eye, but nearer the central part of the valves, their orifices are frequently so minute as not to be readily discernible. This is in consequence of the formation of an additional lamina within the old one, and of the contraction of the canals in their passage through it."

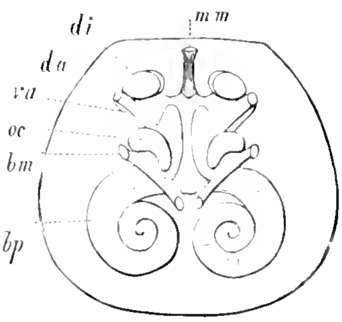
Prof. King states that "*Crania anomala* agrees with the Ancylobrachs in having both valves perpendicularly perforated; but this character is not, as in them, distinctly manifested on the outer surface of the shell. In the upper valve, the perforations, somewhat slender, are widest at their base, that is, where they open out on its inner surface; in other words, their apertures, when observed with a high magnifying power, are seen to be funnel-shaped, separated from one another by a tolerably well-defined ridge-like space; but, with a low power, they simply appear to be separated by a space approximately equalling their own diameter. The apertures occur on the whole of the inner surface of this valve; and they also occur on the corresponding surface of the lower one. . . . . Leaving the contracted portion of their funnel-shaped base, the perforations pass upwards, with a slight attenuation, towards the opposite surface of the valve; but generally, on reaching the brown layer, they become divided, each one splitting into three, four, or more widely diverging branches; occasionally this takes place before the perforations leave the white layer. The branches on approaching the dark-coloured or epidermal portion of the external layer, become minutely subdivided into from two to five branchlets, which appear like arborescent tufts. The branchlets, belonging to the immediately adjacent perforations, become intermixed, causing the intervening spaces, when viewed as a transparent object, to appear as if marked with an irregular net-work of very fine lines. It is difficult to determine whether the branchlets terminate in the epidermal portion of the exterior layer. Both the branches and branchlets are subradially disposed; an arrangement which is, however, much disturbed near the margin of the valve owing to their tendency to this part.

"As regards the intimate structure of the flat or under valve, which is habitually fixed by its entire surface to stones and other foreign objects, I am only imperfectly acquainted with it; all I can say is, the apertures of the perforations are widely funnel-shaped, and less regularly disposed than those already noticed. . . . . A vertical section, obtained from a specimen of *C. anomala*, shows that the outward growth of its upper valve is occasionally interrupted; which is manifested by the continuity of the external brown layer being here and there broken."

The animal of *C. anomala* seems to have been partially described and figured for the first time in 1788 by Otto Frederic Müller. He gave enlarged illustrations showing the position and shape of the labial appendages, which extend horizontally, each forming a plume-like curve, the fringe side being outermost. He likewise figured the vascular impressions and some of the muscles. He styled the animal "*Vermes singularissimus*," and while placing it in the genus *Patella*, admitted that on close inspection the shell differs entirely from that of a Limpet. Furthermore, as observed by Dr. Gwyn Jeffreys, "his comparison of the branching arrangement of the arms to the dusky horns of a wild goat is not inappropriate."

In 1853 the animal of *C. anomala* was to some extent examined by Dr. S. P. Woodward and myself, and in vol. i. of my 'British Fossil Brachiopoda,' and subsequently in his 'Manual of the Mollusca,' we briefly noticed and figured the thick, fleshy, and spirally coiled labial appendages, directed vertically to the cavity of the dorsal valve and in this respect differing from those we found in *Discina lamellosa*; we also observed that the mantle-lobes extend to the edges of the valves and adhere closely, as in *Thecidium*, their margins being plain and thin. Dr. Gwyn Jeffreys observes, at p. 26 of vol. ii. of his 'British Conchology,' that "the animal is by no means timid; when a camel-hair brush is thrust between the gaping valves, they immediately close, but in a few seconds after open again, and this teasing experiment can be repeated many times without alarming the *Crania* or making it sulky. The cirri are not contractile, and do not withdraw or shrink when touched. Each arm has about sixty of them. The fry are quite white and semitransparent, and they have only a few tubular perforations. They adhere in the same way as their parents."

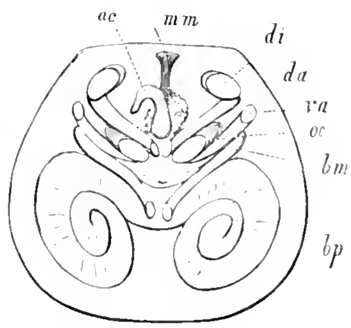
Fig. 20. A.



A. Dorsal surface of an animal of *Crania anomala* (after Hancock).

mm, mesenteric muscle; *di*, divaricators; *da*, dorsal adjustors; *va*, ventral adjustors; *oc*, occlusor; *bm*, brachial muscles; *bp*, brachial process.

B.



B. Ventral surface of animal of *Crania anomala* (after Hancock).

mm, mesenteric muscle; *ac*, alimentary canal; *di*, divaricators; *da*, dorsal adjustors; *va*, ventral adjustors; *oc*, occlusor; *bm*, brachial muscles; *bp*, brachial process.

Lucas Barrett, who had seen many specimens of *C. anomala* in life between Drontheim and Tromsoe attached to stones and shells, in 40 to 150 fathoms water, stated, in the Annals and Mag. Nat. Hist. for 1855 (vol. xvi.), that the cirri, but not the arms, are protruded beyond the margin of the shell. The valves open by moving upon the straight side as on a hinge without sliding the valves—consequently no sliding-muscles were required. At my request in 1859 Mr. A. Hancock examined the animal of *C. anomala*, and in sending me the sketches here reproduced he said "*oc* are undoubtedly the *occlusor* muscles, *di* the *divaricators*; when the former relax, and the latter contract, the fluid in the perivisceral chamber will be forced forward, and then the valves will be opened a little in front. The action is the same as in *Lingula*; *va* may be called the *ventral adjustors*, they form a scar close to the outer border of the divaricators in the ventral valve. The other extremities of the muscles converge and pass round the outer margin of the occlusors to which they adhere; but, he adds, I could not determine exactly how they terminate. I presume that the other extremities form, as stated, a scar in the ventral valve of *C. anomala* from the fact of such a scar existing in the fossil *Crania ignabergensis*. Both the *dorsal adjustors*, *da*, and the *ventral adjustors*, *va*, are much torn in all the specimens; but I think there can be little doubt that they are as represented in the sketch—one end being attached to the dorsal valve close to the outer border of the divaricators, the other most probably to the anterior process of the ventral valve; but I could not satisfactorily determine this; the fibres of this extremity, however, are firmly united to the inner layer of the occlusors. The brachial muscle, *bm*, has both the extremities attached to the same valve (the dorsal), the anterior end to the cardinal process, the dorsal close to the outer margin of the occlusors, with which it blends its fibres; the arms are fixed to these muscles, which perhaps may be named *brachial*: *mm* is a flat thin membranous muscle binding the dorsal extremities, to which, according to Woodward, the cardinal muscle is attached. The ovarian impressions have some resemblance to the uniform scars in the *Productidæ*, but they take their origin from behind the occlusor muscles; I have little doubt that they are ovarian, they can also, I believe, be traced in both valves" *.

Uncertain Species.

102. Crania Pourtalesii, Dall. (Plate XXVII. figs. 12, 12 *a*.)

Crania Pourtalesii, Dall, Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 35, 1871.

Dr. Dall states, *loc. cit.* p. 35, that "the few specimens of *Crania* dredged by the United States Coast Survey Expedition (off the Sambos, Florida, in 116 fathoms, and off the Sand Key in 105 fathoms †) offer some apparently constant differences from *C. anomala*. They are somewhat distorted, very transverse, and have obscure indications of radiating rugosities. The shells are smaller than *C. anomala*, have a strong concentric foliation caused by the imbrication of the lines of growth. The colour is much the same as in *anomala*; one white specimen with a few radiating brown lines was dredged on a stone in 126 fathoms, off Sand Key, by Mr. de Pourtales. The interior of the lower valve was of a green colour. The posterior muscular impressions are smaller and closer together than in *C. anomala*. It is very possible, however, a strongly marked variety of that species; but in case the collection of a larger number of specimens should prove its distinctness I would propose for it the name of *C. Pourtalesii*, Dall."

Obs. Never having seen this shell, I reproduce verbatim Dr. Dall's description of it.

103. Crania turbinata, Poli, sp. (Plate XXVII. figs. 14–23, Plate XXVIII. figs. 1, 1 *a*.)

Anomia turbinata, Poli, Test. utriusque Siciliæ, ii. p. 189, tab. 30. fig. 15, 1795: *Criopus fimbriatus* (animal), *Criopoderma turbinatum* (shell).

Patella kermes, Humphey and Da Costa, Nat. Hist. of Shells, p. 7, pl. i. fig. 10, 1770.

Anomia craniolaris (part.), Gmelin, Linn. Syst. Nat. ed. xiii. vol. iv. p. 3340, 1788.

Anomia turbinata (part.), Dillwyn, Cat. of Recent Shells, p. 286, 1817.

Crania personata, Blainville, Dict. Sci. Nat. vol. xi. p. 312, pl. 304, fig. 2, Cat. xv. 1818 (not Lamarck).

Crania ringens, Hœninghaus, Beitr. Monogr. *Crania*, p. 3, fig. 2, 1828.

Crania rostrata, Hœninghaus, Beitr. Monogr. *Crania*, p. 3, fig. 3, 1828.

* [A series of remarkable observations on the living animals of *Crania* and *Discina* were recorded by M. L. Joubin at the Arago zoological station, Banyuls-sur-Mer, in the years 1884, 1885, and 1886. A brief abstract of his important memoir, 'Recherches sur l'Anatomie des Brachiopodes Inarticulés,' is appended to this monograph.—A. C.]

† *Crania Pourtalesii* has also been dredged off St. Vincent, West Indies, in 88 fathoms (Dall, Bull. Mus. Comp. Zoöl. Harvard, vol. xii. p. 205, 1886).

Orbicula turbinata, Deshayes, ed. Lamarck, An. sans Vert. vol. vii. p. 317, 1836.

Crania ringens, Anton, Verz. der Conchylien, p. 21, 1839; G. Sow. Thes. Conch. i. p. 367, pl. lxxii. figs. 10 & 11, 1846; E. Forbes, Report on the Mollusca of the Ægean Sea, Brit. Assoc. for the Advancement of Science, 1843.

Crania ringens and *C. rostrata*, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 223, 1859.

Crania rostrata, L. Reeve, Conch. Icon., Monogr. of *Crania*, pl. i. fig. 3, 1862.

Crania ringens and *C. rostrata*, Goldfuss, Petrefaktenk. Deutschlands, p. 291, and p. 292, pl. clxii. figs. 2 & 3, 1826–33; Brusina, Moll. Dalmati, Reale Soc. Botanica di Vienna, vol. xvi., 1866.

Crania turbinata, L. Reeve, Conch. Icon., Monogr. of *Crania*, pl. i. fig. 1, 1862; H. C. Weinkauff, Die Conch. des Mittelmeeres, p. 291, 1867.

Crania anomala, var. *turbinata*, Dall, Revision of the Craniidæ and Discinidæ, Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 31, 1871; and Proc. Acad. Nat. Sci. Philadelphia, p. 199, 1873.

Crania rostrata, L. Joubin, Comptes Rendus, t. xcix. p. 985, 1884; t. c. p. 464, 1885; Arch. de Zool. Expér. t. iv. p. 161, 1886.

Shell marginally more or less rounded, rather wider than long, broadest anteriorly, slightly indented at its posterior and anterior margins; labial margins outwardly curved and slightly pinched in close to the posterior margin. Upper valve more or less subtrapezoid, conical or limpet-like. Vertex central or submarginal, pointed or hooked, curving towards the posterior margin, valve flattened from the apex to the posterior and often anterior margins. Smaller or lower valve moulding itself to main objects by its entire outward surface. Upper valve small or roughened. In the interior of the flattened lower valve a wide, thickened, sloping, granulated rim or border, thin at the edge, surrounds the shell; it forms a slight inward curve posteriorly, then curves in just under the posterior angles and again outwardly all round the anterior portion of the shell. Each of the posterior angles of the inner margin is taken up by a projecting circular scar, left by the divaricator muscle. These two scars are widely separated, and the intervening space is occupied by two other small projecting eminences, which Hancock refers to mesenteric muscles, destined probably to draw the alimentary tube backward. At the anterior labial angles of the divaricator scars another smaller one is seen, which has been attributed by the same distinguished zoologist to the dorsal adjustors. Lower down towards the middle of the bottom of the valve are two oblique, almost contiguous oval-shaped scars, which have been referred to the adductor muscles, and between them and more towards the posterior edge is seen a nose-like projection composed of two small oblique oval-shaped scars, which have been referred to the anterior extremities of the dorsal adjustors. The remaining anterior portion of the interior of the valve is traversed by digitate vascular (?) impressions. In the interior of the upper valve a raised thickened rim or border margins the interior of the shell and follows the ins and outs or curves of the lower valve. At the inner angles are two oblique oval-shaped scars due to the divaricator muscles, and in the space separating them are two other smaller scars, perhaps due to the mesenteric muscles; under these and lower down are two large oblique projecting elevations caused by the adductors, these impressions being separated from each other by a narrow hollow space, the remaining area between these and the rim being taken up by digitate vascular (?) impressions. The shape and position of the labial appendages have been described under *Crania anomala* and need not here be repeated. Colour light yellow or light brown. Length 6 lines, breadth 7 lines.

Hab. Mediterranean and Ægean Sea, attached to rocks and coral at a depth of from 40 to 150 fathoms (Forbes); Gulf of Lyons, Banyuls-sur-Mer, in from 50 to 60 metres, on rocks (L. Joubin).

Obs. This Mediterranean shell seems to have been described for the first time by Poli in 1795. He gave enlarged illustrations of the interior, to show the position of the principal muscles, mouth, labial appendages, and vascular impressions; but, strange to say, he described the animal under the name of *Criopus*, and the shell by that of *Criopoderma*. As observed by Dall (*loc. cit.* p. 36), "Poli evidently considers *Anomia* as a synonym, and only uses it by way of explanation. It is evident that such a system of nomenclature as the above can never be fairly squared with the binominal system."

By some malacologists *Crania turbinata* has been considered to be the same as or a synonym of *Crania anomala*, by Dall as a variety of the last-named species, and by some others as a distinct form. I have therefore preferred to leave it, for the present at least, as a separate species. It certainly bears considerable resemblance to the northern form, yet it possesses some peculiarities of its own. It is, on the whole, a smaller shell, differing in colour as well as in some of its interior details. Its upper valve is generally less conical; but exceptional examples of the Mediterranean shell are quite as conical or limpet-like as some of those that occur in the northern seas.

Crania turbinata is often much out of shape from having its thickened lower valve attached to corals, to which it moulds itself, as in the case of the specimen figured by Sowerby in pl. xxvi. fig. 3 *c* of the 'Transactions' of the Linnean Society of London for 1818, under the name of *Crania personata*. Sowerby considered that species and *C. anomala* to be one species; for he says that "the only difference observable between the specimens from Shetland and those from the Mediterranean is in the thickness and irregularity of the lower valve; those from the latter sea being very thick and irregular; whereas those from Shetland are much thinner and more regular in their shape; but this difference, I imagine, may be easily accounted for from the different situation of the respective specimens; the one being found upon rugged old corals, and the other being attached to a comparatively smooth stone." (See Plate XXVII. fig. 22.)

This is no doubt the case with respect to the Mediterranean form. On a specimen of coral now before me three examples of the lower valve are attached, one of these, affixed to a flat portion of the coral, is perfectly regular in shape, the other two being attached to the circular part of the coral are irregular in form, the shell having been obliged to follow the irregularities of surface, which were imparted to the shell itself.

There appears to be likewise a good deal of difference in the shape and projections or depressions of the muscular scars in different specimens, and it is on these differences that Hœninghaus seems to have established his *Crania ringens* (Plate XXVIII. figs. 1–1 *a*) and *C. rostrata* (Plate XXVII. fig. 21), both Mediterranean shells, which I believe to be synonyms of the *Crania turbinata* of Poli. The so-termed *C. rostrata* figured by Reeve in his Conch. Icon. does not agree with Hœninghaus's figures of his species. Thus in the type of *C. ringens* the divaricator scars are figured as large sunken-in depressions, only slightly separated, and the occlusors as formed of a large transverse oval-shaped scar, no rostellum being present; while in *C. rostrata* the divaricators are more separate, and the adductors have a more or less developed and projecting rostellum. These extremes, however, will vanish when a number of specimens are examined, and every intermediate form will be found connecting the two extremes. The intimate shell-structure of *Crania turbinata* seems very much the same as that of *C. anomala*, but when describing the structure of the attached valve of *C. anomala*, Prof. King observes, "*Crania ringens* (Hœninghaus) [*turbinata*, Poli] has afforded me more information; inasmuch as the same valve, which is thick, and adhering to coral, shows, in a vertical section, the perforations distinctly passing direct downwards, and traversing nearly its entire thickness; becoming forked and attenuated as they approach the attached surface."

I know nothing of the species (?), which Sowerby and Reeve erroneously, I think, refer to the *Crania rostrata* of Hœninghaus *.

Sowerby and Reeve describe it as follows:—"Shell with the lower valve rotundately subtrapezoidal, posterior margin rather straight, posterior scars orbicular, the anterior small, semilunar, anteriorly coalescing, rostellum small, rather sharp, disk sinuated, rim grained, anteriorly irregular, thickened; upper valve thinner, white, somewhat radiately roughened, interior with two raised ribs radiating from the centre towards the posterior margin."

No fresh observations have been made on this species since the publication of Mr. Sowerby's monograph of the genus in 1846, and his characters are copied by Reeve verbatim. Its habitat, Mr. Cuming informs me, is "not the Mediterranean, as given by Sowerby, but South Africa."

104. Crania japonica, Adams. (Plate XXVII. figs. 10, 11.)

Crania japonica, A. Adams, Ann. & Mag. Nat. Hist. vol. xi. p. 100, 1863; Davidson, Proc. Zool. Soc. p. 311, pl. xxx. fig. 6, 1871; Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 199, 1873; G. Dunker, Index Moll. Maris Japonici, p. 254, 1882.

Shell small, almost square, with rounded angles, nearly straight or slightly indented posteriorly, rounded laterally and in front. Upper valve conical, vertex situated at about one third of the length of the valve from the posterior margin; surface smooth, marked with concentric lines. Lower valve almost flat, attached to marine objects by its exterior surface. In the interior of the upper valve a narrow margin encircles the valve, and close to the posterior margin are two slightly oblique oval-shaped projecting divaricator muscular scars widely separated from one another; towards the middle of the bottom of the valve two large oblique projecting elevated oval-shaped adductor muscular projections arise, gently excavated along their middle; these scars are so large that they almost divide the valves into two portions, and are separated at the middle of the shell by a blunt ridge, which extends some distance towards the front. In the interior of the lower or attached valve the adductor and divaricator muscular scars occupy a similar position to those in the upper valve, but do not project nearly so much. Colour dirty white. Length and breadth $3\frac{1}{2}$ lines.

Hab. Dredged by A. Adams at Gotto, Japan, in 71 fathoms.

* *Crania rostrata*, Sowerby, Thes. Conch. p. 368, pl. lxxiii. figs. 12–14, 1846; L. Reeve, Conch. Icon., Monogr. of *Crania*, pl. i. fig. 3, 1862.

Obs. This appears to be a distinct species, remarkable on account of the large size and projection of its adductor scars, which remind us of those described and figured by F. W. Hœninghaus in the Tertiary *Crania abnormis* of Defrance.

Crania japonica was briefly described, but not figured, by A. Adams in 1863. I figured in 1871 the type specimen presented to me by its discoverer.

105. CRANIA SUESSII, L. Reeve. (Plate XXVII. fig. 13.)

Crania Suessii, L. Reeve, Conch. Icon., Monogr. of *Crania*, pl. 1. fig. 2, 1862; Dall, Amer. Journ. of Conch. vol. vii. p. 73, 1871; Bull. Mus. Comp. Zoöl. Harvard, p. 32, 1871; Proc. Acad. Nat. Sci. Philadelphia, p. 199, 1873.

"Shell sub-orbicular, somewhat truncately squared on the posterior side, posterior scars ovate, oblique, rostellum large, callous, anterior rim thickened, granulated; upper valve rather solid, rough, faintly tinged with orange-red, internal posterior scars narrowly ovate, obliquely flowing together.

"*Hab.* Sydney (*Strange*).

"*Obs.* Of this interesting Australian *Crania* Mr. Cuming possesses five specimens, collected by Mr. Strange at Sydney. It comes very near to the West-African species which has been assigned to *C. rostrata* of Hœninghaus, but it is of a more convex and roughly solid growth; and the difference of habitat leaves no room for doubt on the subject. The internal posterior scars of the lower valve are obliquely ovate and somewhat isolated, while in the upper valve they are narrow and callously raised. The rostellum is large and prominent. Another character is the delicate tinge of orange-red on the outer surface, quite different to the red stained colouring of the European species."—*L. Reeve*.

I have reproduced Mr. Lovel Reeve's descriptions and figures of this species, as I know so little of it. Mr. John Brazier, of Sydney, informs me that he has neither found nor seen a specimen in Australia; the above reference to Sydney therefore seems doubtful. Furthermore, if found by Strange in Australia, it would probably be at Moreton Bay, a locality in which he collected extensively.

Family DISCINIDÆ, Gray, 1840.

Genus DISCINA, Lamarck, 1819.

Type *Discina ostreoides* (Rang)=*Crania striata* (Schumacher).

For many years the recent species of this family were classed with *Orbicula*. In 1825, in the 'Annals of Philosophy,' Dr. Gray pointed out that *Orbicula* was a synonym of *Crania*, and that it was necessary to adopt Lamarck's excellent genus *Discina*, a view now generally admitted. In his 'Revision' of the Craniidæ and Discinidæ published by Mr. W. H. Dall in the 'Bulletin of the Museum of Comparative Zoology, Harvard,' vol. iii. p. 37, 1871, the author proposes to divide the recent species into two subgeneric groups as follows:—

Genus DISCINA, Lamarck. Type *D. striata*, Schumacher, sp., 1817.

Subgenus DISCINA, *sensu stricto*. Shell with subequal externally convex valves, with subcentral apices. Lower valve with a small subtriangular longitudinal septum or prominence in the centre, with a minute circular orifice beneath it, for the peduncle, from which an impressed line or furrow extends on the inside, posteriorly, for a short distance. Shell of rather solid texture, impunctate; perforated by very minute tubuli (?). Type *D. striata*, Schum. = *D. radiosa*, Gld. + *D. Evansi*, Dav. + *D. norvegica*, Sby. + *D. ostreoides*, Lamarck.

Subgenus Discinisca, Dall, = Discina, auct. Lower valve more or less flattened, concave or compressed. Upper valve more convex; apices of both subcentral or subposterior. Lower valve with a small septum as in *Discina*, behind which is an impressed disk or area, externally concave, and internally elevated. This is perforated by a longitudinal fissure, extending from a short distance behind the septum nearly to the posterior margin, which is often slightly indented behind it. Shell more or less horny in texture, minutely tubulous. Type *Discina lamellosa*, Brod. Rve. Conch. Icon. pl. i. fig. 4, 1862.

We are acquainted with only one recent species of *Discina* proper, namely the *Discina striata* of Schumacher.

Of *Discinisca* we have the following:—

Smooth species.
- *Discinisca lævis*, Sowerby, sp., 1818 (or 1822).
- *Discinisca tenuis*, G. Sowerby, sp., 1847 (may be only a variety of the preceding species).
- *Discinisca lamellosa*, Broderip, sp., 1833.
- *Discinisca atlantica*, King, sp., 1868.

Radiately striated.
- *Discinisca Cumingii*, Broderip, sp., 1833.
- ? *Discinisca antillarum*, d'Orbigny, sp., 1853 (an uncertain species).
- *Discinisca stella*, Gould, sp., 1860.

106. Discina striata, Schumacher, sp. (Plate XXV. figs. 18–26.)

Crania striata, Schumacher, Essai d'un Nouveau Système des Hab. des Vers Test. pl. xx. fig. 1, 1817 (not of Defrance).

Orbicula norvegica, Sowerby, Trans. Linn. Soc. vol. xiii. p. 464 (syn. excl.), pl. xxvi. fig. 2 *a* to *f*, 1818 (not of Lamarck).

Discina ostreoides, Lamarck, An. sans Vert. vol. vi. p. 337, 1819.

Orbicula ostreoides, Rang, Man. des Moll. p. 263, 1829.

Discina ostreoides, T. Brown, Conch. Textbook, ed. 3, p. 108, pl. xiv. fig. 8, 1835.

Orbicula striata, G. B. Sowerby, Thes. Conch. vol. i. p. 366, pl. lxxiii. fig. 8, 1846.

Crania radiosa, Gould, Moll. U. S. Expl. Exped. p. 465, fig. 480 *a–c*, 1852.

Discina striata, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 376, 1852.

Orbicula Evansii, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 376, 1852; and Proc. Zool. Soc. 1852, p. 81, pl. xiv. figs. 32–34.

Discina striata and *D. Evansi*, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. pp. 225 & 226, 1859.

Orbicula ostreoides, L. Reeve, Conch. Icon., Monogr. of *Orbicula*, no. 7, pl. i. fig. 7 *a–b*, 1862.

Discina striata, Dall, Bull. Mus. of Comp. Zoöl. Harvard, vol. iii. p. 39, 1871; and Cat. of the Recent Species of the Class Brachiopoda, Proc. Acad. Nat. Sci. Philadelphia, p. 300, 1873.

Shell elongated oval or circular, generally irregular in shape, sometimes exceedingly thick. Valves convex. Upper valve conical and more or less elevated. Apex submarginal, sometimes central. Lower valve less convex than the upper one, perforation or foramen small, oblique, situated at about one third of the distance from the posterior margin. Surface of valves radiately finely striated, the narrow riblets increasing in number by the interpolation of shorter ones at various distances from the vertex or foramen. The valves are also strongly marked with concentric lines or ridges of growth. In the interior of the generally much thickened upper valve the muscular scars occupy the margins of a rather large sunken space; there are four obliquely placed adductor scars—two are situated at a short distance from the posterior margin of the valve and are separated by two very small retractor muscular impressions. The second pair of oval-shaped adductor scars are obliquely situated towards the middle of the bottom of the valve, with a narrow ridge between them which extends some distance along the bottom of the cavity in the shell. In the interior of the lower valve the adductor muscular scars meet in front of a small longitudinal septum, which rises from the centre, hiding a small tubular perforation which traverses the valve in an oblique manner; the posterior adductor scars are small and widely separated. Shell-structure horny and calcareous. Colour yellow and brownish yellow. Length $8\frac{1}{2}$ lines, breadth 8 lines.

Hab. Cape Palmas, West Africa.

Obs. Mr. W. H. Dall has given much attention to the history and identification of the species under description. He states in his Report on the Brachiopoda obtained by the United States Coast Survey Expedition, *loc. cit.* p. 40, "when changes in nomenclature depend upon the identification of types described by the early authors, the work is one of great difficulty, and requires the utmost caution, lest fresh confusion be the result. In many cases an approximation to a determination alone can be arrived at, and authors may conscientiously differ as to the decision, and its bearings on nomenclature. In the present case, however, there is but little difficulty, as the species under consideration has been well described and carefully figured by the describers, though under several names [both generic and specific]; the history of the type specimens is very clear, and was put on record at the time.

"Lamarck constituted the genus *Discina* to receive a shell which he called *D. ostreoides*, but of which he did not give any figure or specific description. The specimen was received from Mr. J. Sowerby, and is the same species and from the same lot of specimens as the shell described by Mr. G. B. Sowerby, in the Linnean 'Transactions,' and well figured by him there, under the name of *Orbicula norvegica*. His very excellent figure enables me to speak with positiveness in saying that it is identical with *Crania radiosa*, Gould, of which the type specimens are before me. The figures of Schumacher are sufficiently exact to allow of identifying the species with his *Crania striata*. The figures given by Reeve and Davidson are excellent, and almost certainly represent the same species, though this is a matter of little consequence, the main point being the identification of Sowerby's shell with the specimens before me, which may be regarded as certain."

If therefore Schumacher's so termed *Crania striata* and Lamarck's *Discina ostreoides* represent the same shell, then of course Schumacher's specific name must be retained for the species. As remarked by Mr. L. Reeve, the species was named *ostreoides* by Lamarck from a specimen sent to him in 1819 by Mr. James Sowerby, father of Mr. G. B. Sowerby, who described it in the following year in a paper read before the Linnean Society under the name of *Orbicula norvegica*. He had then discovered it in abundance in the crevices of a quantity of ballast-stone used in the neighbourhood of Lambeth for mending roads, and it was again described by G. B. Sowerby in 1846, under the name of *Orbicula striata*. The same shell was also found some years age by Mr. L. Binney in ballast-stone on the shores of the Clyde near Glasgow.

It should also be recorded here that in a paper entitled "Observations on the Synonima of the Genera *Anomia*, *Crania*, *Orbicula*, and *Discina*," published in the 'Annals of Philosophy' for 1825, Dr. J. E. Gray, of the British Museum, maintained that the genus *Discina* was established for the species under description. Both Mr. Dall and Mr. Reeve have referred my *Orbicula Evansi* to Schumacher's or Lamarck's species, and I am quite willing to agree to their identification.

Subgenus Discinisca, Dall.

107. Discinisca lævis, Sowerby, sp. (Plate XXVI. figs. 1, 9–11.)

Orbicula lævis, Sowerby, Trans. Linn. Soc. vol. xiii. p. 468, pl. xxvi. fig. 1, *a–d*, (read in 1818) published in 1822; G. B. Sowerby, Thes. Conch. i. p. 265, pl. lxxiii. figs. 2, 3, 1846; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 376, 1852.

Discina lævis, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 226, 1859.

Orbicula lævis, L. Reeve, Monogr. of *Orbicula*, Conch. Icon. pl. i. figs. 4 & 5, 1862.

Discina lævis, Dall, Amer. Journ. of Conch. vol. vii. p. 76, 1871; Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 42, 1871; and Proc. Acad. Nat. Sci. Philadelphia, p. 201, 1873.

Shell horny, almost orbicular, and nearly as wide as long, a little broader and more rounded anteriorly. Surface either nearly smooth or more or less strongly marked with concentric lines or ridges of growth. Upper valve compressed, limpet-like, or gently conical. Vertex submarginal. Lower or smaller valve moderately convex, most elevated towards the middle at about one third the length of the shell from the posterior margin. Central third of the posterior half of the valve abruptly depressed, with a flattened, smooth, oval, or heart-shaped disk, which does not quite reach the slightly indented posterior margin of the shell. Along its centre an oval-shaped, narrow, longitudinal fissure extends to within a short distance of the posterior ridge of the disk, and through which a short stout peduncle passed, which expanded all over the disk prior to becoming cylindrical, and again expanded at its extremity, where it became firmly attached to some marine object. In the posterior half of the interior of the larger valve a slightly sunken oblong depression occupies rather more than a third of the breadth of the shell, and commences at some little distance from the posterior margin of the valve. It is of an oblong shape, almost straight posteriorly, slightly indented laterally and obtusely angular anteriorly. Along the posterior edge or portion are two transversely oval-shaped adductor scars, separated by two other very small impressions attributed to the retractor muscles; on the anterior portion of the depressions or disk are two larger obliquely placed adductor impressions, separated by a small rudimentary ridge. In the interior of the smaller valve an elevated or convex disk occupies the central third of the posterior half of the valve, and along the middle is a narrow oval-shaped fissure, which extends along the disk to about half its length; anteriorly a small triangular-shaped septum divides the anterior pair of adductor muscles. Mantle highly vascular, fringed with setæ, which extend to fully one third of the length of the shell and beyond the margin of the shell. The labial appendages curve backwards, return upon themselves, and end in a small spiral directed downwards. Colour light yellow or chestnut-brown. Length 15 lines, breadth $14\frac{1}{2}$ lines.

Hab. Great Ocean from Cobija (Bolivia) to the Island of San Lorenzo, Concepcion, Chili (15 fathoms). It was obtained by Mr. F. H. Bradley at Callao, Peru, clustered together in vast numbers and adhering in all stages of growth by its peduncle to the surface of the shells of its neighbours, till a living mass of considerable breadth and thickness was formed, living at a depth of six or more fathoms.

Obs. On the 17th of March, 1818, Mr. George B. Sowerby read before the Linnean Society a paper on the genera *Orbicula* and *Crania* of Lamarck, in which for the first time he introduced his *Orbicula lævis*, with good figures of the exterior and interior of the valves. It can hardly be said that he described the species; for all he said of it was, "*Orbicula lævis, O.* valvulis tenuibus lævibus, tab. xxvi. fig. 1. Habitat in mari, saxis adhærens." In 1862, Mr. Lovel Reeve, in his monograph of *Orbicula*, states that "this species was first described by Mr. Sowerby in a paper read before the Linnean Society in December 1820, from a specimen attached to a grey flint or pebble nearly coated by the roots of an *Isis*, of which the habitat was not known. Twelve years later it was found attached to shells dredged by Mr. Cuming, as above noted, off Concepcion, Chili. It is a stout horny shell, with surface smooth and faintly malleated. The vertex, which much inclines posteriorly, is conically raised, swollen and rather obtuse."

What we know of the animal of this species will be found recorded under *Discinisca lamellosa*. Having had before me a very large number of typical specimens and others of *Discinisca lævis*, *D. tenuis*, and *D. lamellosa*, I am much inclined to consider them as variations in shape, or varieties of a single species; but as malacologists generally seem to differ with me in this respect, I will provisionally describe them separately. If a large number of specimens of *Discinisca lævis* are examined, especially those from Callao and Peru, it will be found that some of them are smooth and marked only by numerous fine concentric lines. In some these lines are more strongly defined, and, again, in others they are replaced by thin rows of adpressed or gently raised lamellæ, which roughen the surface of the shell. I am also of opinion that fig. 5 of plate i. of Reeve's Monogr. of *Orbicula*, and referred by him to *Orbicula tenuis*, is no more than a smoother shell of *Discinisca lævis*. If it should be therefore eventually found necessary to unite *D. lævis*, *D. tenuis*, and *D. lamellosa* under a single denomination, the name *lævis* would have to be retained for the species.

108. DISCINISCA TENUIS, Sowerby, sp. (Plate XXVI. figs. 12–17 *a*.)

Orbicula tenuis, G. B. Sowerby, Thes. Conch. vol. i. p. 366, pl. lxxiii. figs. 4, 5, 1847; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 376, 1852.

Discinisca tenuis, Dall, Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 41, 1871.

Shell elongated, orbicular or circular, broadest anteriorly, thin, horny, semitransparent, shining, smooth, marked only by fine concentric lines of growth. Colour light yellow or pale yellowish brown. Upper or larger valve moderately convex, limpet-like; apex small, slightly hooked, submarginal. Anterior half of lower or smaller valve and lateral portions of the posterior half convex, less so than in the opposite valve; highest elevation about the middle; larger portion of the posterior half of the valve abruptly sunken; disk oval-shaped, commencing close to the posterior margin, extending to the middle of the valve and forming an obtuse angle with the plane of the sunken portion. Fissure oval-shaped, rather narrow, commencing close to the posterior margin of the valve and extending a little more than half the length of the disk. In the interior of the valves the muscular and other impressions are exactly similar to those seen in *Discinisca lævis* and *D. lamellosa*. Length 13 lines, breadth 12 lines.

Hab. Uncertain.

Obs. Sowerby describes this species in the following words:—"Shell smooth, thin, apex of the upper valve near the posterior margin; disk of adhesion obtusely angular, close to the hinder edge; perforation linear." Sowerby's figures 4 and 5 are somewhat exceptional, the larger number of specimens given to me by Mr. Sowerby being more regularly oval, and even rounded, and nearly resemble some of *Discina lævis* from Concepcion, Chili. The group of specimens attached to one another figured by L. Reeve on pl. i. fig. 5 of his Monogr. of *Orbicula* seem to me and, I believe, also to Mr. Dall more referable to *Discinisca lævis* than to the variety (?) *D. tenuis* of Sowerby.

109. DISCINISCA LAMELLOSA, Broderip, sp. (Plate XXVI. figs. 1–8.)

Orbicula lamellosa, Broderip, Trans. Zool. Soc. vol. i. p. 142, pl. xxiii. fig. 2, 1835; Owen, On the Anatomy of the Brachiopoda, Trans. Zool. Soc. vol. i. p. 153, pl. xxiii. figs. 2–13, 1835; Anton, Verzeichniss der Conch. p. 21, 1839; G. B. Sowerby, Thes. Conch. vol. i. p. 365, pl. lxxiii. fig. 1, 1846; Davidson, Ann. & Mag. Nat. Hist. vol. ix. 2nd ser. p. 376, 1852, and Intr. to Br. Foss. Brach. vol. i. p. 127, figs. 47–49, 1853; A. d'Orbigny, Voyage dans l'Amérique méridionale, vol. v. p. 677, 1847.

Discina lamellosa, S. P. Woodward, A Manual of the Mollusca, pp. 336, 337, figs. 160–162, 1856; H. & A. Adams, The Genera of Recent Mollusca, p. 584, pl. xiii. fig. 4, 1858; E. Suess, Ueber der Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 227, 1859.

Orbicula lamellosa, L. Reeve, Conch. Icon., Monogr. of *Orbicula*, pl. i. fig. 3, 1862.

Discinisca lamellosa, Dall, Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 41, 1871, and Proc. Acad. Nat. Sci. Philadelphia, p. 202, 1873.

Discina lamellosa, Davidson, Brit. Encycl. 9th ed. p. 188, fig. 10, 1876.

Discina (*Discinisca*) *lamellosa*, Zittel, Handbuch der Paläontologie, p. 667, fig. 191, 1880.

Discina lamellosa, L. Joubin, Comptes Rendus, t. ci. p. 1170, 1885; Arch. Zool. expér. t. iv. 2e sér. p. 161, pls. 13, 14, 1885.

Shell circular or orbicular, about as broad as long, horny in substance; valves convex, somewhat depressed; colour light chestnut-brown, disk in lower valve white. Upper or larger valve compressed, conical, or limpet-like, vertex submarginal or situated at about one third of the length of the shell from the posterior margin, concentrically lamellose; anterior half or two thirds of the lower valve moderately convex; in posterior half there exists a sunken and perforated disk; fissure narrow, commencing at a short distance from the posterior margin, and extending to about two thirds of the length of the disk of adhesion. Surface, with the exception of the disk, covered with numerous squamose, slightly projecting, concentric laminæ (as in the upper valve). In the interior of the larger valve rather more than one third of the posterior half of the valve is occupied by an oblong space, on part of which are situated the scars left by the adductor muscle; the posterior pair are on a horizontal line at a short distance from the margins of the valve, and separated by two very small scars attributed to the retractor muscles (?). The anterior pair of adductor scars are obliquely placed at about the middle of the valve, and are larger than the posterior ones. In the interior of the smaller valve the disk forms an elevated, convex, oval-shaped area, with a small, sharp, central, triangular-shaped prominence in front of the foramen, which separates the anterior pair of adductor muscular scars. The fissure, which is narrow, begins at a short distance from the posterior margin, and extends to about two thirds of the length of the disk. The animal is extremely delicate and transparent; mantle-lobes distinct all round and not adhering to the interior of the shell, which is smooth and polished, highly vascular, bordered with a dense fringe of long horny setæ, which are stiff, barbed, and extremely brittle. Labial folds united, not extensile. Spiral extremities of the arms directed towards the lower valve, and not dorsally, as in *Crania*. Length and breadth nearly 1 inch.

Hab. Iquiqui, adhering to living *Mytilus*, and Bay of Ancon, Peru. From Panama to Peru (Cuming). It occurs in groups or piled one over the other in vast numbers on sandy bottoms and at depths of from 5 to 9 fathoms. Mr. Reeve mentions that at Ancon *Disciniscа lamellosa* was found attached to dead shells, also clinging to the wreck of a Spanish vessel of about three hundred tons that went down in the bay about ten years before. A. d'Orbigny states that it is common on all the shores of the Great Ocean, from Cobija (Bolivia) to Callao (Peru), and that he has obtained it in shallow sea in great numbers near the island of San Lorenzo.

Obs. This species has been well figured by Broderip, Sowerby, L. Reeve, and others. The animal was anatomically described and illustrated by Owen in the Trans. of the Zool. Soc. of London, vol. i. 1835, as well as by Dr. S. P. Woodward and myself in 1852 *.

Prof. Owen states (p. 153, *loc. cit.*):—"On carefully removing the imperforate valve, the vascular mantle is seen with the margin entire in the whole of its circumference. The muscles and *viscera* form a rounded mass, situated in the posterior half of the shell. First are seen the extremities of two muscles, of an oblong figure, converging anteriorly, and measuring two lines by nearly one: in the triangular space between these muscles is situated the green liver, behind which is the grey ovary; and at the posterior part of the circle are the extremities of two smaller muscles. The four impressions of these muscles are observable on the interior of the shelly valve.

"On removing the lower valve, which should be cut through from either side as far as the fissure in order to avoid disturbing the soft parts, the vascular lobe of the mantle with similar free margins is exposed, but the *viscera* are quite concealed by the dilated disk or foot.

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

* [More recently Dr. L. Joubin has described (*loc. cit.* p. 33) the mantle of *Discina* as a thin membrane, closely adherent, with a thickly ciliated border. It acts as a respiratory organ, bounds the visceral cavity, and contains arborescent prolongations of the body-cavity as in *Crania*. The main vascular trunks are subdivided into branches having numerous little orifices at their terminations. There is no trace of a heart or arterial system. The genital glands resemble those of *Crania* and *Lingula*. The arms cannot be extruded beyond the shell-margins; the cirri are thick and very long. The peduncle, which differs much from that of *Lingula*, is formed of a fold of the mantle; and, being enclosed as in a sac, is entirely separated from the body-cavity. This structure is identical with that subsequently shown by the same author (Bull. Soc. Zool. de France, vol. xii. 1887, pp. 119–126) to exist in young forms of the articulated genera *Argiope* and *Terebratulina*.—A. C.]

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

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

"The muscular system of *Orbicula* differs in some respects from that of *Terebratula*. Eight distinct muscles may be perceived, without including the labial arms. The four thick and strong muscles which form the anterior and posterior pairs above noticed, do not decussate each other, but pass a little obliquely from one valve to the other. On the lower valve they are attached to the margin of the elevation caused by the oval depression noticed on the exterior of the shell. Some of the fibres of the large anterior pair pass through the chink in the perforated valve and expand into the organ of adhesion. Within the space included by the above pairs of muscles, there are two slender pairs of muscles which decussate each other. The superior pair take their origin from the anterior part of the strong membrane that circumscribes and protects the *viscera* below the stomach, and between the insertions of the anterior shell-muscles; they then ascend, diverge on either side of the alimentary canal, and are inserted into the opposite valve outside the posterior shell-muscles. The inferior pair arise from the sides of the membranous circle, and converge as they pass below the preceding, to be inserted into the perforated valve on the inner side of the posterior shell-muscles. While, therefore, the larger muscles have the more important office of guarding the animal by closing the shell, the smaller muscles would admit the water by sliding the margin of one valve over the other; and they are also calculated to produce a compression of the *viscera*.

"The labial processes or *brachia* are scarcely more adapted to protrude externally than in *Terebratula chilensis*, the only parts that are free being the short spiral extremities; but in the more muscular character of their basis or stem they exhibit a close affinity with *Lingula*. Considering the arms as a pair, the stems are then joined below the mouth, forming on that aspect a transverse, semilunar, fleshy basis, fringed and convex anteriorly. This is attached to the anterior part of the tendinous belt of the *viscera*. At the sides of this basis the arms make a sudden bend upon themselves towards the mouth, above and in front of which the extremities make a spiral turn and a half. The bent portions are closely adherent to each other, not free, as in *Lingula*. . . . . The arms in *Orbicula* are not, however, supported by an internal calcareous process. The muscular basis, when cut into, exhibits on each side a well-defined cylindrical cavity, which commences near the mesial plane in the transverse part below the mouth, and is continued into the spiral extremity. . . . . But I conclude, nevertheless, that the canals serve to extend outwards the free spiral extremities, by being forcibly distended with fluid propelled along them.

"The mouth, a small puckered orifice, is best seen by dissecting away the transverse basis of the arms. The *œsophagus* passes obliquely through the tendinous wall of the *viscera* in a direction towards the upper or imperforate valve; having then passed between the anterior shell-muscles, it becomes slightly dilated and surrounded by the liver, forming a less capacious stomach than in *Terebratula*. The intestine is continued straight to the opposite end of the visceral cavity, and is there again contracted, and making a sudden bend upon itself, passes in a slight sigmoid curve to the middle of the right side of the visceral belt, which it perforates obliquely, and terminates between the lobes of the mantle about half a line below the bend of the arm. The liver is of a beautiful green colour; it is a congeries of elongated follicules closely compacted together, which communicate by numerous orifices with the stomach. . . . . The coats of the stomach and intestines are thick and pulpy, and apparently glandular. Posterior to the liver the whole of the visceral cavity not occupied by the muscles and vessels is filled with grey masses of *ova*." Owen also detected traces of the nervous system.

Prof. E. S. Morse states, in his paper on the systematic position of the Brachiopoda (Proc. Boston Soc. Nat. Hist. vol. iv. 1873, p. 21), that Fritz Müller has shown that in the embryo of *Discina* there are remarkably *barbed* setæ of great length, which are afterwards discarded. The shell-structure of *Discina* is very similar to that of the genus *Lingula*, to which we have alluded under *Lingula anatina*. That of *Discina* has been carefully described by M. S. Cloez in the pages of the 'Institut,' p. 240, 1859, and is also referred to by Dr. Gratiolet in his admirable memoir "Etudes anatomiques sur la *Lingula anatina*, Lamarck," Journal de Conchyliologie, vol. viii. 2e sér. 1860.

110. DISCINISCA ATLANTICA, King, sp. (Plate XXVI. figs. 18–22.)

Discina atlantica, King, Proc. Nat. Hist. Soc. Dublin, vol. v. pp. 170–173, 1868.

Discinisca atlantica, Dall, Cat. Recent Brach., Proc. Acad. Nat. Sci. Philadelphia, p. 177, 1873.

Discina atlantica, Jeffreys, Ann. & Mag. Nat. Hist. 4th ser. vol. xviii. p. 252, 1876, and Proc. Zool. Soc. 1878, p. 415; Davidson, Report on the Scientific Results of the Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 62, 1880.

Shell small, slightly oval longitudinally, broadest anteriorly, sometimes marginally almost circular. Shell very thin, semitransparent, corneous, marked with numerous concentric lines or ridges of growth. Upper valve conical; vertex situated at about one third of the length of the valve from the posterior margin: ventral valve exceedingly thin, fissure small, longitudinally oval. Colour light yellowish brown. Length and breadth $2\frac{1}{2}$ lines, height $1\frac{1}{4}$ lines.

Hab. This small species was not known previous to 1862. Since then it has been dredged in nine or ten separate and far distant localities. It appears to be a very abundant shell, occurring only at very great depths. Prof. King, to whom we are indebted for the first description and illustration of this interesting species, informs us "that it was first dredged in 1862 by Staff-Commander Richard Hoskyn, R.N., at the time in command of H.M.S. 'Porcupine,' for purposes in connexion with the then-proposed telegraphic connexion between Ireland and Newfoundland." The specimen was not quite perfect, and "came up in the sounding-machine from a depth of 1240 fathoms, in lat. 52° 8′ N., long. 15° 30′, W., or nearly due west of Dingwall Bay."

The second specimen was dredged by Dr. Gwyn Jeffreys, in nearly the same place, at a depth of 1366 fathoms, during the 'Porcupine' Expedition, 1856. It was also dredged by Sir James Anderson in the North Atlantic, when fishing up the telegraph cable, in 2400 fathoms depth; and again by Dr. J. Gwyn Jeffreys during the cruise of the 'Valorous' in Baffin's Bay, at depths of 1450 and 690 fathoms.

Discina atlantica was obtained at seven or eight different localities by the 'Challenger' Expedition. In lat. 1° 47′ N., long. 24° 26′ W., attached to *Limopsis aurita*, Brocchi, and associated with one example of *Megerlia incerta*, Davidson, at a depth of 1850 fathoms. This station is situated between the Cape Verde Islands or Sierra Leone (Africa) and Fernando Noronha (South America). Again in lat. 4° 33′ S., long. 120° 58′ E., depth from 200 to 360 fathoms, attached to volcanic detritus; also in lat. 34° 37′ N., long. 140° 32′ E., depth 1875 fathoms, associated with one example of *Terebratula* (?) *Dalli*. In lat. 36° 10′ N., long. 178° 0′ E., depth 2050 fathoms, attached to fragments of pumice-stone; in lat. 0° 33′ S., long. 151° 34′ W., at a depth of 2425 fathoms; in lat. 33 °31′ S., long. 74° 43′ W., depth 2160 fathoms, along with *Waldheimia Wyvilli*; and, lastly, in lat. 12° 8′ S., long. 145° 10′ E., off Australia, at a depth of 1400 fathoms.

Dr. Alleyne Nicholson observes that abyssal or deep-sea forms are usually widely diffused, their range depending chiefly on temperature and being influenced mainly by oceanic currents.

Obs. I believe I have seen nearly all the upper valves of this small species hitherto collected, but only one specimen of the smaller valve. Dr. Gwyn Jeffreys, in his paper "On North-Atlantic Brachiopoda," published in the Ann. & Mag. Nat. Hist. for Sept. 1876, says (p. 252) that the "arms (labial processes) are furnished with very long and slender setæ or stiff hair-like cilia, which project beyond the edge of the shell on every side to an extent fully equalling its diameter." He meant, or should have said, from the margin of the mantle, not of the arms. The brachial appendages are, as stated by Dr. S. P. Woodward and myself, curved backwards, returning upon themselves, and ending in small spires directed downwards towards the ventral valve. Prof. Owen, who in 1835 described with much care the anatomy of the genus *Discina*, says (pp. 155, 156), "The labial processes, or brachia, are scarcely more adapted to protrude externally than in *Terebratula chilensis*, the only parts that are free being the short spiral extremities. . . . The brachial filaments, when viewed through the lens, presented an equal cylindrical figure and an entire surface." He also minutely describes and illustrates the two lobes of the mantle, and states that "the branchial vessels may be seen in rich profusion on their inner surface." In a highly magnified view of a small portion of the edge of the mantle he shows the "terminal divisions of the branchial vessels and their setose cilia" *.

At my request Dr. Halifax, of Brighton, made for me a series of preparations of the mantle of both *Discinisca lævis* and *D. atlantica*. These last, from specimens brought home by the 'Challenger' Expedition, showed in the most clear and admirable manner the highly vascular mantle, fringed with long horny setæ, entirely agreeing with the

* R. Owen, "On the Anatomy of the Brachiopoda of Cuvier, and more especially on the Genera *Terebratula* and *Orbicula*," Trans. Zool. Soc. vol. i. p. 145, pl. xxii. figs. 2–13, 1835.

descriptions of Prof. Owen and Dr. S. P. Woodward. The cirri are of great length and barbed throughout, with spine-like asperities; in some cases they bifurcate near their extremities and lie close together at their origin. In some specimens of *Discinisca lævis* great numbers of full-grown *Pedicellinæ*, a genus of Bryozoa, adhered to the long barbed cirri, looking like *Lingulæ* with their long pliant peduncles. The smaller valve of *Discinisca atlantica* was thus described by Dr. Gwyn Jeffreys (*loc. cit.* p. 252) from a North-Atlantic specimen obtained during the 'Valorous' Expedition:—"Flat, thin, having near its middle a comparatively small round disk, within which is an oval slit for the passage of the byssal (peduncle) of attachment; this disk is slightly sunk within any calcareous substance to which it is attached, as if the byssus had the power of excavation; the rest of the lower valve is free and concentrically striate, like the upper valve: muscular (adductor) scars in the upper valve, club-shaped, rather close together; no scars observable in the lower valve. Not the slightest trace of tubular or perforated structure could be detected in either valve with one of Smith and Beck's best microscopes, under a lens of one-fifth power."

I have nothing further to state with reference to this species, which was fully described in my 'Challenger' Report.

I am not certain that *Discinisca atlantica* has been hitherto positively found in the fossil state; but Dr. Gwyn Jeffreys thinks that the *Discina fallax*, S. Wood, from the Crag of England, may perhaps be referable to the species under description.

111. Discinisca Cumingii, Broderip, sp. (Plate XXVI. figs. 23–26.)

Orbicula Cumingii, Broderip, Proc. Zool. Soc. p. 124, 1833, and Trans. Zool. Soc. vol. i. p. 143, pl. xxiii. fig. 1, 1835.

Orbicula strigata, Broderip, Trans. Zool. Soc. vol. i. p. 143, pl. xxiii. fig. 1*, 1833.

Orbicula Cumingi and *O. strigata*, G. B. Sowerby, Thes. Conch. vol. i. p. 366, pl. lxxiii. figs. 6, 7, 1846.

Orbicula Cumingi, A. d'Orbigny, Voyage dans l'Amérique méridionale, vol. v. p. 677, 1847.

Orbicula Cumingi and *O. strigata*, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 276, 1852.

Discina Cumingi and *O. strigata*, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. pp. 226–227, 1859.

Orbicula Cumingi, L. Reeve, Monogr. of *Orbicula*, Conch. Icon. pl. i. fig. 6, 1862 (Mr. Reeve considers *O. strigata*, Broderip, to be a synonym).

Discina Cumingi, Dall, Amer. Journ. of Conch. vol. vi. p. 77, 1870; Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 42, 1871; and Proc. Acad. Nat. Sci. Philadelphia, p. 201, 1873.

Shell orbicular, or elongated oval, broadest anteriorly. Larger or upper valve moderately thick, limpet-like; vertex submarginal; surface covered with numerous very fine (sometimes interrupted) raised striæ, which radiate from the vertex to the margin of the valve; surface crossed likewise by numerous, fine, concentric lines of growth. Lower valve extremely thin, concave or flat, often taking the shape of the object upon which it rests. About half the posterior portion of the valve is taken up by an elongated oval or heart-shaped, slightly concave disk or area, perforated longitudinally along the middle by an oval-shaped fissure which does not reach either to the posterior margin of the shell or to the anterior extremity of the depressed smooth disk. The remainder of the surface of the valve is very finely striated radiately and crossed by numerous concentric lines of growth, the riblets increasing in number both by bifurcation and by the interpolation of shorter ones. In the interior of the upper or larger valve four adductor muscular scars limit posteriorly and anteriorly a rather large sunken space, which occupies, as it does in the lower valve, about half the posterior half of the valve. The posterior adductor muscular impressions are transversely oval, obliquely situated at a short distance from the posterior margin of the shell, and separated by two very small impressions or projections attributed to retractor muscles. The anterior, oval-shaped, adductor scars are situate towards the middle of the bottom of the shell, and are obliquely placed and separated by a small longitudinal ridge, which extends for a short distance along the sunken portion of the valve. In the interior of the extremely thin lower or smaller valve its posterior half is, to a great extent, occupied by a heart-shaped disk with convex lateral borders, but which does not quite reach to the posterior edge of the shell. Along part of its centre a small, longitudinal, oval-shaped foramen is seen; two small, oblique, adductor scars occupy the posterior edge of the disk, and two others the anterior part of the same disk, these last being separated by a longitudinal ridge which, commencing to rise at the anterior extremity of the foramen, extends nearly to the front margin of the shell. Shell-structure horny and calcareous. Colour light brownish yellow. Length 9 lines, breadth 8 lines.

Hab. Cape St. Lucas to Panama, Central America; dredged at Payta, St. Elena, Island of Caña, Guatemala, attached to the lower side of stones in sandy mud at low water, and in some instances from a depth of from 6 to 8 fathoms (Cuming). Ecuador (d'Orbigny); Mazatlan, on various shells (Carpenter). Isle St. Joseph, Cayenne (Deplanche).

Obs. Exteriorly both in shape and striation the upper valve of *Discinisca Cumingii* much resembles that of *Discina striata*; but the smaller one, flat or concave in the first, is convex in the latter. Again, the absence of the flattened disk in *D. striata* and the difference in the shape and position of the foraminal aperture are characters by which the two forms may be easily distinguished.

In his monograph on *Orbicula* Mr. L. Reeve observes that "Mr. Broderip's *O. strigata*, which he did not describe along with *O. Cumingii* in the 'Proceedings of the Zoological Society,' but as an afterthought, when figuring the *Orbiculæ* in the 'Transactions,' is a less worn state of the species, in which there are faint rays and bands of colour. The upper valve is calcareous and firm, of quite a different type from the horny species of Chili and Peru. The habitats, Malacca and Philippine Islands, given with this species by Mr. Sowerby, in addition to the above, are erroneous. He probably mistook specimens of *O. stella* for it."

Broderip's figures of *Orbicula Cumingii* and *O. strigata* differ a good deal in shape; for while the posterior margin of the first is rounded, that of the latter is strongly indented; but this may be accidental. He likewise represents the mantle-fringe of horny setæ in his figure of *Orbicula Cumingii*; they are very much shorter in this species than in *Discinisca atlantica*.

Discinisca Cumingii varies a good deal in the elevation of its upper valve; in some specimens the apex is also almost marginal, while in others it is more or less distant from the posterior margin.

Uncertain Species.

112. DISCINISCA (?) ANTILLARUM, d'Orbigny. (Plate XXVI. figs. 31–31 *a*.)

Orbicula antillarum, d'Orbigny, Moll. de l'Isle de Cuba dans le voyage à Cuba de Ramon de la Sagra, p. 368, pl. 28. figs. 34–36, 1853.

Discina antillarum, E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 228, 1859.

Orbicula antillarum?, L. Reeve, Conch. Icon., Monogr. of *Orbicula*, pl. i. fig. 2, 1862.

Discinisca? antillarum, Dall, Report on the Brach. obtained by the United States Coast-Survey Exp., Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 42, 1871, and Proc. Acad. Nat. Sci. Philadelphia, p. 177, July 1873.

Shell small, circular. Larger or upper valve limpet-like; apex subcentral; one third of the valve from the apex is smooth, the remainder radiately striated. Lower valve not known. Shell-structure horny and calcareous. Colour light yellowish brown. Length and breadth 2 lines.

Hab. Cuba, Martinique (d'Orbigny & Cuming).

Obs. I have never seen a real type of this very small species (or young stage of some other?). D'Orbigny says, "Cette espèce n'a que les bords marqués de stries rayonnantes, le reste est lisse; elle est mince, fragile, transparente et pourvue de long cils tout autour. Nous l'avons rencontrée fixée sur un madrepore provenant de l'île de Cuba."

In his monograph on *Orbicula* Mr. L. Reeve observes that "Mr. Cuming possesses specimens of *O. antillarum*, both from Cuba and Martinique, in all of which the vertex is inclined more posteriorly, while the shell is less regularly striated and less cancellated than in the Eastern *O. stella*; but the shells are wonderfully alike in general aspect." The specific claims of this so-termed species will require confirmation by the inspection of additional Cuban specimens.

113. DISCINISCA STELLA, Gould. (Plate XXVI. figs. 27–30.)

Discina stella, Gould, Mem. Boston Soc. Nat. Hist. vol. vii. p. 323; Otia Conch. p. 120, 1860.

Orbicula stella, L. Reeve, Conch. Icon., Monogr. of *Orbicula*, pl. i. fig. 1, 1862.

Discina stella, A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. ii. p. 100, 1863; Dall, Amer. Journal of Conch. vol. vii. part 2, p. 76, 1871.

Discinisca stella, Dall, Report on the Brachiopoda obtained by the United States Coast-Survey Exp. in charge of L. F. de Pourtales, Bull. Mus. Comp. Zoöl. Harvard, vol. iii. p. 41, 1871, and Proc. Acad. Nat. Sci. Philadelphia, p. 201, 1873.

Discina stella, Davidson, Proc. Zool. Soc. April 1871, p. 311, pl. xxx. fig. 5, and Report on the Brachiopoda of the Voyage of H.M.S. 'Challenger,' Zoology, vol. i. p. 64, 1880; G. Dunker, Index Moll. maris Japonici, p. 254, 1882.

Shell orbicular, about as broad as long. Upper valve conical and moderately elevated; vertex subcentral. Surface marked by numerous radiating striæ; vertex almost smooth The attached or lower valve is remarkably thin, almost flat or slightly concave, and sometimes does not seem quite to reach the edge of the upper valve; in the posterior half of the valve a wide heart-shaped disk exists, with an elongated oval-shaped slit or foramen for the passage of the peduncle. From the margins of this disk radiate fine raised striæ with very wide interspaces. Colour light yellow. Length and breadth $6\frac{1}{2}$ lines.

Hab. Singapore and Philippines (Cuming); China Seas (Stimpson, Wilkes, Gould); Seto-Uchi (Akasi), 17 fathoms; Isu-Sima, 17 to 25 fathoms; Tabu-Sima, 26 fathoms, on coral; Japanese waters (Adams). Five upper valves were dredged by the 'Challenger' Expedition at Station 190, lat. 8° 56′ S., long. 136° 5′ E. The species was also dredged by Capt. St. John in the Straits of Corea, attached to shells and associated with *Laqueus pictus*, lat. 33° 4′ N., long. 129° 18′ E.

Obs. Although usually radiately finely striated, the striæ were so faintly indicated in some examples that have come under my notice that the shell appeared smooth, and in that condition it was difficult to distinguish it from *Discinisca atlantica*. In his Conch. Icon., Monograph of *Orbicula*, Lovell Reeve states that "this species has a wide distribution in Eastern seas. On comparing authentic specimens received from Dr. Gould, one of which is given at fig. 1 *b*, pl. ii., collected in the China Sea by Wilkes's exploring expedition, I find them identical with specimens collected by Mr. Cuming, attached to fragments of *Pullastra*, *Pinna*, and *Malleus*, at Singapore and at the Philippine Islands. The sculpture varies in strength; on young specimens, as stated by Dr. Gould, the radiating striæ are scarcely developed; in older specimens, and especially specimens that have had to contend with irregularities in their place of attachment, the sculpture has a minutely-latticed character, like the grains of a thimble. The under valve is thinly membranaceous, or thicker, concave or convex according to circumstances of habitation; and the position of the slit obviously varies with the position of the vertex in the opposite valve. On a flat place of attachment the shell is symmetrically orbicular, and the vertex and subincumbent slit are nearly central, but when attached to a sloping or declivitous substance the vertex is pressed to one side, and the slit of the under valve follows the same direction."

Family LINGULIDÆ.

The recent species belonging to this family are representatives of the genus *Lingula*, Bruguière (1789), and of the genus or subgenus *Glottidia*, Dall (1870).

Genus LINGULA.

1. *Lingula anatina*, Lamarck, 1819.
2. —— *hians*, Swainson, 1823.
3. —— *tumidula*, Reeve, 1841.
4. —— *Murphiana*, King, 1859.
5. *Lingula Reevii*, Davidson, 1852.
6. —— *exusta*, Reeve, 1857.
7. —— *jaspidea*, Adams, 1863.
8. —— *Adamsi*, Dall, 1873.

There are, besides these, three uncertain so-termed species—*Lingula smaragdina*, Adams, 1863; *L. hirundo*, Reeve, 1859; and *L. lepidula*, Reeve, 1863. Hancock's *L. affinis* I consider to be the true *Lingula anatina*, the species Hancock figured as *L. anatina* being really the *L. Murphiana* of King.

Up to the year 1870 the species now classed with *Glottidia* had been described as

Lingulæ, viz.:—*Glottidia albida*, Hinds, sp., 1845; *Glottidia Palmeri*, Dall, sp., 1870; and *Glottidia Audebarti*, Broderip, sp., 1883 (emend. Deshayes), of which the *L. pyramidata* of Stimpson must be considered a synonym. A careful comparison of many specimens of *L. Audebarti*, Broderip, and *G. pyramidata*, Stimpson, has convinced me that they are one and the same species, and Broderip's name takes priority. The specific claims of *G. antillarum*, Reeve, sp., 1861, and of *G.* ? *semen*, Broderip, sp., 1833, are still uncertain.

114. LINGULA ANATINA, Bruguière, sp. (Plate XXIX. figs. 1–8.)

Patella unguis, Linné, Syst. Nat. ed. xii. p. 1260, 1766.

Rostrum anatis, Petiver, Rumphius, D'Amboinsche Rariteitkamer, t. xl. fig. 2, 1766; Seba, Moll. vol. iii. t. xvi. fig. 4.

Mytilus lingula, Solander, Cat. Museum, Portland, no. 1718.

Pinna unguis seu *lingua*, Chemnitz, Conch. Cab. x. p. 360, tab. clxxii. figs. 1675–1677.

? *Lepar* seu *Patella*, "*Rostrum anatis*," Humphrey & Da Costa, Nat. Hist. of Shells, p. 3, pl. ii. fig. 2, 1770.

Patella unguis, Gmelin, Linn. Syst. Nat. ed. xiii. p. 3710, 1789.

Lingula anatina, Bruguière, Hist. des Vers, Encycl. Méth. pl. ccl. figs. 1 *a*, *b*, *c*, 1789; Cuvier, Soc. Philomatique de Paris, vol. i. p. 111, pl. vii. figs. A, B, C, 1797; Cuvier, Mémoires du Muséum, vol. i. p. 69, pl. vi. figs. 1–13, 1802.

Mytilus lingua, Dillwyn, Cat. of Recent Shells, p. 322. no. 47, 1817.

Lingula anatina, Lamarck, An. sans Vert. vol. vi. p. 258, 1819; Sowerby, Genera of Shells, 1822; W. Swainson, Phil. Mag. vol. lxiii. p. 403, 1823; Sowerby, A Cat. of Shells of the late Earl of Tankerville, p. 28, 1825; Blainville, Mal. pl. lii. fig. 3, 1825–27; Sander Rang, Man. de l'Hist. Nat. des Mollusques, 1829; Deshayes, ed. An. sans Vert. vol. vii. p. 390. no. 1, 1866; Deshayes, ed. Encyclop. Méth., Vers. vol. ii. p. 364. no. 1, 1836; Anton, Verzeichniss der Conchyl. p. 24. no. 911, 1839; Küster, ed. Chemnitz, Conch.-Cab. vol. vii. p. 12, pl. i. figs. 1, 2, 3, 1843.

Lingula Chemnitzii, Küster, ed. Chemnitz, Conch.-Cab. vol. vii. p. 13, pl. i. figs. 4, 5, 6, 1843.

Lingula anatina, G. B. Sowerby, Thes. Conch., Monogr. of *Lingula*, i. p. 337, pl. lxvii. figs. 1–10, 1846.

? *Lingula anatina*, Vogt, Anatomie der *Lingula anatina*, pp. 1–16, pls. i., ii., 1845.

Lingula anatina, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 377, 1852; Brit. Foss. Brach., Introd. to vol. i. p. 134, 1853, and vol. v. p. 327, 1884; Article Brachiopoda, Brit. Encycl. 9th ed., 1876; Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zool. vol. i. p. 60, 1880; R. Owen, Anatomy of *Terebratula* and *Lingula*, Davidson's Br. Foss. Brach., Introduction to vol. i. chap. i., 1853.

? *Lingula affinis*, Hancock, Phil. Trans. vol. cxlviii. 2nd part, 1858.

Lingula hirtula, Gray, Coll. of Brit. Mus.

Lingula anatina, S. P. Woodward, A Manual of the Mollusca, p. 239, figs. 155–157, 1856; H. & A. Adams, The Recent Genera of Mollusca, p. 585, pl. cxxxii. fig. 5, 1858; Semper, On *Lingula*, Zeitschr. f. Wiss. Zool. vol. ii. p. 100, and vol. xiv. p. 424, 1864; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 229, 1859; L. Reeve, Conch. Icon., Monogr. of *Lingula*, pl. ii. figs. 10, 11, 1859; Gratiolet, Anatomie de la *Lingula anatina*, Journ. de Conch. vol. viii. 2nd ser. pls. vi.–ix., 1860; Dall, Amer. Journ. of Conch. vol. vi. p. 155, 1870, and Proc. Acad. Nat. Sci. Philadelphia, p. 203, 1873; King, Ann. & Mag. Nat. Hist. 4th ser. vol. xii. pl. ii., 1873; A. Zittel, Handb. der Paläontologie, p. 663, fig. 486, 1880; A. Crane, The Brachiopoda and Polyzoa, Cassell's Nat. Hist. p. 263, 1881; G. Dunker, Index Moll. maris Japonici, p. 254, 1882; D. E. Lischke, Japonische Meeres-Conch. Suppl. iv. p. 163, 1884.

Shell oblong, elongated, sides nearly straight and subparallel. Valves very slightly convex and nearly straight in front, attenuated at the posterior extremities; almost equal, slightly gaping at the beaks, most convex along the middle, somewhat flattened laterally; dorsal valve a little shorter at the beaks than the ventral one. Texture horny and calcareous; surface smooth. Colour various shades of green up to bright emerald-green. Length 1 inch 10 lines, breadth 10 lines.

Hab. Indian Ocean and the Moluccas (Cuming), shore and low water; off Yeddo, Japan (Adams). Dr. Willemöes-Suhm, of the 'Challenger' Expedition, in a letter published in Siebold and Kölliker's 'Zeitschrift,' 1876, mentions finding on the beach at Zamboanga, Philippines, a *Lingula* (*L. anatina*) in hundreds, and that he gave a dollar for a hundred specimens. Three large bottles full were forwarded to me for examination, collected by the 'Challenger' Expedition in sand at low water at the same place, on October 23, 1874, and February 1, 1875. These specimens, of all ages, from 4 lines in length up to 1 inch 7 lines, were of a most brilliant emerald-green colour. Mr. L. Reeve states in his monograph on *Lingula*:—"Mr. Cuming happened to be at Manilla in 1836 after an unusually boisterous typhoon, when as many as twenty bushels of this species were collected on the shore of the bay." It occurs no doubt in other places. In the Zoological Department of the British Museum there are specimens from Timor (Stokes's Coll.) and from the Fiji Islands (Hind's Coll.).

Obs. Cuvier, who was, I believe, the first to describe the animal of *Lingula* in 1797 and 1802, observes:—"Comme elles n'ont point de dents à leur charnière, on ne pouvait deviner, en les voyant isolées, qu'elles étaient bivalves; et Linnæus, qui n'en avoit vu qu'une, l'avoit placée parmi les patelles sous le nom d'*unguis*, sous lequel elle paraît encore, quoique avec doute, dans l'édition de Gmélin, Rumphe, et après lui Favanne avoit pensé que ce pouvait être le bouclier testacé de quelque limace. Chemnitz ayant u occasion d'en voir les deux valves, jugea, je ne sais trop pourquois, qu'elle devoit passer dans le genre des jambonneaux, et la nomma *Pinna unguis*. Bruguière est le premier auteur systématique qui ait su que ces deux valves sont naturellement attachées à un pédicule membraneux, comme celles des *Térébratules* et des *Anatifes*, et qui en ait fait en conséquence, dans les planches de l'Encyclopédie, un genre particulier, dont il ne donne point de description, parceque son voyage et sa mort l'empechèrent de conduire jusque là son dictionnaire d'Helminthologie. Mais le citoyen Lamarck a adopté et caractérisé ce genre."

No species of Brachiopoda has been more carefully studied by several of our best contemporary zoologists. Owen described it in 1833, and again referred to it in his chapter on the anatomy of *Terebratula* in the Introduction to my work on British Fossil Brachiopoda. In 1845 the same subject was well treated by Dr. C. Vogt, in his memoir 'Anatomie der *Lingula anatina*.' In 1856 it was studied by Dr. S. P. Woodward, and alluded to in his excellent manual of the Mollusca. In 1858 the anatomy of *L. anatina* was admirably treated by Albany Hancock, in the memorable memoir "On the Organization of the Brachiopoda," published in the 'Philosophical Transactions' of the Royal Society, vol. cxlviii. 1858. This was followed in 1860 by Dr. Gratiolet's remarkable memoir "Études anatomiques sur la *Lingula anatina*" in the 'Journal de Conchyliologie.'

Professor Semper also published important observations on the animal of *Lingula anatina* in the 'Zeitschrift für wissenschaftliche Zoologie,' Bd. xi. p. 100, 1862, and in the "Reisebericht" in the 'Zeitschrift für wissenschaftliche Zoologie,' Bd. xiv. p. 424, 1864; and, lastly, Professor W. King's instructive memoir "On some Characteristics of *Lingula anatina*," appeared in the Ann. & Mag. Nat. Hist. 4th ser. vol. xii. 1873. To all these works we shall again refer. The publications of Morse, Brooks, and others on the animal of *Glottidia* will also be alluded to under *G. albida* and *G. Audebarti* *.

Having had the advantage of being able to study more than five hundred specimens of *Lingula anatina*, four hundred of which were collected by the 'Challenger' Expedition in a single locality, I observed that when quite young and up to 9 lines in length the shell was completely elongated, oval and rounded at its anterior margin; the beaks tapering more than in the adult condition. As the shell grows the sides become subparallel and its front line nearly as wide as the rest of the shell, and slightly rounded in front, with a small rounded mesial rib, which, commencing at about two thirds of the length of the valve, forms at the front line a small projecting angle. The horny portion of the shell, especially round its margins, is so thin that as the animal dries it bends over or shrinks, sometimes to a considerable extent. The colour also varies very much in different specimens, being generally of a more vivid or intense green at and close to the concentric lines of growth which cover its surface. In some places also the green is more bright than in others on all the specimens. It is of a brilliant emerald-green in the Philippine examples, but more sap-green in the Manilla specimens. The valves are not exactly the same; the ventral valve is somewhat the larger, and it has an acutely tapering beak, with a channel along its middle, to which the long fleshy peduncle is attached; the beak of the dorsal valve is, on the contrary, obtusely rounded and shorter, with a narrow, flattened, horizontally striated area on its inner surface. In the interior of the valves an elongated lozenge-shaped area is occupied chiefly by the muscular and other impressions; here where the calcareous element prevails the shell is thickest, the remaining portion of the valves being more essentially horny.

The structure of the shell has been carefully investigated by Dr. Carpenter †, Dr. Gratiolet ‡, and M. S. Cloëz §. Dr. Carpenter says:—"The structure of the shells of *Lingula* and *Orbicula* is peculiar. These shells are almost entirely composed of laminæ of horny matter, which are perforated by minute tubuli, closely resembling those of ivory in size and arrangement, and passing obliquely through the laminæ. Near the margin of the shell, these tubuli may be seen lying nearly parallel to the surface."

Dr. Gratiolet states that:—"There exists in the shell of *Lingula* two distinct elements, that is to say a horny element and a testaceous one ‖. They are found arranged

* [The more recent investigations of Dr. H. G. Beyer on the structure of *Lingula* (*Glottidia*) *pyramidata*, Stimpson ('Studies from the Biological Laboratory of Johns Hopkins University,' vol. iii. no. 5, March 1886), will be found summarized under Broderip's earlier described species *Lingula* (*Glottidia*) *Audebarti*, with which Dr. Davidson found *Lingula pyramidata* to be specifically identical.—A. C.]

† "On the Microscopic Structure of Shells." Report Brit. Assoc. 1844, p. 18.

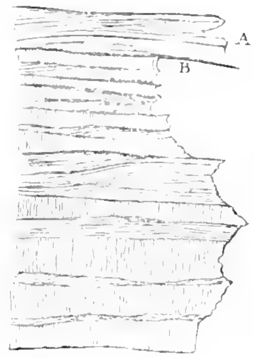
‡ 'Journal de Conchyliologie,' 2e sér. vol. iv. 1860, p. 59.

§ L'Institut, 1859, p. 240.

‖ [Dr. H. G. Beyer records the presence of a third element in one genus of the Lingulidæ, *i. e.* an outer "cuticle," differing in structure from the underlying so-called horny layers which alternate with the calcareous ones. See anatomy of *Glottidia Audebarti*, p. 227.—A. C.]

in layers or thin laminæ, which succeed each other alternately from the convex to the concave surface of the valves after a superficial layer, which is horny. The layers do not present anywhere the same thickness; on the convex face of the shell the thickness of the horny layer is the largest, on the inner or visceral face the calcareous layers are the thickest; these thick testaceous layers are separated by thin horny layers, the shell being more semitransparent where the horny layers prevail. The structure of the horny layers is very simple; they are transparent, yellowish, passing into green in certain species, and appeared to me formed of parallel fibres without any trace of perforations. The structure of the calcareous layers recalls that of the Terebratulidæ. They are traversed by a multitude of microscopic canals, and are likewise traversed by striæ of an extreme delicacy. The internal surface of the valves is lined by a very dry and very thin membrane, which can be detached without tearing away at the same time portions of the very thin testaceous laminæ. M. S. Cloëz has prepared an analysis of the test of *Lingula*, which has been published in the 'Comptes Rendus de la Société Philomatique' of Paris; and this author remarks that the composition of the shell resembles that which M. Chevreul has shown, in a work published some years ago by Hatchard, to exist in the scales of the Lépidostrées and insects, and that the great proportion of phosphate of lime in the shell of the living *Lingulæ* deserves the attention of zoologists and geologists, and gives a great interest to the results furnished by microscopic analysis."

Fig. 21.



Magnified section of thickest portion of shell of *Lingula anatina* (after Gratiolet).

A. Horny layer.
B. Calcareous layer, perforated by canals.

Space unfortunately will not allow of my entering into details in connection with the anatomy of the animal of *Lingula anatina*, which would require many elaborate illustrations. I must therefore refer the student to the special works upon the subject above quoted.

Cuvier, in 1797, gives the first very brief account of the animal with which we are acquainted. He represents the two lobes of the mantle, one of which he has partly bent backwards, so as to expose the spirally coiled labial appendages. He describes also the alimentary canal, mouth, and anus; and in 1802 he published a more elaborate account of the animal accompanied by thirteen figures.

Hancock states, in his memoir on the "Organization of the Brachiopoda" (Phil. Trans. Roy. Soc. cxlviii. 1858, p. 794), that in *Lingula* "the body of the animal is depressed, and occupies a much larger portion of the shell-cavity than it does in either the *Terebratulidæ* or *Rhynchonellidæ*. The pallial lobes are rather stout; but the great sinuses are nevertheless distinctly seen through their membranes; they are not united behind, as in the articulated Brachiopods, but are free, and extend some distance from the body all round the posterior or umbonal region. The body thus becomes well defined, the lateral walls being at right angles to the dorsal and ventral. The two latter are very delicate, and so transparent that the viscera are quite apparent through them, the liver and genitalia being the most conspicuous. The lateral parietes are strong and muscular, and, having their edges attached to the valves, give a definite form to the enclosed space, which is wide, rounded in front, and tapering backwards.

"On turning back the ventral pallial lobe the arms are observed occupying the greater portion of the pallial chamber, which is about half the length of the shell. The mouth is situated, as in the Terebratulidæ, in the brachial groove; and on each side of it, a little below, are the ovarian outlets, which penetrate the anterior wall of the body. On the right side of the animal, between the margins of the mantle, is placed the anal orifice, which is very distinct and easily detected.

"On removing the dorsal parietes in *Lingula*, the alimentary tube is found to occupy a central position as in the articulated tribes, the anterior portion being buried, as in them, beneath the lobulated liver, which is rather bulky. On displacing the latter, the heart is seen attached to the upper surface of the stomach, and the two dorsal genital organs are entirely exposed, extending nearly the whole length of the perivisceral chamber. At the sides and in front of these are the extremities of the muscles, and behind are the convolutions of the intestine."

Elaborate descriptions of the various muscles and of their functions have been published by Cuvier, Owen, Vogt, Hancock, Gratiolet, Semper, Woodward, Morse, Brooks, Beyer, and others, each anatomist giving different names to the different muscles and interpreting their functions differently. Much confusion consequently ensued. In 1873 Prof. W. King devoted much time and care to an examination of the muscular system in *Lingula anatina* *; and as I had occasion to confirm his observations by personal investigations, I cannot do better than reproduce some of the details given in his valuable memoir.

In the interior of both valves the muscular and visceral area forms a large lozenge-shaped space, which, commencing close to the beak, extends to about two thirds of the length of the shell and tapers most anteriorly, and is most elevated along the middle; this area constitutes the thickest part of the shell, where the calcareous element prevails, and its colour is whitish, contrasting with the greenish horny aspect of the remainder of the interior. This is also the most important compartment of the posterior half of the shell-cavity, and is bounded by a highly muscular wall or parietal band, *b* (fig. 22, A, B), and contains the viscera and muscles. King proposes to name this division the *splanchnocœle*, or visceral cavity, and adds:—"The anterior half of the pallial inter-space is open all round (sides and front) except at its back, which is formed by the anterior parietal. It encloses the arms or brachial appendages, and may therefore be called the *brachiocœle* or brachial chamber. Its upper and under surfaces (dorsal and ventral lobes of the pallium or mantle) are highly vascular.

"The sides of the *splanchnocœle* in its posterior half, as just stated, are rather strongly incurved, giving rise to two lateral spaces. . . . . I propose to give the name *pleurocœles* to these spaces, simply from their position as side chambers." The area within the parietal, *b*, is occupied by the liver, genitalia, and *shell-muscles*. "There are five pairs, and an odd one. Three pairs, woodcut, fig. 22, A, B (*j*, *k*, *l*), are lateral, having their members limited to the sides of the shell. One pair is *transmedian* (*i*), each

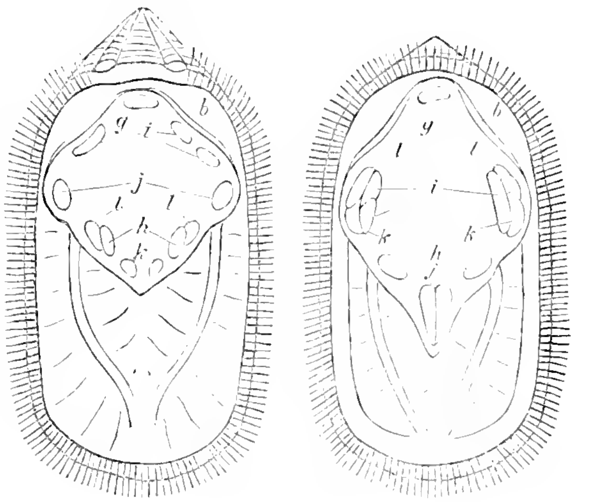
* Ann. & Mag. Nat. Hist. 4th ser. vol. xii., 1873.

member passing across the middle to reverse sides of the shell. One pair (h) has its members confined to nearly the *central* region. The odd muscle (g) occupies the umbonal cavity.

Lateral muscles.—In the dorsal valve one pair (j), which may be termed the *anterior* is attached to the median plate, a member passing from each of its sides to the corresponding one in the opposite valve." [This median plate or rounded ridge is very prominent in some specimens and species, especially so in *Lingula Murphiana.*] "The second or outside pair (l) in the ventral valve has each member passing from the outer side of the central muscles to the same side in the dorsal valve, close to the posterior half of the ante-latero-parietal, and in the widest part of the splanchnocœle. The third or *middle* pair (k) springs from the ventral valve between the central muscles, each member passing to its corresponding side in the opposite valve, increasing much in size in the passage, and becoming inserted in front of, and inwardly to, the attachments of the muscles belonging to the last pair." These muscles leave deepish oval-shaped scars in the interior surface of the valve, and are generally easily recognizable.

Fig. 22.

A. B.



Lingula anatina.

A. Interior of the ventral or pedicle valve.

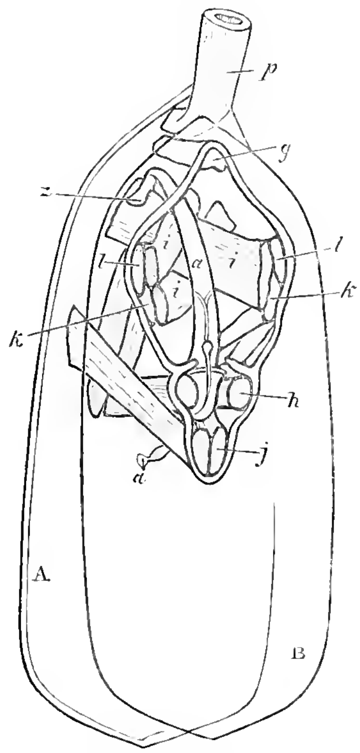
B. Interior of the dorsal valve (after King): g, umbonal muscular impressions (open valves); h, central muscles (close valves); i, transmedian or sliding muscles; b, parietal band; j, k, l, lateral muscles (j, anteriors; k, middles; l, outsiders), enabling the valves to move forward and backward on each other.

"*Transmedian muscles* (i).—In the dorsal valve both members of this pair are implanted in the widest part of the splanchnocœle, one on the inner side of, and immediately adjacent to, the termination of the *laterals* k and l. Passing backward, each member crosses diagonally to the *reverse* side of the ventral valve; but while one preserves its unity, and terminates by inserting itself near the middle of the left post-latero-parietal, the other is divided in its passage, a division becoming inserted near the posterior, and another near the anterior, end of the opposite and corresponding parietal. The divided member embraces the undivided one."

The lateral muscles do not always leave well-marked impressions in the interior of the valves; they are only seen occasionally on very well-preserved specimens. "It may be assumed," continues Prof. King, "that the central and umbonal muscles (g, h) effect the direct closing and opening of the shell, and that the laterals (j, k, l) enable the valves to move forward or backward on each other: but with respect to the transmedians (i), it is difficult to conceive otherwise than that they allow the similar extremities (the rostral) of the valves to turn from each other to the right, or the left, on an axis subcentrally situated—that is, between the anterior attachments of these muscles a little behind the medio-transverse line of the dorsal valve."

It was long a question under discussion whether the animal could really displace its valves sideways when about to open the shell; but this has been actually observed by Profs. Semper, Morse, and Brooks, who saw the animal perform the operation. They mention that it is never done by jerks, as the valves are first always pushed to one side several times and back again on each other, at the same time opening gradually and in the transverse direction till they rest opposite to one another and widely apart. Those who have not seen the animal in life, they observe, and did not believe in the possibility of the valves crossing each other with a slight obliquity, would not consent to the appropriation of any of the muscles to that purpose, and consequently attributed to all the lateral muscles the simple function of keeping the valves in opposite position or holding them adjusted. Prof. King states, in the paper already quoted, that "the umbonal muscle," (g), "is in no way fettered by the pedicle, or any other part. The shell is not only edentulous, but its hinge-margins are widely and totally separated from each other. The beaks have their margins persistently apart, even when the umbonal muscle is most rigid. The post-latero-parietals are highly muscular, necessarily permitting an unusual play of motion between the valves at their posterior extremity. The ordinary muscles (h, j, k, l), principally, are limited to the middle third of the valves. . . . . All these structural peculiarities are reciprocally related, and they are strictly consistent with the office herein ascribed to the transmedian muscles."

Fig. 23.



Lingula anatina.

Diagram, after Hancock, showing the muscular system. The letters indicate the muscles as in fig. 22, A and B.

A, ventral valve: B, dorsal valve: p, peduncle: a, alimentary canal: z, anus.

"The mantle-lobes forming the dorsal (upper) and ventral (under) surfaces of the chamber are well characterized by the vascular system. Both lobes are traversed by a pair of primary vessels that run forward from the anterior parietal, a member from each of its sides: gradually approximating in their progress, without becoming united, they terminate, the dorsal pair at about a quarter of an inch, and the ventral pair at about twice this distance, from the margins of the chambers. From their inner side numerous secondary vessels strike inwardly, with a backward curve, and meet in the middle line of the valves. . . . . Although the *setal band*, as it may be termed, runs along the pallial margins in their entire extent, the course of the setæ in the ventral valve is interrupted in one part—that is, in the region of the pedicle: there is no interruption in the opposite part of the dorsal valve."

The brachial organs of *Lingula anatina* are described by Mr. Hancock (at p. 810 of the memoir already quoted) to be "strong and fleshy, and rise from the back of the pallial chamber in the usual manner. They are entirely without calcareous support, even at their origin; and form two spiral coils, with six or seven turns each, directed inwards and upwards. The arms are very thick at the base, taper more suddenly than in the articulated species, and terminate in fine points. On making a transverse section they are found to differ in organization from those of *Rhynchonella*, to which, externally, they bear the strongest resemblance. Instead of one, as in that genus, there are two great brachial canals, which may be denominated respectively the anterior and posterior. The former is the equivalent of the great canal in the other Brachiopods, and, like it, terminates at the side of the œsophagus in a blind sac. It is pretty regularly cylindrical, with the walls excessively thick, being composed, for the most part, of a white cartilage-like substance, which is most developed towards the side opposite the cirri. These latter organs are supported upon a semicartilaginous grooved ridge, which is very similar to that in *Waldheimia*, and in like manner supplied with a very ample brachial fold. Muscular fibres are also provided for the movements of these parts; but the fibres, though similarly arranged, are not so extensively developed. This canal is lined with a muscular stratum, the fibres of which run in a transverse direction in the vicinity of the brachial fold; elsewhere they are longitudinal or slightly diagonal.

"The posterior canal is much flattened, and stretches along the inner surface of the arm, extending from the base of the cirri halfway round it. The canal has the appearance of being formed by a process of the pallial membrane similar to that which extends along the lateral portions of the loop in *Waldheimia*. The posterior canals of the two arms terminate at the sides of the œsophagus behind the anterior canals, and are separated from each other by a considerable space, which is divided on the median line by a delicate, membranous septum. The two chambers thus formed communicate with the perivisceral cavity by two small oval orifices placed one on each side of the septum; these orifices open into the cavity close behind the œsophagus, and directly above the transverse fold of the anterior wall of the body. . . . . It seems clear enough that the arms of *Lingula* have the power of extension in a greater or less degree (p. 811) . . . . . The anterior canals in *Lingula* will perform the same office as the great canals do in other Brachiopods; that is, they will give firmness to the parts, so that the cirri and the brachial fold may be brought into play. When the arms are retracted the walls of these canals, which it will be remembered are closed tubes, will relax a little to relieve themselves from the pressure of the contained fluid; when they are extended the walls will contract to maintain the required pressure. Thus the cirri and brachial fold will be under the control of their proper muscles, however much or little the arms may be extended.

"The alimentary tube in *Lingula* (p. 815, *loc. cit.*) presents two or three interesting modifications. The mouth is perfectly similar to that of *Waldheimia*, and the œsophagus, which is somewhat elongated, is at first depressed; but on emerging backwards from between the anterior occlusors becomes compressed. The stomach is short, being almost lenticular, and the transverse dorsal ridge is much produced. In front it is slightly convex, where it receives the œsophagus; behind it is a little produced, and an inconspicuous constriction marks the commencement of the intestine, which running backwards, buried beneath the lobules of the liver, and resting above the posterior adjustor muscles, gradually descends towards the ventral lobe, immediately in front of the divaricator muscle. This straight portion of the intestine corresponds to the entire intestine of the articulated Brachiopods, and it thus appears that in *Lingula*, as well as in them, the first inflection of the intestinal tube is towards the ventral surface. From thence the tube bends to the left, and turning forwards and upwards, forms two large loops at the posterior portion of the perivisceral chamber; it then advances along the right side, and, dipping under the dorsal extremities of the adjustor muscles and the pseudo-heart, opens through a nipple-like anus situated at the right side of the body between the margins of the mantle. The anal orifice is ample, and is very easily distinguished; it is placed considerably nearer to the dorsal than the ventral surface. . . . . The liver is composed of ramified cæca, and is of a greenish colour, as in all the Brachiopods" (p. 816).

Hancock then describes the reproductive organs, which, he states, are really developed between the two layers composing the ilio-parietal bands. He adds that the reddish-yellow marks are the ovaries, and that it would be fair to conclude that *Lingula*, at least, is androgynous; and if the red matter in connection with the genitalia in the articulated Brachiopoda should prove to be the same as the dendritic organ of the former, then in them also the sexes are combined (p. 819, *loc. cit.*) *.

The ova of *Lingula anatina* were figured in Prof. Owen's memoir on the anatomy of the *Terebratulæ* appended to the Introduction to my monograph of British Fossil Brachiopoda.

The peduncle in *Lingula anatina* attains a very great length, and has been minutely described by the zoologists already named. Drs. Vogt and Gratiolet state that it is composed of two essential parts—(1) a horny envelope, (2) a central muscular mass. The external envelope is very thick, resisting, and constitutes a tube open at both ends. The opening of the lower end is gaping, that of the other end, perforated in the centre of the inflated portion, is very narrow, and affords passage to small muscular bundles. It is remarkable how very much this peduncle shrinks and shrivels up when in the dried condition. In an abstract of Prof. Morse's paper on Japanese *Lingulæ* and shell-mounds, published in the 'American Journal of Science and Arts,' vol. xv. 1878, it is stated that his studies of *Lingula* have brought out many points new to science. The discovery of auditory capsules in the class of Brachiopods is one of the most important. These organs he determined in a species of *Lingula*, and their position and general appearance recall the auditory capsules as figured by Claparède in certain tubicolous Annelids †. He has also cleared up many of the obscure points in regard to the circulation, and is prepared to maintain the absence of anything like a pulsatory organ, the circulation being entirely due to ciliary action. Prof. Morse also described some of the habits of *Lingula*. While partially buried in the sand the anterior border of the pallial membranes contract in such a way as to leave three large oval openings, one in the centre and one on each side. The bristles, which are quite long in this region of the animal, are arranged in such a way as to continue these openings into funnels, and entangle the mucus which escapes from the animal; these funnels have firm walls. A continual current is seen

* [The recent investigations of Dr. H. G. Beyer fully confirm Hancock's views as to the hermaphroditism of *Lingula* (*Glottidia*) *pyramidata*. See Note p. 238.—A. C.]

† Dr. W. K. Brooks states at p. 63 of his paper on "The Development of *Lingula*" (Results of the Chesapeake Zoological Laboratory, 1878), that these octocysts do not exhibit any annelidan characteristics: they are precisely such structures as are found in most of the Mollusca.

passing down the side-funnels and escaping by the central one. They bury themselves very quickly in sand, and the peduncle agglutinates a sand-tube. They attach themselves by means of this tube to the bottom of dishes in which they are confined. Prof. Morse exhibited living specimens of a *Lingula* (probably *anatina*) which he had brought from Japan in a small glass jar. The water had only been changed twice during the last six months, and yet no specimen had died. This illustrated more fully the vitality of *Lingula* than the experiments he had made on the North Carolina *Lingula* (*Glottidia*) *pyramidata* several years since.

Lingula anatina at Manilla and elsewhere are made use of as articles of food; and Prof. Morse tells me he has eaten them. Some examples attributed to *Lingula anatina* described by Adams and C. E. Lischke from Japanese waters are green; others, which are partly yellowish brown and green near the frontal margin, cannot be specifically separated from *L. anatina*. I compared several examples sent to me by Lischke, and found them to be identical.

115. Lingula affinis, Hancock. (Plate XXIX. figs. 9, 10.)

Under this name A. Hancock describes and figures the animal of a *Lingula* (Phil. Trans. Roy. Soc. vol. cxlviii. 1858), which I believe to be in reality the true *Lingula anatina*, and I am also convinced that the species he describes and figures by the name *anatina* is the *Lingula Murphiana*. His descriptions show that the animal in those two forms is sufficiently different to be referred to distinct species. Mr. Hancock, soon after the publication of his admirable memoir, sent a specimen of his *L. affinis* for my inspection. I found it to be of a bright green colour, and apparently agreeing both in shape and appearance with *L. anatina*; while, on the contrary, the specimen he had referred to *L. anatina* was much wider in proportion to its length, of a yellow coppery tint, and exactly resembled specimens of *Lingula Murphiana* in my collection. The point cannot, however, be definitely settled until the animal of *L. Murphiana* has been again examined.

116. Lingula Murphiana, King, MS. (Plate XXIX. fig. 11.)

Lingula Murphiana, King, MS., Mus. Cuming; L. Reeve, Mon. of *Lingula*, Conch. Icon. pl. i. fig. 3. 1859; Dall, Amer. Journ. Conch. vol. vi. p. 155, 1870.

Shell large, squarish oblong, longer than wide, sides almost parallel, slightly curved inwards towards the middle of their length. Anterior edge gently rounded, with angular projection in the middle; beaks attenuated, that of the ventral valve pointed and the longest. Valves about equally convex, with a flatness commencing close to the beaks and extending to the front and on each side sloping to the lateral edges. Colour coppery red, with bands of different shades of green and brown. In the interior of the valves the muscular area is white, the remainder of the surface light and dark green. Shell-structure horny and calcareous. Length of shell 2 inches 6 lines, breadth 1 inch 1 line; length of peduncle $6\frac{1}{2}$ inches.

Hab. Moreton Bay, Australia (Strange).

Obs. In his monograph on *Lingula*, Mr. L. Reeve observes, "Whether this should be regarded as an Australian form of *Lingula anatina* or as a distinct species, it is certain that the differences are obvious and constant. The late Capt. Phillip King, who was an excellent conchologist (witness his paper on the collections of his exploring voyage in the 'Zoological Journal'), was struck by the peculiarities of this *Lingula*, and sent specimens home to Mr. Cuming with the above name. More have been collected by Mr. Strange in nearly the same locality, and all are distinguished from *L. anatina*, collected abundantly by Mr. Cuming in the Bay of Manilla, by a more square outline and a peculiarly coppery-red tone of colour."

The shell of *L. Murphiana* seems to attain to larger dimensions than that of *L. anatina*, and the structure of the animal would differ, if I am correct in my belief that Albany Hancock described that of *L. Murphiana* by the name of *anatina* (in the Trans. of the Royal Society, vol. cxlviii. pl. lxiv. and pl. lxv. figs. 1 and 2, 1858). The shell is wider in comparison to its length, thicker, and differs in colour. The anatomy of *Lingula* having been noted under *L. anatina* need not be here repeated.

117. LINGULA TUMIDULA, Reeve. (Plate XXVIII. figs. 14, 15.)

Lingula tumidula, L. Reeve, Proc. Zool. Soc. 1841, part ix. p. 100.

Lingula compressa, L. Reeve, Proc. Zool. Soc. 1841, part ix. p. 100.

Lingula tumidula, G. B. Sowerby, Thes. Conch., Monogr. of *Lingula*, vol. i. p. 393, pl. lxvii. fig. 7, 1846.

Lingula tumida, Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 377, 1852.

Lingula tumidula and *L. compressa*, L. Reeve, Conch. Icon., Monogr. of *Lingula*, pl. i. fig. 2, 1859; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 47, 1859; Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 204, 1873.

Shell large, horny, thin, squarely oblong, slightly attenuated at and towards the beaks; umbones indistinct; sides subparallel, nearly straight in front, with a small angular projection in the middle; valves closed on each side. Colour coppery brown or reddish olive, sometimes bright green near the posterior margin. Surface smooth, marked with concentric lines of growth. Length 2 inches 2 lines, breadth 1 inch 5 lines.

Hab. Island of Masbate, Philippines (Cuming); Moreton Bay, Australia (Strange).

Obs. This is the largest and finest recent species of the genus with which we are at present acquainted, and is broader in proportion than any other known recent form. As stated by L. Reeve in his description of the species, the variety *compressa*, which he regarded in 1841 as a distinct species, was only a badly preserved specimen resulting from the mode of drying, which had been collected by Mr. Cuming in sandy mud and low water at Palanas, Isle of Masbate, one of the Philippines. The *Lingula* from Japanese waters, referred by Mr. A. Adams and myself to *L. tumidula*, was afterwards found to differ from Reeve's species, and subsequently received from Mr. W. H. Dall the specific name of *L. Adamsi* (see p. 218 of this Monograph, Pl. XXVIII. fig. 19). *Lingula tumidula* seems to be nearly allied to *Lingula Murphiana*, which is longer in proportion to its breadth. I have not seen good interiors of the valves of *L. tumidula*.

118. LINGULA HIANS, Swainson. (Plate XXIX. figs. 12, 13.)

Lingula hians, Swainson, The Phil. Mag. and Journal, vol. lxii. p. 401, 1823.

? *Lingula anatoni*, Küster, ed. Chemnitz, Conch.-Cab. p. 14, pl. i. figs. 7–9, 1843.

Lingula hians, G. B. Sowerby, Thes. Conch., Monogr. of *Lingula*, p. 338, pl. lxvii. fig. 1, 1846; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 377, 1852; L. Reeve, Conch. Icon., Monogr. of *Lingula*, pl. 2. fig. 12 *a–b*, 1859; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 229, 1859; Gratiolet, Études anatomiques de la *Lingula anatina*, Journ. de Conch. 2ᵉ sér. vol. iv. 1860; Dall, Amer. Journ. of Conch. vol. vi. p. 156, 1871, and Proc. Acad. Nat. Sci. Philadelphia, p. 203, 1873.

Shell thin, lengthened oblong, rather broadest anteriorly and tapering a little posteriorly; beak of ventral valve extending considerably beyond that of the dorsal valve, and much attenuated and sharply pointed at its extremity; lateral edges of the valves slightly curved inwards. Colour pale green, surface marked with numerous concentric lines; colour pale yellowish green, vivid sometimes at or near the front; peduncle more than twice the length of shell. Length of shell 1 inch 10 lines, breadth 9 lines.

Hab. China Seas.

Obs. This species seems to vary a good deal in shape, some specimens being broader anteriorly, others posteriorly, judging from the figures given by Reeve. Swainson says, in his paper on the species, "The belief that two distinct shells had been hitherto confounded under the same name of *L. anatina*, first struck me when examining the magnificent collection of Lord Tankerville, and the observations I have since made and the numerous specimens I have examined, have both tended to strengthen this belief. I have therefore here assigned to each its specific character."

Sowerby says that *L. hians* is distinguished from *L. anatina* "by being much thinner, and of a more delicate green colour, it is also slightly and gradually attenuated towards the base; it only gapes at the extremities when the valves are separated from the animal and dried." L. Reeve, on the contrary, states, in his monograph on *Lingula*, "the gaping of this species does not appear to depend upon the drying of the shell; it always dries into a gaping attitude, which is not the case with other species."

I am, however, of opinion that the drying has a great deal to do with the gaping observed in the dried specimens. The shell is very horny and thin, and when such is the case the shell gets much out of shape when drying. Mr. W. H. Dall considers *L. Antoni*, Küster, to be a synomyn of *L. hians*. Prof. E. Suess admits *L. Antoni* among the distinct species of the genus. Never having seen a specimen of Küster's species, I am unable to express any opinion with respect to its specific claims. It seems like a variety of *L. anatina*. Some parts of the anatomy of this species have been described and illustrated by Dr. P. Gratiolet in the 'Journal de Conchyliologie' for 1860.

119. Lingula exusta, Reeve. (Plate XXVIII. figs. 20–21 *a*.)

Lingula exusta, L. Reeve, Conch. Icon., Monogr. of *Lingula*, pl. ii. fig. 9, 1859; Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 203, 1873.

Shell oblong, much longer than wide, a little broader anteriorly; sides almost subparallel, slightly curved inwards near the middle of their length; front line very gently curved, with a projecting angle in the middle. Valves convex, beaks obtusely angular, surface smooth, shining, darkish coppery yellow-brown, especially towards the lateral and frontal margins. Peduncle longer than the length of the shell, dark in colour. Length of shell 1 inch 7 lines, breadth 8 lines.

Hab. Moreton Bay, Australia (Strange).

To his description of this shell Mr. Lovell Reeve adds:—"If *L. Murphiana* be an Australian form of *L. anatina*, this might be regarded as the representative in the same locality of *L. hians*. Both species exhibit a peculiar coppery redness, heightened in this to a dark, shining, swarthy tone of colour." I, however, believe both *L. anatina* and *L. Murphiana* to be distinct species, as Hancock found the animal to be different.

Obs. I have seen a number of specimens of this shell, and all presented the same shape and marked dark colour.

120. LINGULA JASPIDEA, Adams. (Plate XXVIII. figs. 23, 24 *a*.)

Lingula jaspidea, A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 101, 1863.
Lingula Dumortieri?, Nyst, Davidson, Proc. Zool. Soc. 1871, p. 310, pl. xxx. fig. 3.
Lingula jaspidea, Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 177, July 1873.
Lingula Dumortieri, G. Dunker, Index Moll. maris Japonici, p. 254, 1882.
Lingula jaspidea, C. E. Lischke, Japanische Meeres-Conchylien, Suppl. iv. p. 163, 1884.

Shell elongated oval, broadest near the beaks, tapering gently to near the front margin, which is gently rounded outwardly. Beaks obtusely angular; valves very moderately convex, surface marked with slight, almost microscopic, and close-set longitudinal lines, the valves being likewise crossed by concentric lines of growth. Colour tan or warm light yellowish brown. Peduncle about four times the length of the valve. Length of shell 1 inch 4 lines, breadth 8 lines, depth 3.

Hab. Mososeki, Japan, 7 fathoms, mud (Adams); Japanese waters (Belcher).

Obs. Adams briefly described, but did not figure, his species; this was done some years later by myself from Adams's type in the Proceedings of the Zool. Soc. for 1871. Since that period I have obtained a much larger and better specimen from Sir E. Belcher, dredged by him in Japanese waters. The specimen was in spirits, and its peduncle showed its full length.

In 1871 I referred Adams's species to the *Lingula Dumortieri* of Nyst (Coquilles et Polypes Fossiles de la Belgique, p. 337, pl. xxxiv. fig. 4, 1843), and I believe I did not err in so doing; but as some malacologists seem uncertain about the matter, I have thought it preferable, at any rate until a large number of specimens have been collected and compared, to retain the name given to the shell by Mr. Adams.

Dr. Gwyn Jeffreys wrote me in 1871, that the Japanese shell could not be distinguished in any way from that of *Lingula Dumortieri* from the Coralline Crag of Suffolk and of Belgium.

121. LINGULA ADAMSI, Dall. (Plate XXVIII. fig. 19.)

Lingula tumidula, A. Adams (not of Reeve), Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 100, 1863; Davidson (not of Reeve), Proc. Zool. Soc. 1871, p. 310, pl. xxx. fig. 1, 1871.
Lingula Adamsi, Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 202, 1873.
Lingula lepidula, G. Dunker (not of Reeve), Index Moll. maris Japonici, p. 251, 1882.

Shell squarely oblong longitudinally, slightly broader anteriorly. Sides almost parallel, nearly straight in front, obtusely tapering at its posterior margin. Valves flattened or very gently convex. Surface marked with very numerous close and minute, equidistant, slightly projecting, concentric lines or ridges of growth. Colour light yellow or brownish yellow, with a reddish-brown spot near the beak. Peduncle about twice the length of the valve. Interior of the valve not known. Length of shell 1 inch 5 lines, breadth 10 lines.

Hab. Tsaulian harbour, Korean Archipelago, 7 fathoms, mud (Adams); dredged by Capt. Weston near the shore, off the island of Formosa.

Obs. Few specimens of this species have been hitherto brought to England. A. Adams, in 1863, identified it with Reeve's *L. tumidula*, but did not figure the shell. He sent it to me to be figured in 1871, and I fell into the same mistake and referred it to Reeve's species. In 1873 Mr. Dall gave it the name of *L. Adamsi*, which I now readily adopt, as I never felt satisfied that the shell had been correctly identified. Heine, in his 'Expedition in die See'n von China, Japan und Ochotsk,' 1858, Bd. i. p. 137, alludes to a *Lingula* from Oosima (N.E. of Formosa) which may possibly be *L. Adamsi*, but I have not been able to consult his work.

122. LINGULA REEVII, Davidson. (Plate XXVIII. figs. 17, 18 *a*.)

Lingula ovalis, L. Reeve, On *Lingula*, Proc. Zool. Soc. part ix. 1841, p. 100; G. B. Sowerby, Thes. Conch. p. 393, pl. lxvii. fig. 8, 1846; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 377, 1852; L. Reeve, Conch. Icon., Monogr. of *Lingula*, pl. i. fig. 1, 1859; Dall, Amer. Journ. of Conch. vol. vi. p. 156, 1870, and Proc. Acad. Nat. Sci. Philadelphia, p. 203, 1873.

Lingula reevii, Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zoology, vol. i. p. 62, 1880.

Shell oblong oval, broadest about the middle, longer than wide, rather narrow; sides very gently curved outwardly, front rounded; posterior edge obtusely acuminated; valves moderately convex. Surface smooth, blue-green or emerald and verdgiris-green, especially along the middle; peduncle thick, much longer than the length of the shell. Length of shell 1 inch 5 lines, breadth 8 lines.

Hab. Sandwich Islands (Pease).

Obs. This beautiful and brilliantly coloured shell was described in 1841 by Mr. Lovell Reeve under the name of *Lingula ovalis*; but, as I have stated in my report on the Brachiopoda of the 'Challenger' Expedition and elsewhere, this name cannot be retained for the recent shell, because it had been applied by Sowerby as far back as 1813 to a well-known Kimmeridge-clay species (Min. Con. tab. 19. fig. 14, April 1813). I therefore, in 1880, proposed that the name of the recent form should be altered to that of *L. Reevii*. In 1841, as stated by Reeve, Mr. Cuming knew nothing of the habitat of the shell under description; but since then a number of specimens of this species have been received from Honolulu, one of the Sandwich Islands.

Uncertain Species.

123. LINGULA SMARAGDINA, A. Adams. (Plate XXVIII. fig. 25.)

Lingula smaragdina, A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 101, 1863; Davidson, Proc. Zool. Soc. 1871, p. 310, pl. xxx. fig. 2; Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 203, 1873.

Shell oblong oval, longer than wide; sides subparallel; front margin almost straight, obtusely angular posteriorly at the beaks; valves very moderately convex, smooth, bright green, whitish in the middle and near the beaks; length of peduncle not known. Length of shell 10 lines, breadth 4 lines, some specimens somewhat exceeding those dimensions.

Hab. Yobuko, 10 fathoms, mud, Japan, also in China seas (Adams).

Obs. This species (?) was described, but not figured, by Adams in 1863. In 1871 I figured the shell from Mr. Adams's type; he adds to his description "a bright green species, found also in the China seas, and most nearly resembling *L. hirundo*, Reeve." I have seen so little of this species (?) that I cannot feel certain as to its specific claims. It bears much resemblance to some young examples of *Lingula anatina*.

124. LINGULA HIRUNDO, Reeve. (Plate XXVIII. fig. 22.)

Lingula hirundo, L. Reeve, Conch. Icon., Monogr. of *Lingula*, pl. ii. fig. 7, 1859; Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 203, 1873.

"Shell oblong-square, thin, greenish, posteriorly abruptly attenuated; umbones rather sharp. Length 11, breadth $4\frac{1}{2}$ lines.

"*Hab.* Port Curtis, North-east Australia (Stutchbury.)

"Several specimens of this little semitransparent species were collected by Mr. Stutchbury at the above-named locality."

Obs. As I know nothing more respecting the specific claims of this so-termed species, I can only reproduce the statements Mr. L. Reeve has published with respect to his species.

125. LINGULA LEPIDULA, A. Adams. (Plate XXVIII. fig. 16.)

Lingula lepidula, A. Adams, Ann. & Mag. Nat. Hist. 3rd ser. vol. xi. p. 101, 1863; Davidson, Proc. Zool. Soc. 1871, p. 311, pl. xxx. fig. 4; Lischke, Japanische Meeres-Conchylien, Suppl. iv. p. 163, 1884.

Shell small, oval, longer than wide, tapering a good deal at the beaks; sides and front gently rounded. Colour yellowish, slightly tinted with red. Length 4 lines, breadth 2 lines.

Hab. Seto-Uchi (Akasi), Japan, 10 fathoms, mud (Adams).

Obs. Mr. Adams did not figure his species, but he sent me his type in 1871, and I figured it in the Proc. of the Zool. Soc. for that year. Mr. Adams adds to his description "that it is a species as small as *L. semen* and shaped like *L. ovalis*." I have seen so little of this so-termed species that I am unable to advocate its specific claims, but I am more inclined to consider it the young of some other form. Some young specimens of *L. anatina* from the Philippine Islands much resemble it in shape.

Genus GLOTTIDIA, Dall, 1870.

Glottidia, Dall, American Journal of Conchology, vol. vi. p. 157, 1870.

Type *Glottidia albida*, Hinds, sp.

"Shell linguiform, elongate, pedunculated; general characters as in *Lingula*. Neural [dorsal] valve provided internally with two sharp, narrow, incurved laminæ, diverging from the beak, and extending about one third the length of the shell; anterior extremities of the laminæ about midway between the mesial line and the margin. Hæmal [ventral] valve with a mesial septum of about the same length, extending forward from the beak. Anterior adductor impressions rounded, separated by a faint mesial ridge, faintly impressed. Scar of the post-adductor close in the cavity of the beak, rounded. No other evident scars. Shell smooth, perforate or imperforate.

"This genus appears to take the place in America of the genus *Lingula*, which has its home in the Australian and Indo-Pacific seas." (*Dall.*)

126. GLOTTIDIA ALBIDA, Hinds, sp. (Plate XXVIII. figs. 2–4.)

Lingula albida, Hinds, Zoology of H.M.S. 'Sulphur,' p. 298, pl. xix. fig. 4, 1845; G. B. Sowerby, Thes. Conch. p. 393, pl. lxvii. fig. 6, 1846; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 377, 1852; L. Reeve, Conch. Icon., Monogr. of *Lingula*, pl. i. fig. 4, 1859; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 230, 1859.

Glottidia albida, Dall, Amer. Journ. of Conch. vol. vi. p. 157, pl. 8. figs. 1–6, 1870; Proc. Acad. Nat. Sci. Philadelphia, p. 204, 1873; Dall, Scientific Results of the Exploration of Alaska, 1877; Davidson, Report on the Brachiopoda, Voyage of H.M.S. 'Challenger,' Zoology, vol. i. p. 26, 1880.

Shell narrow, elongated oval, linguiform, tapering at the beak, sides almost subparallel, very slightly curved in front; rather rolled, creamy white, smooth, shining, marked with concentric lines of growth, rather flat, especially along the middle, or from near the extremity of the beak to the front, with a slight mesial rounded ridge along the middle. Peduncle stout, short, transversely wrinkled, exhibiting two longitudinal edges with a groove between them. In the interior of the longest or ventral valve the beak is pointed, with a small triangular-shaped thickening, grooved along the middle; from under it a narrow mesial septum of very small elevation extends to about one third of the length of the valve. Posterior occlusor or central muscles obliquely oval, situated near the middle of the valve, and separated by a faint mesial ridge. In the interior of the dorsal or smaller valve two diverging narrow septa of very small elevation extend to a little beyond a third of the length of the valve; at about the middle of the valve two oblique oval-shaped central muscular scars, or posterior occlusors, are separated by a long faintly marked mesial ridge; shell-structure calcareous and horny. Length of shell 1 inch 2 lines, breadth 6 lines.

Hab. Magdalena Bay, California, in 7 fathoms, among sandy mud (Hinds); San Diego Bay, California (Hemphill). Dredged by Dr. W. Newcomb off Santa Barbara Island, California, in 28 fathoms (Dall); Monterey (Stearns); Catalina Island (Cooper), in 10 to 60 fathoms; muddy bottom, rarely on tidal flats in mud at lowest water (Dall).

Obs. This species was briefly described by R. B. Hinds in 1845, and since then more fully by Sowerby, Reeve, and Dall. In 1870 it was selected by Dall as the type of his genus *Glottidia*. When describing *G. albida*, he states, at p. 158 of his 'Revision of the Terebratulidæ and Lingulidæ,' "This species differs from the typical species of *Lingulidæ*, in the diverging lamellæ which support the post-parietals, in the form of the anterior adductor scars, and in its colour. A microscopical examination of the shell gave the following results:—There were no punctures visible with a good light and a power of 900 diameters. The substance of the shell was shown by a cross section to be composed of translucent horny laminæ, nearly parallel with one another and separated by layers of white amorphous calcareous matter, which looked much like powdered sugar. There were no tubuli visible after the most careful search; the horny layers presented faint indications of a partially fibrous structure, but nothing of the kind extended to the calcareous layers. A section of the lamina much resembled the end of a T-rail, with one flange taken off and obliquely inclined. The anterior part of the shell contained less calcareous matter than that nearer the beaks, and the margin seemed entirely horny. The number of horny layers amounted to eight or ten, in the thickest part of the shell. They were not uniform in thickness, but were thinner than the amorphous calcareous layers."

Only the central muscular scars are well defined in the interior of the valves.

Mr. Dall observes, in his report on the Brachiopoda of Alaska in 1877, that *Glottidia albida* "has not been found to the northward of Monterey, though it may yet turn up somewhere. It is usually not over three inches in length, peduncle included. Like other species of Lingulidæ, when young, it is free, and burrows in the mud. Adult specimens, with favorable opportunity, often fasten themselves to a pebble or fragment of shell by the distal extremity of the peduncle. This has been also observed with *Glottidia pyramidata*, Stm., in Florida, by Mr. F. B. Meek, though that species had been supposed to be always free. It would seem probable, from information communicated to me by Mr. Meek, that these creatures are of rapid growth, and live at most but one or two seasons."

127. Glottidia Palmeri, Dall. (Plate XXVIII. figs. 5, 6 *a*.)

Glottidia (? *albida*, var.) *Palmeri*, Dall, American Journal of Conchology, vol. vii. p. 77, 1871.

Glottidia Palmeri, Dall, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 204; Davidson, Brit. Foss. Brach. vol. iv. p. 362, figs. 1–4, 1881.

Shell narrow, elongated, beaks sharply acuminated, sides subparallel, or very slightly curved; front line nearly straight. Valves very moderately convex, with two obscurely rounded ridges, commencing at the extremity of the beaks, and deviating until they reach the anterior rounded corners of the front of the valves, and with another similar ridge along the median line; lateral portions of the valves sloping from the deviating ridges to the lateral edges of the shell. Colour creamy white, smooth, glossy, with obscure impressed lines and concentric ones of growth. Shell-structure calcareous and horny. In the interior of the dorsal and ventral valves the septa and muscular impressions are similar to those already described under *Glottidia albida*. Length of shell 1 inch 8 lines, breadth 7 lines; length of peduncle over 4 inches.

Hab. At the head of the Gulf of California, on the Lower Californian shore, opposite the mouth of the Colorado River; on sandy shelly mud at low-water mark. Ten specimens of the animal were collected by Dr. Edward Palmer, who spent many hours groping in the mud for the small number of specimens above recorded.

Obs. This is the largest species of recent *Glottidia* hitherto discovered. It was carefully described by Dall in 1871 as a variety (?) of *G. albida*, but in 1873 he considered it a distinct species, and I feel inclined to agree with him in his last determination. *G. Palmeri* is, as stated by Dall, a much more elongated shell than *G. albida*, and narrower. The beaks are more acute, the internal laminæ are closer together, and less widely divergent. The peduncle, he adds, is much longer, and the brown colour, so conspicuous on the exterior, is not found in *G. albida*, which also has a much more prominent median carina, and a more solid shell, which does not gape. It is most desirable that the animal of this fine species should be anatomically examined. When describing *Lingula* (or *Glottidia*) *Lesueuri* from the Silurian rocks of Brittany and Budleigh Salterton, I remarked that it had been questioned by M. de Tromelin whether that species was a true *Lingula*. It is characterized by the presence of a median septum on the interior of the ventral valve, and two diverging ones on the dorsal one, and in external shape and character so closely resembles *Glottidia Palmeri* that were this recent form fossilized, it would be hard to distinguish it from the Lower Silurian *L. Lesueuri*.

128. Glottidia Audebarti*, Broderip, sp. (Plate XXVIII. figs. 7–11.)

Lingula Audebardi, Broderip, Trans. Zool. Soc. vol. i. p. 143, pl. xxiii. fig. 14, 1835; Owen, Trans. Zool. Soc. vol. i. p. 157, 1835; Küster, ed. Chemnitz, Conch.-Cab. pl. i. fig. 11, 1843; G. B. Sowerby, Conch. Icon. i. p. 338, pl. lxvii. fig. 5, 1846; Anton, Verzeich. d. Conch. p. 24, 1839; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix. p. 377, 1852; L. Reeve, Conch. Icon., Monogr. of *Lingula*, pl. i. fig. 5, 1859: E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 230, 1859.

Lingula pyramidata, Stimpson, Amer. Journ. Sci. & Arts, vol. xxxix. p. 444, 1860.

Lingula Audebarti, Deshayes, in Lamarck, An. sans Vert. ed. 1836; E. Morse, Amer. Naturalist, vol. iv. p. 314, figs. 76–78, 1870; Amer. Journ. Sci. & Arts, vol. l. figs. 1, 2, 3, 1870; On the Systematic Position of the Brachiopoda, Boston Soc. Nat. Hist. vol. xv., 1873.

Glottidia Audebarti and *G. pyramidata*, Dall, Amer. Journ. Conch. vol. clviii., 1870; Proc. Acad. Nat. Sci. of Philadelphia, p. 204, 1873.

Lingula pyramidata, Davidson, "Brachiopoda," Encyclopædia Britannica, ix. ed. p. 188, 1876; Brooks, On the Development of *Lingula*, Scientific Results, Chesapeake Zool. Laboratory, p. 35, 1878.

Lingula (*Glottidia*) *pyramidata*, Davidson, Brit. Foss. Brach. vol. v. pp. 328, 329, 1884; H. G. Beyer, Studies from the Biol. Laboratory, Johns Hopkins University, vol. iii. no. 5, March 1886.

Shell oblong, thin, narrow, broadest posteriorly, beaks tapering to an acutely angular termination. At about one third of its length the margins gradually taper posteriorly, front margin nearly straight. Valves moderately convex, smooth, marked with

* The word printed by Broderip "*Audebardii*" was corrected by Deshayes, in his edition of Lamarck, into *Audebarti*, the species being named in honour of M. J. d'Audebart de Férussac.

concentric lines of growth; texture horny, with a slight deposit of lime in the thickest part of the shell, very finely perforated. Colour cream-white, with sometimes transverse lines or bands of green, especially on its anterior half and edge. In the interior of the ventral or longest valve two thin septa or ridges of small elevation diverge from the beak to about one third of the length of the valve, and in the dorsal valve a single median similar ridge or septum extends from under the beak to about one third of the length of the valve; muscular scars as in *Glottidia albida*. The peduncle is very long, and secretes a mucus to which grains of sand adhere, especially for some distance along its posterior extremity. Length of shell 1 inch 1 line, breadth 5 lines.

Hab. Island of Punam, Bay of Guayaquil, at about half-tide, on an extensive bottom of hard coarse sand, at from four to six inches below the surface (Cuming and Broderip); United States, Newberne to Port Royal; coasts of North and South Carolina (Dall); Fort Wool (Brooks). Mr. Dall informs me by letter, 29 Jan., 1885, that he has received *Glottidia pyramidata* from Mr. Hemphill, South Florida Keys, where the shell grows larger and slightly thicker than the more northern specimens, but is otherwise identical, and that it becomes attached when adult to beds of shell or pebbles.

Obs. An attentive comparison of many specimens of *G. Audebarti*, Broderip, and *G. pyramidata*, Stimpson, has convinced me that they are the same species. Broderip's name must consequently hold priority, and that of Stimpson be placed among the synonyms. *Glottidia Audebarti* is well distinguished by its shape from *G. albida*, Hinds. In 'Science,' vol. iii. p. 325, 1884, Mr. W. H. Dall says that the *Glottidia* (?) *antillarum*, Reeve, described from the West Indies, may be identical with it.

Glottidia Audebarti varies a good deal in shape; and Broderip * observes:—"The rounded anterior edge of this shell is green, and the transverse lines of that colour are produced by the progressive increase of the shell, which is smooth and parchment-like. In all the dried specimens the thin anterior edge is contracted into a square form, so as to produce a resemblance to a very square-toed shoe; but in its natural state this edge is rounded. A general contraction, moreover, gives the dried shells a narrower and more ventricose character than they really possess; and the remains of the cilia (setæ) give to their anterior edges a bearded appearance."

The anatomy and embryology of this well-defined species have been studied with great care by Professors Owen †, E. S. Morse ‡, and W. K. Brooks §. As it will not, however, be possible in this monograph to reproduce all the important details they have published upon the subject, we must limit ourselves to giving a few extracts from their works, and refer the reader for more ample details to their respective memoirs upon the subject.

In an abstract of his paper on "The Brachiopoda, a Division of the Annelida"

* Trans. Zool. Soc. vol. i. p. 144, 1835.

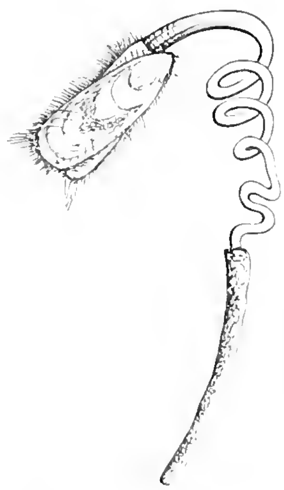
† Ibid. p. 157.

‡ American Naturalist, vol. iv. 1870; Amer. Journ. Sci. & Arts, vol. l., 1870; and Boston Soc. Nat. Hist. vol. xv., 1873.

§ Chesapeake Zool. Lab. Scientific Results, 1878. [See also Beyer, "A Study of the Structure of *Lingula* (*Glottidia*) *pyramidata*, Stimp., Dall." Studies Biol. Labor. Johns Hopkins University, Baltimore, vol. iii. no. 5, March 1886.—A. C.]

(Amer. Journ. Sci. and Arts, July 1870), Prof. E. S. Morse is stated to have found *Glottidia* (*pyramidata*) *Audebarti* "in a sand shoal at low-water mark, buried just below the surface of the sand. The peduncle was six times the length of the shell, and was encased in a *sand-tube*, differing in no respect from the sand-tubes of neighbouring annelids. In many instances the peduncle was broken in sifting them from the sand, yet the injury was quickly repaired, and another sand-case was formed. He observed that the animal had the power of moving over the sand by the sliding motion of the two valves, using at the same time the fringes of setæ, which swung promptly back and forth like a galley of oars, leaving a peculiar track in the sand. In the motion of the setæ he noticed the impulse commencing from behind, and running forward. Within the mantle he found a series of rows of prominent lamellæ, in which the blood rapidly circulated, thus confirming the correctness of Vogt's observations. These lamellæ were contractile, however. The peduncle was hollow, and the blood could be seen coursing through its channel. It was distinctly and regularly constricted or ringed, and presented a remarkably worm-like appearance. It had layers of circular and longitudinal muscular fibre, and coiled itself in numerous folds or unwound at full length. It was contractile also, and would quickly jerk the body beneath the sand. But the most startling observation in connection with this interesting animal was the fact that its blood was *red*. This was strongly marked in the gills and various ramifications of the mantle and in the peduncle. At times the peduncle would become congested, and then a deep rose blush was markedly distinct."

Fig. 24.



Glottidia pyramidata, from life (after Morse).

Prof. Owen states, in his observations on the anatomy of *Lingula Audebardii* (p. 157), that "the structure of this species corresponds in all essential particulars with that of *Lingula anatina* as given by Cuvier. The differences appear first in the length of the cilia, which in the present species are three times longer than in *Lingula anatina*. The subdivisions of the branchial vessels project from the inner surface of the mantle, in linear series similar in their direction to those of *Lingula anatina*; but the lines are not continuous; they are composed of distinct and separate folds of the mantle, of a minute size, along the convexity of each of which a single vascular loop is extended without giving off lateral ramulets, the whole structure affording a beautiful example of the first stage in the composition of a complex lamellated gill. All the glandular masses communicating with the alimentary canal bear the green colour characteristic of the liver, especially that central one surrounding the stomach, which Cuvier has marked as the salivary gland of *L. anatina*. With respect to *L. Audebardii*, I shall only add, that the distal end of its pedicle is dilated and rounded, and in the small specimen dissected did not present any appearance of having been attached to a foreign substance. . . . . . *Lingula*, living more commonly near the surface, and sometimes where it would be left exposed by the retreating tide were it not buried in the sand of the shore, must meet with a greater variety and abundance of animal nutriment than can be found in those abysses in which *Terebratula* is destined to reside. Hence, its powers of prehension are greater, and Cuvier suspects it may even enjoy a species of locomotion from the superior length of its peduncle. The organization of its mouth and stomach indicates, however, that it is confined to food of a minute description; but its convoluted intestine shows a capacity for extracting a quantity of nutriment proportioned to its superior activity and the extent of its soft parts. A more complex and obvious respiratory apparatus was therefore indispensable, and it is not surprising that the earlier observers failed to detect a corresponding organisation in genera destined to a more limited sphere of action."

Prof. W. K. Brooks has studied with great care the development of *Glottidia Audebarti*; and my only regret is that it is not possible here to transcribe all his admirable observations. He begins by remarking that "it has been known since about the year 1860 that some of the hingeless Brachiopoda pass through a free-swimming larval state. Fritz Müller has figured and briefly described this stage of development of an unknown Brachiopod from the coast of Brazil, and Mr. Crady has given a brief description from memory of the swimming larva of *Lingula*." Prof. Brooks states that he obtained the larva of *Lingula pyramidata* [= *Glottidia Audebarti*] in the vicinity of Fort Wool during the summer, in considerable abundance, that he had succeeded in tracing its development from a very early stage to the time when most of the adult characters appeared, and that his observations not only show that Mr. Crady's fragmentary account is correct in every particular, but also give us a very thorough acquaintance with the embryo. "The free-swimming embryos of *Lingula pyramidata* were met with in abundance at Fort Wool, from about the middle of July to the middle of August; and as the youngest stages were met with in the early part of this period, while only the older larvæ were found at the end, it is probable that the breeding-season is short. No adults were found until the end of July, and the reproductive organs did not then present any indications of functional activity, and although a number of individuals were kept in an aquarium for several weeks, no eggs were laid, and I was unable to obtain the early stages of development. The larva is enclosed between two orbicular flattened valves, which are not articulated to each other, but are free round the entire circumference. The dark-coloured, somewhat opaque, flask-shaped digestive organs occupy the centre of the cavity of the shell, and are in contact above and below with the integument which lines the valves. Around the digestive organs is a body-cavity bounded externally by the integument, which is continuous with the mouth above and below, and is bent downward at right angles to the valves to form the body-walls. On the sides of, and behind, and in front of the body, there is a capacious mantle-chamber which is open around the entire circumference. The mouth opens in the centre of a broad, flat, nearly circular disc or lophophore, around the margin of which are the ciliated tentacles. The plane of the lophophore is not at right angles to the long axis of the body, but inclined so as to be nearly parallel to it. The tips of the tentacles may be extended beyond the edges of the valves, and thus form a swimming-apparatus, somewhat like the velum of a mollusk, by the aid of which the larva floats in the water or rises slowly to the surface." (See Pl. XXX. figs. 7–11.)

"The changes undergone by the larva during development are gradual, and do not involve any marked metamorphosis. . . . In the figures, that valve of the shell which is uppermost, is to become the movable valve of the adult: that which conchologists have agreed to call the dorsal valve; while the peduncle is to be attached to the opposite valve, which is accordingly ventral. The nearly straight margin of the shell is that from which the peduncle is subsequently to project, and therefore indicates the posterior end of the body, while the opposite rounded margin is anterior." Prof. Brooks then proceeds to explain the changes in the form of the larva, and adds:—"Before I pass to the description of the internal organization of the larva, I wish to call attention briefly to the fact that the recent and fossil shells of various species of *Crania*, *Discina*, *Lingula*, *Lingulella*, *Obolus*, and other hingeless Brachiopoda, furnish a series of adult forms representing all the changes through which the outline of the shell of *Lingula pyramidata* passes during its development."

Prof. Brooks then describes the digestive organs, the body-cavity or perivisceral chamber, the blood, the mantle and integument, the pallial sinuses, the muscles, the nervous system and sense-organs, the peduncle, the lophophore and tentacles, and concludes with an elaborate discussion of the bearing of the development of *Lingula* upon the systematic position of the Brachiopoda. Indeed, the whole memoir is replete with original and valuable details and suggestions, which have materially added to our knowledge on many difficult and important questions*.

* [An important memoir was published by Dr. H. G. Beyer "On the Structure of *Lingula pyramidata* (= *Glottidia Audebarti*) in vol. iii. no. 5, March 1886, of the 'Studies from the Biological Laboratory of Johns Hopkins University, Baltimore.'

Dr. Beyer considers the shell in this species to be composed of *three* layers, an outer periostracum or cuticle, "a simple homogeneous and comparatively thin layer or membrane. . . . probably a changed original larval ectoderm or in some way produced by it." This cuticle covers the valves and the peduncle, becoming thickened and corrugated at the point of attachment of the peduncle to the animal. Beneath this cuticle a large number of peculiar rounded corpuscles are seen imbedded in the shell substance, sometimes in linear series, but generally scattered irregularly, or aggregated in clusters. "Immediately adjacent to the cuticle and this layer of homogeneous round corpuscles, we find a rather broad layer of horny substance." This varies in thickness according to the age and size of the animal. Closely adjoining this broad horny layer a very thin calcareous layer occurs, and this alternation of horny and calcareous layers continues through the shell. The horny layers, Dr. Beyer believes, partake of the nature of a supporting substance, and "represent the homologies of the vertical septa found in the substance of the shells in testicardine (articulated) genera. The calcareous layers probably are the result of a secretion on the part of the former, or that of a calcareous degeneration of the ectodermal cells of that part of the mantle and body-wall which is next the shell."

The dorsal and ventral body-walls are closely adherent to and covered by the valves of the shell, while the remaining parts are comparatively free. The mantle is a fold of the body-wall itself. "The peduncle may properly be looked upon as a worm-like backward prolongation of the body-wall and its cavity. The structural elements of the body-wall, mantle and peduncle, are, first, an outer layer of ectodermal epithelium; secondly, a middle layer of supporting tissue, variously modified according to situation; and thirdy, an inner layer of lining or peritoneal epithelium."

Immediately beneath the ectodermal covering the calcareous plates are situated, more particularly distributed over the inner leaflet of the mantle and the lateral body-walls. The supporting tissue, in its ordinary aspect, is a homogeneous layer of tissue either entirely structureless, or presenting a very faintly longitudinally striated appearance.

All the so-called mesenteric bands are simply bridges of a substance hitherto regarded as muscular, which also

Uncertain Species.

129. GLOTTIDIA (?) ANTILLARUM, Reeve, sp. (Plate XXVIII. fig. 13.)

Lingula antillarum, L. Reeve, Conch. Icon., Monogr. of *Lingula*, pl. ii. fig. 8, 1861.
? *Glottidia antillarum*, Dall, Proc. Acad. Nat. Sci. Philadelphia, p. 204, 1873.

Shell elongated ovate, broadest posteriorly, tapering at the beak, pinched in anteriorly at the sides, and almost straight in front. Valves very slightly convex and flattened; surface smooth, marked only by concentric lines of growth, light yellowish anteriorly, tinged with blue-green towards the umbones. Length of shell 8, breadth $3\frac{1}{2}$ lines. Length of the peduncle not known.

Hab. Martinique, dredged at a depth of sixteen fathoms (Cuming).

Obs. This is a very uncertain species, and may be a young specimen of some other form. Mr. L. Reeve states that he has seen only one specimen, which appears distinct, and whose

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permeates the mantle-leaflets. But Dr. Beyer considers these fibres as nothing more nor less than supporting fibres. "passing in various directions, but having for their purpose the fixation of the cavities through which they extend."

The peritoneal epithelium "consists of flattened polygonal cells, with small, round, central nuclei: these cells are joined together edgewise, and form a very thin and delicate membrane, which lines the walls of the perivisceral chamber, the mantle sinuses, and blood-lacunes, covers all the viscera and mesenteric bands, and gives rise to blood-vascular spaces and channels within the body-cavity."

"All the muscles in *Lingula* are composed of long parallel fibres, and belong to the variety of smooth muscle-fibres." The structures described by Hancock as 'parietal muscles,' and by Gratiolet as 'muscles haussières,' as well as the muscles on the arms and the peduncle, Beyer regards *not* as muscles, but rather "as a mesenchymatous supporting substance possessing a certain amount of elasticity, but lacking the contractibility proper to muscular tissue only."

He was unable to detect any central propelling organ of the vascular system, and confirms the views held by Shipley, Shulgin, Semper, and Morse as to the absence of a heart. He detected the presence of three different kinds of corpuscles floating in the circulating fluid, in addition to those connected with the structure of the shell: the blood-corpuscles proper, small round granular corpuscles, recurring chiefly within the mantle-sinuses and their branches. These he was led to regard "as young ova which sooner or later become transformed into fully developed ones." and peculiar, spindle-shaped, or oblong ovoid, striated bodies called spermatophores by Hancock, and young *Lingula* by Gratiolet.

Dr. Beyer divides the digestive apparatus of *Lingula* into three parts, viz., "The mouth and œsophagus, the stomach and liver-lobules, and the intestinal canal proper. . . . The apparent great strength of the tissues surrounding the mouth and the prominences in the wall itself seem to imply a certain power for grinding the most solid food-particles before they pass on into the œsophagus through a valve-like structure permeated with supporting fibres. . . . The opening of the anus seems to be valve-like, running for a short distance within the supporting layer of the body-wall before opening to the exterior."

The author adheres to the number and division of the nervous ganglia as given by Hancock in *Waldheimia australis*. "There are in *Lingula*," he says (p. 250), "five distinct nervous ganglia connected with the circum-œsophageal commissure. . . . The great central subœsophageal, the two ventro-lateral, and the two dorso-lateral or supra-œsophageal ganglia" (the smallest of all).

"The description of the genital apparatus of *Lingula* may be divided into two parts, namely:—1. That of the genital glands, the organs producing the ova and spermatozoa respectively; and 2. That of the oviducts or segmental organs (Morse), which conduct the spermatozoa and ova into the pallial chamber, and thence into the sea-water. . . . The description of the generative glands in *Waldheimia australis*, a Testicardine Brachiopod given by Hancock, is in habitat is peculiar. Mr. Dall places it with two ? ? in his genus *Glottidia*; but we have no direct evidence that it belongs to that genus; and in a letter to me, dated 29th Jan., 1885, that writer says, "we have recently received *Glottidia pyramidata* from the Florida Keys, where it grows larger, and with a slightly more thickened shell, than the more northern specimens, but is otherwise identical; and there can be no doubt that it is identical with the *Lingula* (*Glottidia*) originally described from Cuba, which long antedates Stimpson's name." It will, however, be better, until the matter is finally determined, to leave it among the uncertain species and under its present name.

130. Glottidia (?) semen, Broderip, sp. (Plate XXVIII. fig. 12.)

Lingula semen, Broderip, Trans. Zool. Soc. vol. i. p. 144, pl. xxiii. fig. 17, 1835; G. B. Sowerby, Thes. Conch. p. 338, pl. lxvii. fig. 11, 1846; A. d'Orbigny, Voyage dans l'Amérique Méridionale, vol. v. p. 671, 1847; Davidson, Ann. & Mag. Nat. Hist. 2nd ser. vol. ix., May 1852; L. Reeve, Conch. Icon.,

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almost perfect accord with what we have found with regard to the genital glands in the Ecardine Brachiopod *Lingula*." He notes the exception that the genital bands contained within the mantle-sinuses are attached to the outer leaflet of the mantle instead of the inner, "and have no genital artery, as is the case in *Waldheimia*" (p. 255).

It was only after considerable hesitation that Dr. Beyer was forced by the weight of evidence "to believe in the fact that, so far, at least, as *Lingula* is concerned, the sexes are united within the same individual. . . . . Hancock's views are still correct," he states, "so far as the genital ridges within the mantle-sinuses are concerned. Within these, according to our interpretation, both ova and spermatozoa develop side by side; it is, however, different within the perivisceral chamber. Here the ova are confined principally to the mesenteric bands and their reflected portions —in other words, occupy a more central position with relation to the animal—while the spermatophores occupy the peripheral walls of the visceral chamber, in fact, are almost exclusively developed from the peritoneal epithelium (covering in many layers, and much modified) the lateral body-wall, and to a slight extent also the dorsal and ventral.

"While, then, in our opinion, *Lingula* is an hermaphrodite animal, it is nevertheless rare to find both ova and spermatozoa present in equal proportions, and equally developed in the same individual. In those individuals in which, for instance, the male elements largely preponderate fully developed ova are sometimes very few, and may even be entirely confined to the mantle-sinuses, so that on a superficial examination they might be entirely overlooked. A more careful examination of an entire series of sections, however, will invariably result in finding both male and female organs of generation within the same individual.

"As already mentioned, the principal seat of development of the spermatophores is the lateral body-wall. This arrangement seems to be in perfect harmony with the close apposition in some individuals of the cup-shaped internal extremity of the segmental organs to the lateral body-walls, which, so far, has remained unexplained. . . . . . We would therefore consider them as movable organs intended to take up spermatozoa or ova, and carry them into the mantle-chamber at certain intervals; and in accordance with this double function the relative position of their internal openings changes; at one time, it will be found snugly applied to the lateral body-walls, and then spermatophores may be seen within the oviducts; at another, their ciliated inner extremity will point directly backward towards the most posterior portion of the visceral chamber, into which fully developed ova usually drop, and under these circumstances ova may be detected within the oviducts. Having never seen either ova or spermatophores within the same oviduct, it is not to be supposed that fructification takes place inside the animal, but rather that this occurs in the mantle-chamber or in the sea-water. . . . We think that there can now hardly be any doubt as to the ova springing directly from the cells composing the peritoneal lining membrane. . . . The development of the spermatophores also takes place from peritoneal epithelium." See Pl. XXX. figs. 12, 13, 14 of this Monograph, where some of Dr. Beyer's illustrations are reproduced.—A. C.]

Monogr. of *Lingula*, pl. ii. fig. 6, 1859; E. Suess, Ueber die Wohnsitze der Brachiopoden, Sitzungsb. k. Akad. Wissensch. Wien, Bd. xxxvii. p. 230, 1859.

Glottidia? semen, Dall, Amer. Journ. of Conch. vol. vi. p. 159, 1870; Proc. Acad. Nat. Sci. Philadelphia, p. 204, 1873.

Shell small, ovate, oblong, broadest posteriorly, beak acuminated, sides subparallel, front nearly straight, or very gently rounded. Valves slightly convex, flattened, smooth and polished, rather thick. Length 5 lines, breadth $2\frac{1}{2}$ lines.

Hab. Dredged off the Isle of Plata, West Columbia, in a fine coral sand, from a depth of seventeen fathoms (Cuming).

Obs. I have seen only one specimen of this so-termed species. The type is in the British Museum, and was described by Broderip, Trans. Zool. Soc. vol. i. p. 144, 1835. He says, "It may be a young individual; but the shell is so much firmer than it usually is in *Lingula* (so firm, indeed, as not to have contracted at all in drying) that I cannot but look on it as an undescribed species. In size and appearance it bears a near resemblance to a melon-seed." It has all the appearance of a young *Glottidia*, but must remain an uncertain species until further material is obtained.

Classification of the Recent Brachiopoda.

ARTHROPOMATA, Owen=CLISTENTERATA, King.

Family	Subfamily	Genus	Species.	Uncertain species.
1st Family TEREBRATULIDÆ.	Subfamily *Terebratulinæ*	I. Genus *Liothyris*, Douvillé	8	2
		II. Subgenus *Terebratulina*, d'Orbigny	9	6
		III. Genus *Waldheimia*, King	10	1
	Subfamily *Terebratellinæ*	IV. Genus *Terebratella*, d'Orbigny	9	3
		V. Subgenus *Magasella*, Dall	6	6
	Subfamily *Megerlinæ*	VI. Genus *Megerlia*, King	2	1
		VII. Subgenus *Laqueus*, Dall	3	
	Subfamily *Magasinæ*	VIII. Genus *Bouchardia*, Davidson	1	
	Subfamily *Kraussininæ*	IX. Genus *Kraussina*, Davidson	5	
		X. Subgenus *Megerlina*, Deslongchamps	2	
	Subfamily *Argiopinæ*	XI. Genus *Argiope*, Deslongchamps	1	2?
		XII. Subgenus *Cistella*, Gray	8	1
	Subfamily not yet determined	XIII. ? Genus *Gwynia*, King	1	
		XIV. Genus *Platydia*, Costa	2	
2nd Family THECIDIIDÆ		XV. Genus *Thecidium*, Defrance	2	
3rd Family RHYNCHONELLIDÆ		XVI. Genus *Rhynchonella*, Fischer	6	
		XVII. Subgenus *Atretia*, Jeffreys	2	

LYOPOMATA, Owen=TRETENTERATA, King.

Family	Genus	Species.	Uncertain species.
4th Family CRANIIDÆ	XVIII. Genus *Crania*, Retzius	4	1
5th Family DISCINIDÆ	XIX. Genus *Discina*, Lamarck	1	
	XX. Subgenus *Discinisca*, Dall	6	1
6th Family LINGULIDÆ	XXI. Genus *Lingula*, Bruguière	8	3
	XXII. Subgenus *Glottidia*	3	2

6 Families. 22 Genera and Subgenera. 99 Species. 29 Uncertain Species.

Classification of the Recent Brachiopoda.

ARTHROPOMATA, Owen=CLISTENTERATA, King.

Family TEREBRATULIDÆ.

Subfamily TEREBRATULINÆ, Dall, 1870.

I. Genus LIOTHYRIS, Douvillé, 1879.

Liothyris vitrea, Born, sp., 1778.
Terebratula vitrea, var. *minor*, Philippi, 1836, = *affinis*, Calcara, 1845.
L. vitrea, var. *Davidsoni*, Adams, 1867.
L. arctica, Friele, sp., 1877.
L. uva, Broderip, sp., 1835.
L. Moseleyi, Davidson, 1878.
L. sphenoidea, Philippi, sp., 1844, = *T. Cubensis*, Pourtales, 1871.
L. Bartletti, Dall, sp., 1882.
L. subquadrata, Jeffreys, sp., 1868–70.
L. Wyvillii, Davidson, 1878.

Uncertain Species.

Liothyris cernica, Crosse, sp., 1873.
L. Dalli, Davidson, 1878.

II. Subgenus TEREBRATULINA, d'Orbigny, 1847.

Terebratulina caput-serpentis, Linné, sp., 1767, = *A. pubescens*, Linné; *aurita*, Fleming; *costata*, Lowe; *retusa*, Linné; *emarginata* and *quadrata*, Risso, = var. *mediterranea*, Jeffreys, 1878; *Chemnitzii*, Küster; *spatula*, Menke; *Gervillei*, Wood.
Terebratulina caput-serpentis, var. *unguiculata*, Carpenter, 1865.
T. cailleti, Crosse, 1865.
T. septentrionalis, Couthouy, 1838 or 1839.
T. Wyvillii, Davidson, 1878.
T. Crossii, Davidson, 1882.
T. japonica, Sowerby, sp., 1846.
T. radiata, Reeve, 1860.
T. cancellata, Koch, sp., 1843.
T. (*Agulhasia*) *Davidsoni*, King, 1871.

Uncertain Species.

Terebratulina Cumingi, Davidson, 1852.
T. abyssicola, Adams & Reeve, sp., 1850.
T.? incerta, Davidson, 1878.
T. Murrayi, Davidson, 1878.
T. tuberata, Jeffreys, sp., 1868–70.
T. trigonia, Jeffreys, sp., 1878.

III. Genus WALDHEIMIA, King, 1850.

Waldheimia flavescens, Lamarck, sp., 1819, = *australis*, Quoy, = *incurva*, Gray.
W. venosa, Solander, sp., 1789, = *globosa*, Lamarck; *dilatata*, Lamarck, = *eximia*, Philippi, = *Gaudichaudi*, Blainville, = *Fontaineana*, d'Orbigny; *physema*, Valenciennes, MS., *fide* Reeve.

Waldheimia lenticularis, Deshayes, sp., 1839.
W. kerguelenensis, Davidson, 1878.
W. Grayi, Davidson, 1852.
W. septigera, Lovén, sp., 1846.
W. Raphaelis, Dall, 1870.
W. floridana, Pourtales, 1868.

Subgenus MACANDREVIA, King, 1859.

Waldhemia (Macandrevia) cranium, Müller, sp., 1776, = *euthyra*, Seguenza.
W. (M.) tenera, Jeffreys, sp., 1878.

Uncertain Species.

Waldheimia Wyvillii, Davidson, 1878.

Subfamily TEREBRATELLINÆ.

IV. Genus TEREBRATELLA, d'Orbigny, 1847.

Terebratella dorsata, Gmelin, sp., 1768, = *T. bilobata*, Blainville, = *magellanica*, Chemnitz, = *chilensis*, Broderip, = *Sowerbyi*, King, = ? *lupinus*, Philippi.

T. transversa, Sowerby, sp., 1846; var. *caurina*, Gould, 1850; var. *occidentalis*, Dall, 1871.

T. coreanica, Adams and Reeve, sp., 1850, = *T. Bouchardi*, Davidson ? = *T. miniata*, Gould, = *T. Lamanoni*, Schrenck.

T. Blanfordi, L. Dunker, sp., 1882.

T. spitzbergensis, Davidson, 1852.

T. rubicunda, Sowerby, 1846, = *T. insconspicua*, Sowerby, = *sanguinea* of several authors.

T. frontalis, Middendorff, sp., 1849.

T. cruenta, Dillwyn, sp., 1817, = *sanguinea*, Solander MS. and of several other authors, = *T. zelandica*, Deshayes, = *Evansi*, Davidson.

T. Mariæ, A. Adams, 1860.

Uncertain Species.

Terebratella pulvinata, Gould, sp., 1850.
T. rubiginosa, Dall, 1870, = *suffusa*, Dall.
T. Frielii, Davidson, 1878.

V. Subgenus MAGASELLA, Dall, 1870.

Magasella flexuosa, P. P. King, sp., 1835, = ? *T. rhombea*, Philippi.
M. crenulata, Sowerby, sp., 1846.
M. aleutica, Dall, 1872.
M. Adamsi, Davidson, 1871.
M. Gouldi, Dall, 1871.
M. Cumingi, Davidson, sp., 1852, = *fibula*, Reeve.

Uncertain Species.

Magasella patagonica, Gould, sp., 1850.
M. lævis, Dall, 1870.
M. ? *Malvinæ*, d'Orbigny, sp., 1846.
M. incerta, Davidson, 1880.
M. radiata, Dall, 1877.
M. labradorensis, Sowerby, sp., 1846.

Subfamily MEGERLINÆ.

VI. Genus MEGERLIA, King, 1850.

Megerlia truncata, Linné, sp., 1767, var. *monstruosa*, Scacchi.
M. sanguinea, Chemnitz, sp., 1785, = *erythroleuca*, Quoy, var. *Reevei*, Davidson, = var. *pulchella*, Sowerby.

Uncertain Species.

Megerlia Willemoesi, Davidson, 1878.

VII. Subgenus LAQUEUS, Dall, 1870.

Laqueus californicus, Koch, sp., 1843, = *Kochi*, Küster, var. *vancouverensis*, Davidson *.
L. rubellus, Sowerby, sp., 1846, = *suffusus*, Dall.
L. pictus, Chemnitz, sp., 1785.

Subfamily MAGASINÆ.

VIII. Genus BOUCHARDIA, Davidson, 1849.

Bouchardia rosea, Mawe, sp., 1823, = *tulipa*, Blainville.

Subfamily KRAUSSININÆ.

IX. Genus KRAUSSINA, Davidson, 1861.

Kraussina rubra, Pallas, sp., 1766, = *capensis*, Gmel. (part).
K. cognata, Sowerby, sp., 1846, *nec* Chemnitz.
K. Deshayesi, Davidson, 1850, = *capensis*, Adams.
K. pisum, Valenciennes, *apud* Lamarck, sp., 1819, = *T. natalensis*, Küster, ? *T. algoensis*, Sowerby.
K. Atkinsoni, Tenison Woods, sp., 1878.

X. Subgenus MEGERLINA, Deslongchamps.

Kraussina (*Megerlina*) *Lamarckiana*, Davidson, 1852.
K. (*M.*) *Davidsoni*, Vélain, 1877.

Subfamily ARGIOPINÆ.

XI. Genus ARGIOPE, Deslongchamps, 1842.

Argiope decollata, Chemnitz, sp., 1785.

Uncertain Species.

Argiope? globuliformis, Schulgin, 1884.
A. Barroisi, Schulgin, sp., 1884.

XII. Subgenus CISTELLA, Gray, 1853.

Cistella neapolitana, Scacchi, sp., 1833, = ? *C. biplicata*, Seguenza.
C. cistellula, Searles Wood, sp., 1841.
C. Woodwardiana, Davidson, sp., 1866.
C. cuneata, Risso, sp., 1826.
C. lutea, Dall, 1870.
C. Barrettiana, Davidson, sp., 1866.
C. Kowalevskii, Schulgin, sp., 1884.
C. Schrammi, Crosse, sp., 1866.

* The shell described as *Megerlia* (*Ismenia*) *Jeffreysii*, Dall, is the young of this species.

Uncertain Species.

? *Cistella lunifera*, Philippi, sp., 1836.

Subfamily (not yet determined).

XIII. Genus ? Gwynia, King, 1859.

Gwynia capsula, Gwyn Jeffreys, sp. (an immature form) = *Terebratula capsula* = *Argiope capsula*, Jeffreys.

XIV. Genus Platydia, Costa, 1852.

Platydia anomioides (Scacchi), Philippi, sp., 1844, = *Terebratula seminulum*, Philippi, 1836, = *Morrisia anomioides*, Davidson.

P. Davidsoni, Deslongchamps, sp., 1855.

Family THECIDIIDÆ.

XV. Genus Thecidium, Defrance, 1828.

Thecidium mediterraneum, Risso, 1826, = *T. spondylea*, Scacchi, = *T. testudinaria*, Michelotti.

T. Barretti, Woodward, MS., 1864.

Family RHYNCHONELLIDÆ.

XVI. Genus Rhynchonella, Fischer, 1809.

Rhynchonella psittacea, Chemnitz, sp., 1785, = var. *Woodwardi*, Adams, 1863.

R. nigricans, Sowerby, 1846, = var. *pyxidata*, R. B. Watson, MS., 1880.

R. cornea, P. Fischer, MS. 1885, = ? *R. sicula*, Jeffreys, *nec* Seguenza.

R. lucida, Gould, 1860.

R. Grayi, Woodward, 1855.

R. Döderleini, Davidson, 1886.

XVII. Subgenus Atretia, Gwyn Jeffreys, 1870.

Atretia gnomon, Jeffreys, 1869.

A. Brazieri, Davidson, 1886.

LYOPOMATA, Owen = TRETENTERATA, King.

Family CRANIIDÆ.

XVIII. Genus Crania, Retzius, 1781.

Crania anomala, Müller, sp., 1776, = *distorta*, Montagu, *norvegica*, Lamarck. *orcadensis*, Leach, *alba*, Jeffreys.

C. turbinata, Poli, sp., 1795, = *C. personata*, part., = *C. rostrata* et *ringens*, Hœninghaus.

C. Suessii, Reeve, 1862.

C. japonica, Adams, 1863.

Uncertain Species.

Crania Pourtalesii, Dall, 1871. ? Var. of *C. anomala*.

Family DISCINIDÆ, Gray, 1840.

XIX. Genus Discina, Lamarck, 1819.

Discina striata, Schumacher, sp., 1817, = *D. ostreoides*, Lamarck, 1819, = *D. radiosa*, Gould, = *D. Evansi*, Davidson.

XX. Subgenus Discinisca, Dall, 1871.

Discinisca lævis, Sowerby, sp., 1818.
D. lamellosa, Broderip, sp., 1835.
D. Cumingii, Broderip, sp., 1835, = *D. strigata*, Broderip.
D. tenuis, Sowerby, sp., 1847.
D. atlantica, King, sp., 1868.
D. stella, Gould, 1860.

Uncertain Species.

Discinisca antillarum, d'Orbigny, 1853.

Family LINGULIDÆ.

XXI. Genus Lingula, Bruguière, 1789.

Lingula anatina, Bruguière, sp., 1789, = *A. anatis, unguis, lingua, Chemnitzi, histula*, = *affinis* Hancock.
L. Murphiana, King, MS., Mus. Cuming; Reeve, 1859, = *anatina* Hancock.
L. tumidula, Reeve, 1841.
L. hians, Swainson, 1823.
L. exusta, Reeve, 1859.
L. jaspidea, Adams, 1863.
L. Adamsi, Dall, 1873.
L. Reevii, Davidson, 1880 (olim auctorum *L. ovalis*).

Uncertain Species.

Lingula smaragdina, Adams, 1863.
L. hirundo, Reeve, 1859.
L. lepidula, Adams, 1863.

XXII. Subgenus Glottidia, Dall, 1870.

Glottidia albida, Hinds, sp., 1845.
G. Palmeri, Dall, 1871.
G. Audebarti, Broderip, sp., 1835, = *L. pyramidata*, Stimpson.

Uncertain Species.

Glottidia? antillarum, Reeve, sp., 1861.
G.? semen, Broderip, sp., 1835.

APPENDIX.

The Anatomy of *Crania* from Dr. L. Joubin's "Recherches sur l'Anatomie des Brachiopodes Inarticulés," Archives de Zoologie Expérimentale, t. iv. p. 161, 1886. (Abstract.)

Dr. L. Joubin dredged *Crania turbinata*, Poli (= *C. rostrata*, Hœninghaus), from a belt of calcareous rocks about 200 metres from the shore, on the rocky coast of Banyuls-sur-Mer in the Eastern Pyrenees, in depths varying from 50 to 60 metres. The specimens were generally covered with algæ, and greatly resembled in colour and form the objects to which they had attached themselves. He kept them alive for six months and then preserved them in alcohol, as he was leaving the neighbourhood. Other specimens were transferred to Roscoff and suffered no ill-effects from the change of water, which differs much from that of the Mediterranean; later, they were again removed to Paris, and were still living fourteen months after they had been dredged. The species exhibited great tenacity of life; exposed to sunlight without change of water for months together, neither extremes of heat nor cold, light nor darkness, appeared to affect them in any way. Although the specimens obtained in November were full of ova, no eggs were deposited during captivity, consequently it was impossible to trace the embryonic development of the genus.

In the course of exhaustive anatomical and histological investigations of this non-pedunculate tretenterate Brachiopod with a wholly calcareous shell, Dr. Joubin recognizes the presence of two layers in the structure of the hingeless shell, which is perforated by canals, the terminations of which in the upper or free valve are arborescent, as described by Carpenter and King. The canals of the lower and attached valve he shows to be irregular, slightly bifurcated, and *non-arborescent* in character. The mantle lining the shells is so transparent as to be scarcely discernible. It adheres closely to the valves and penetrates into the tubular perforations of the shell, and is permeated with yellow or whitish ramifications of a glandular aspect. These are the genital bands. The true colour of the mantle is slightly green, due to special granulations contained in certain cells analogous to those of the red cells described by M. Lacaze-Duthiers as present in *Thecidium*. The free portion of the mantle is covered with short vibratile cilia, which cause incessant currents in the water admitted into the pallial cavity. Additional currents are produced by the movements of the "arms." The mantle is composed of a thin transparent tissue, and the animal of *Crania* might almost be defined "as a layer of cartilaginous tissue enclosed between two epithelia." The genitalia are contained in a fold of the mantle. The pallial genital canals are from five to eight in number, uniting in one trunk on each side and for each valve, and empty into the perivisceral cavity. The pallial cartilaginous tissue ("Stutzsubstance" of Van Bemmelen) is thickest at the points of insertion of the muscles, where the shell-substance is not perforated by canals. There are five pairs of muscles and an odd one. The mantle limits the size of the visceral cavity, serves for the attachment of the muscles and of different membranes, and evidently plays an important part in the respiratory processes and production of the shell. The cells of the "sponginous band" yield the calcareous particles for thickening the valves. The perforations in the valves containing prolongations of the mantle subserve the nourishment of the lining tissue of the shell. There *are no calcareous spicules in the mantle of Crania,* which resembles in general structure that of *Lingula* and *Rhynchonella,* but is simpler in character.

The body-walls in *Crania* are pierced by four orifices, the mouth at the top, the anus below on the axis of the body, and on each side by the oviductal organs. No gastro-parietal bands are present in *Crania,* and the ilio-parietals are comparatively insignificant. The brachial organs cannot be unrolled in the small space between the gaping valves; the brachial muscles are extremely rigid, and would restrain free movements. Dr. Joubin maintains that the arms cannot be extruded beyond the shell-margins in *Crania.* The numerous specimens in captivity under frequent observation for consecutive months never extended their arms nor even the cirri, as figured by Barrett.

The stomach of *Crania* is filled with transparent mucus. The presence of Diatoms, the chief nourishment of the animal, was frequently detected, also cells of filamentous pelagic algæ, and of the calcareous algæ (*Melobesia*) common on the coast, fragments of Radiolarians and of sponge-spicules. The rectal portion of the alimentary canal, which is voluminous and well defined, extends from the great adductor muscles to the median muscle (Hancock's mesenteric). The non-lateral position of the anal orifice, which is situated in *Crania* between the two posterior adductors *exactly in the median line,* is a unique feature among the Brachiopoda, and recalls the analogous position of that organ in the Bryozoa. There is no trace of the existence of a heart or arterial system. All the organs are bathed in the colourless liquid filling the perivisceral cavity. The rudimentary nervous system is divisible into two sections—the brachial ganglion, whence radiate the numerous nerves of the arms, and a minute peri-œsophageal collar with a slight dorsal enlargement = the cerebral ganglion of Mollusca. The two centres are connected by nerves passing down each side of the œsophagus to the base of the arms, and this union leads Dr. Joubin to believe that arms may be regarded as an organ of sense, those of smell and taste being localized in the ciliated brachial gutter at their base near the mouth *. No organs of sight or hearing are present. Dr. Joubin maintains that the sexes are distinct in *Crania.* There are six genital organs, three on each side of the body, one on the ventral and one on the dorsal, and the third is situated on the perivisceral cavity. The oviductal functions of Owen's so-called "hearts" and of Morse's segmentary organs is demonstrated.

From a comparative study of the articulate and inarticulate Brachiopoda, it becomes evident that the pedunculated *Lingula* and *Discina* with horny shells are much more closely related to each other than the non-pedunculate calcareous *Crania,* which appears to have affinities with the articulate *Rhynchonella* and *Thecidium. Crania* seems to be intermediate in character between the two great groups, and the position of the anus in the median line distinguishes it not only from the rest of the Tretenterata but from all other Brachiopoda. While fully recognizing the structural differences between these two groups, Dr. Joubin maintains that *Crania* and *Rhynchonella* each present in a different way characters which are common to both. The Brachiopoda, he concludes, approach the Bryozoa more than any other group of organisms, and are sufficiently distinct to form a class absolutely independent of all other animals. [A. C.]

* Prof. J. W. Sollas has recently adduced evidence (Proc. Roy. Dublin Soc. 1887, pp. 318–320) to show that the cæcal processes are sense-organs. They are obviously composed of epithelial cells, and exhibit traces of an axial fibre continuous with the nerve-cells of the mantle.

NOTE.

Since the publication of Dr. Davidson's and Mr. W. H. Dalton's extensive "Bibliography of the Brachiopoda," in the volume of the Palæontographical Society, for 1886, the following memoirs on the recent species have been issued, or were omitted therein:—

Beyer, H. G. "The Structure of *Lingula pyramidata*." Studies from the Biological Laboratory of the Johns Hopkins University, Baltimore, vol. iii. (1886), pp. 228–245; 5 plates.

Blochman, F. "On the Structure of the Brachiopoda." Zool. Anzeig. viii. 1885, pp. 164–167.

Brazier, J. "List of the Brachiopoda or Lamp Shells found in Port Jackson and on the coast of New South Wales." Proc. Linn. Soc. N. S. Wales, vol. iv. p. 399, 1879.

Crane, Agnes. "On a Brachiopod of the Genus *Atretia*" (named in MS. by the late Dr. T. Davidson, *A. Brazieri*). Proc. Zool. Soc. 1886, pp. 181–184.

Davidson, Thomas. "On a living spinose *Rhynchonella* from Japan" (with figure). Ann. Mag. Nat. Hist. 5th ser. vol. xvii. pp. 1–3, 1886; (posthumous; edited by Agnes Crane).

Dall, William H. "The Molluscoidea of the Blake Expedition.—Brachiopoda," pp. 199–205. Bull. Mus. Comp. Zool., Harvard; 1 plate.

Joubin, L. "Sur les organes digestifs et reproducteurs chez les Brachiopodes du genre *Cranie*." Comptes Rendus, xcix. 1884, pp. 985–7.

——. "Sur l'Anatomie du genre *Cranie*." Comptes Rendus, c. 1885, pp. 464–6.

——. "Sur l'Anatomie du genre *Discine*." Comptes Rendus, ci. 1885, pp. 1170–1.

——. "Recherches sur l'Anatomie des Brachiopodes Inarticulés." Archives Zool. Expérim. et Gén. 1886, 2e sér. t. iv. pp. 161–303, pls. vii.–xv.

——. "Sur l'Anatomie des Brachiopodes articulées." Bull. Soc. Zool. France, t. xii.; 1 plate.

Schulgin, M. A. "*Argiope Kowalevskii.*—Ein Beitrag zur Kenntniss der Brachiopoden." Zeitschrift für wissenschaftliche Zoologie, Leipzig, 1884, Bd. xli. pls. viii. & ix. pp. 117–144.

Sollas, J. W. "On the Cæcal Processes of Shells of Brachiopoda." Proc. Royal Dublin Society, v. pp. 318–20; 1 plate (1887).

DESCRIPTION OF THE PLATES.

Plate XXVI.*

Figs. 1–8. *Discinisca lamellosa*, Broderip, sp. 1–3. Exterior of shell; 4. Interior of upper valve. 5. Interior of perforated or lower valve; same specimen; Bay of Callao, Peru (Davidson Coll., Brit. Mus.). 6. Group of young and old, after G. Sowerby. 7. Interior, to show labial appendages. 8. A magnified view of the superior mantle-lobe injected, with ovary, digestive and nervous system, after Owen. *q*, the mouth; *r*, œsophagus; *u*, the anus; *t*, intestine; *w*, ovaries; *v*, liver.

Figs. 9–11. *Discinisca lævis*, Sowerby. 9. Perforated or lower valve, after Reeve. 10. A group of specimens, from Callao, Peru (Davidson Coll., Brit. Mus.). 11. A small group of species from off Conception Island (Davidson Coll., Brit. Mus.).

Figs. 12–17, 17 *a*. *Discinisca tenuis*, Sowerby. 12–14. Types, after Sowerby; no habitat given. 15. Exterior of the lower valve. 16. Interior of same valve. 17. Another specimen.

Figs. 18–22. *Discinisca atlantica*, King. 18. Natural size, dredged by the 'Challenger' Expedition, North Pacific, at a depth of 2050 fathoms. 19. Specimens attached to *Limopsis aurita*, Brocchi ('Challenger' Exped., Brit. Mus.). 20. Upper valve, with its long, slender, barbed

* *Discina striata* is figured on Pl. XXV. of Part II. of this Monograph.

setæ, dredged by 'Challenger' Expedition between the Cape Verde Islands and Fernando Noronha, South America; much magnified. 21. Lower valve, dredged by the 'Valorous' Expedition, North Atlantic. 22. One of the barbed setæ, much enlarged.

Figs. 23–26. *Discinisca Cumingi*, Broderip. 23. Upper valve, nat. size. 23 *a*. Enlarged. 24. Interior of lower valve, nat. size. 25. The same, enlarged. 25 *a*. Exterior of upper valve, enlarged. All from St. Helena, and Panama, collected by H. Cuming (Davidson Coll., Brit. Mus.). 26. *O. strigata*, Broderip, after Broderip.

Figs. 27–30. *Discinisca stella*, Gould. 27, 29. Dredged by the 'Challenger' Expedition in lat. 8° 56′ S., long. 136° 5′ E.; off Bermuda (Brit. Mus.). 28, 29. Much enlarged. 30. A large example, after Reeve, nat. size. China Seas. (Cuming Coll., Brit. Museum.)

Figs. 31, 31 *a*. *Discinisca antillarum*, d'Orbigny. Cuba, Martinique, much enlarged, after d'Orbigny.

Plate XXVII.

Figs. 1–8. *Crania anomala*, Müller. 1. Exterior of shell; Oban. 2. Interior of upper valve. 3. Interior of attached valve; same locality (Davidson Coll., Brit. Mus.). 3 *a*. Specimen dredged by L. Barrett, Coast of Norway; enlarged. 4. Interior of a specimen in the Jermyn-Street Museum, enlarged to show the labial appendages. 5. Vertical section of shell of *C. anomala*, after Carpenter, showing its successive layers, traversed by vertical channels, which present an arborescent division near the external surface, and a marked contraction near the interior; magnified 10 diameters. 6. External surface of shell (after Carpenter), showing the radiating arrangement of the subdivisions of its canals; magnified 100 diameters. 7, 8. Vertical sections of same, after King, showing that the vertical canals, on approaching the dark-coloured or epidermal portion of the external layer, become minutely subdivided into from 2 to 5 branchlets, which appear like arborescent tufts.

Figs. 9, 9 *b*. *Crania anomala*, var. *alba*, Jeffreys; Shetland. After Jeffreys's type.

Figs. 10, 11. *Crania japonica*, A. Adams; Gotto, Japan (Davidson Coll., Brit. Mus.). 10. Natural size. 10 *a*, *b*. Exterior of upper valve, enlarged. 11. Interior, enlarged.

Figs. 12, 12 *a*. *Crania Pourtalesi*, Dall (*C. anomala*? var. *Pourtalesi*, after Dall's figure); Sambos, Florida.

Fig. 13. *Crania Suessi*, Reeve; Sydney, Australia (after Reeve). (Cuming Coll., Brit. Mus.)

Figs. 14–23. *Crania turbinata*, Poli, = *Crania rostrata*, Hœninghaus. 14. Exterior of upper valve (after Poli). 15, 15 *b*. A very conical example from the Mediterranean Sea (Davidson Coll.). 16. Interior of lower valve, from another Mediterranean specimen; natural size (Davidson Coll.). 17. Interior of attached valve, enlarged. 18. Interior of upper valve, enlarged. 19, 20. Other specimens from the same habitat (Davidson Collection, Brit. Mus.). 21. *Crania rostrata*, Hœninghaus's figure; Mediterranean; = *C. turbinata*, Poli. 22. *Crania personata*, after Sowerby; doubtless a malformed specimen of *C. turbinata*. 23. Another similar specimen; from the Mediterranean (Davidson Coll., Brit. Mus.).

Plate XXVIII.

Figs. 1, 1 *a*. *Crania turbinata*, var. *ringens*, after Hœninghaus; Mediterranean. 1 *a*. Enlarged.

Figs. 2–4. *Glottidia albida*, Hinds. 2 & 4. Specimens from the Bay of Magdalena, California (Davidson Coll., Brit. Mus.). 3. A larger example, after Reeve; same habitat (Cuming Coll., Brit. Mus.).

Figs. 5–6 *a*. *Glottidia Palmeri*, Dall. Dredged by Dr. Palmer in the Gulf of California, on the Lower Californian side, opposite the mouth of the Colorado river; one of ten examples obtained; presented by Mr. Dall (Davidson Coll., Brit. Mus.). 5 *a*. Interior of dorsal valve. 6 *a*. Of ventral valve.

Figs. 7–9. *Glottidia Audebarti*, Broderip. A series of specimens from Guayaquil. 7. Broderip's type. 8. After Reeve. 9, 9 *a*. Exterior; 9 *b*. Interior of ventral valve, showing the two diverging septa. 9 *c*. Interior of dorsal valve, showing a single median septum (Davidson Coll., Brit. Mus.).

Figs. 10, 10 *a*–11. *Glottidia Audebarti*. These specimens, representing *L. pyramidata*, Stimpson, sp., were dredged by Prof. E. Morse in North Carolina waters (Davidson Coll., Brit. Mus.).

Fig. 12. *Glottidia? semen*, Broderip; Isle of Plata, West Columbia. After Broderip. Type in Zool. Dept., Brit. Mus.

Fig. 13. *Glottidia? antillarum*, Reeve. After Reeve. Martinique (Cuming Coll., Brit. Mus.).

Figs. 14, 15. *Lingula tumidula*, Reeve. 14. From Masbate, Philippines; after Sowerby. 15. Moreton Bay, Australia; after Reeve. (Brit. Mus.)

Fig. 16. *Lingula lepidula*, A. Adams, probably the young stage of another species; Seto-Uchi (Akasi), Japan (Davidson Coll., Brit. Mus.).

Figs. 17, 18 *a*. *Lingula Reevei*, Davidson, formerly *L. ovalis*. 17. A fine large specimen, after Reeve; Sandwich Islands (Cuming Coll., Brit. Mus.). 18, 18 *a*. Another specimen; same habitat (Davidson Coll., Brit. Mus.).

Fig. 19. *Lingula Adamsi*, Dall. Dredged by Capt. Weston near the shore of the island of Formosa (Davidson Coll., Brit. Mus.).

Figs. 20–21 *a*. *Lingula exusta*, Reeve. 20. After Reeve; Moreton Bay, Australia (Zool. Dept., Brit. Mus.). 21, 21 *a*. Another specimen; same habitat (Davidson Coll., Brit. Mus.).

Fig. 22. *Lingula hirundo*, Reeve. After Reeve. Port Curtis, north-east Australia (Cuming Coll., Brit. Mus.).

Figs. 23, 24. *Lingula jaspidea*, A. Adams. 23. Adams's type; Mososeki, Japan. 24. A fine large example dredged by Sir E. Belcher (Davidson Coll., Brit. Mus.).

Fig. 25. *Lingula smaragdina*, A. Adams; Yobuko, Japan. Adams's type (Davidson Coll., Brit. Mus.).

Plate XXIX.

Figs. 1–8. *Lingula anatina*, Lamarck. 1, 2, 4, 5. A series of specimens of a brilliant emerald-green, in different stages of development, dredged at low water by the 'Challenger' Expedition off Zamoanga, Philippines. 1. Zool. Dept., Brit. Mus., others Davidson Coll. 3. A specimen from Manilla, collected by Mr. H. Cuming (Davidson Coll., Brit. Mus.). 6. Interior of upper valve. 7. Interior of lower valve. 8. A specimen with its peduncle seen in profile, after Gratiolet: *a*, ventral valve; *b*, dorsal valve; *c*, base of peduncle.

Figs. 9, 10. *Lingula affinis*, Hancock. 10. Shell from the type forwarded, but which I take to be a valve of *Lingula anatina*. 9. Ventral view of the animal of *Lingula affinis*, after Hancock (Trans. Roy. Soc. vol. cxlviii. 1858, pl. lxvi. fig. 3). "The dorsal labial lobe divided longitudinally, and one half of it turned back, so as to expose the pallial chamber; the marginal setæ are not represented: *a a*, pallial sinuses; *b*, marginal fold; *c*, liver seen through the wall of the perivisceral chamber; *d*, dorsal ovaries; *e*, *e*, intestine; *f*, lateral walls of the body, or perivisceral chambers; *g*, anal nipple; *h*, brachial apparatus; *i*, cirri; *j*, adjustor muscles; *k*, divaricators; *l*, anterior wall of body."

Fig. 11. *Lingula Murphiana*, King, MS. A large example with its peduncle; from Moreton Bay, Australia (Davidson Coll., Brit. Mus.).

Figs. 12, 13. *Lingula hians*, Swainson. 12. A fine example with peduncle, after Reeve; China Seas (Cuming Coll., Brit. Mus.). 13. A normally-shaped example (Davidson Coll., Brit. Mus.).

Plate XXX.

Figs. 1–3. *Lingula Murphiana*, King. 1. Exterior of shell. 2. Interior of dorsal valve. 3. Interior of ventral valve; Moreton Bay, Australia (Davidson Coll., Brit. Mus.).

Figs. 4–5. *Lingula* sp.? Bay of Yeddo, Japan (Davidson Coll., Brit. Mus.).

Fig. 6. *Lingula anatina*, Lamarck; from Japanese Seas, showing extremity of peduncle (Davidson Coll., Brit. Mus.).

Figs. 7–10. Young stages of *Glottidia Audebarti*, Broderip, = *L. pyramidata*, Stimpson; after W. K. Brooks (*l. c.*). Fig. 7. Dorsal view of the youngest larva figured, ×250 diameters. Fig. 8. A little older larva. Fig. 9. Dorsal view of somewhat older embryo. Fig. 10. Ventral view of a small *Lingula* soon after it becomes sedentary. The letters have the same signification in all the figures. A. Dorsal or aboral valve of shell. B. Ventral or oral valve. C. Peduncular or posterior end of shell. D. Anterior end. *a a*, hinge-teeth of aboral valve; *b b*, hinge-teeth of oral valve; *c*, semicircular plate of aboral valve; *d*, median tentacle; *d d**, the pair of oral tentacles; *d* 2, *d* 3, *d* 4, *d* 5, the tentacles of one side numbered according to their order of appearance. *d*, *n*, the most recent pair of tentacles, in process of development at the sides of the aboral tentacles; *e*, the lip; *f*, lateral walls of the body (parietal bands); *g*, body-cavity; *h*, liver; *i*, œsophagus; *k*, hepatic chamber of stomach; *l*, intestinal chamber of stomach; *m*, intestine; *n*, anus; *o*, mouth; *p*, central and side muscles = at this stage the central, trans-median, and lateral muscles of King; *q q*, the lophophore; *r*, posterior unpaired muscle, = *g*, or umbonal muscle of King; *s*, peduncle; *s**, free end of peduncle; *s***, cavity of peduncle; *t*, pallial cavity; *u*, ventral end of anterior lateral muscle; *u***, dorsal end of transmedian muscles; *v*, pallial sinus; *w*, its opening into the body-cavity; *x*, ventral portion of nerve-ring. *x**, œsophageal commissure; *x***, ganglionic enlargement of *x**; *x****, otocyst; *y*, retractor muscles; *z*, reflection of the dorsal portion of the body-wall on to the inner surface of the shell.

Fig. 11. Diagram of longitudinal section of the embryo at stage shown in fig. 9. *a*, tips of valves; *b*, thickened margin of mantle; *c*, mantle; *d*, dorsal median tentacle; *e*, lophophore; *f*, lip; *g*, mouth; *h*, oral cavity; *i*, body-cavity; *k*, wall of œsophagus; *l*, œsophagus; *m*, hepatic chamber of stomach; *n*, intestinal chamber of stomach; *o*, intestine; *q*, ventral ganglion; *r*, posterior muscle; *s*, dorsal valve of shell; *t*, ventral valve of shell.

Figs. 12–14. Structures of *Glottidia Audebarti*, Broderip, = *Lingula pyramidata*, Stimpson; after H. G. Beyer (*l. c.*). Fig. 12. Transverse section through lateral body-wall: *e.c.*, ectodermal covering; *vac.*, vacuoles; *l.c.*, lime-cells; *s.l.*, supporting lamella; *p.e.*, modified peritoneal epithelium; *r.sp.*, cross-sections of ripe spermatophores; *sp.*, spermatophores. Fig. 13. Longitudinal section through intestinal canal below stomach: *p.e.*, dense layer of peritoneal epithelium; *st.*, supple layer of supporting lamella; *w.*, wall of intestine; *cil.*, ciliated internal layer of same. Fig. 14. Transverse section through margin of mantle, shell, and mantle-sinus: *cu.*, cuticle; *h.*, hair; *sh.*, body of shell diagrammatically represented; *s.f.*, supporting fibres; *ec.*, ectodermal layer lining shell; *y.o.*, young ova; *g.r.*, generative ridge contained within; *m.s.*, mantle-sinus; *sp.*, spermatophores; *m.m.*, mantle margin; *ec.*, ectodermal layer; *pl.*, plexus of corpusculated supporting fibres or "sensory cells" of Schulgin.

ADDENDA ET CORRIGENDA.

Part I. p. 29, line 20, *for* " W. H. Binney " *read* W. G. Binney.

Part II. p. 98, line 4, *for* " Heads and Pigs Rock " *read* Sow and Pigs Rocks.

p. 103, note, *for* " *vancouverensis* " read *vancouveriensis*.

p. 109, line 4 from bottom, *for* " near Bird's Island, North Australia," *read* from Bird Island, North-east Australia.

p. 110, line 2, *add* " and by Mr. J. Brazier, at Sandal Bay, N.W. of Lifron, Loyalty Islands."

p. 111, line 22, *for* " South Australia " *read* New South Wales.

p. 124, last line, *for* " Dredged in great abundance by Mr. Brazier in Double Bay " *read* Found under stones at the outer point of Double Bay, Port Jackson, New South Wales.

p. 125, line 3, *for* " Tamai " Heads *read* Tamar Head.

p. 162, four lines from bottom, *add* " Off Barbados in 100 fathoms; St. Vincent and Montserrat, 88 fathoms " (Dall, Bull. Mus. Comp. Zool. Harvard, 1886, vol. xii. p. 205).

p. 182, " Pl. XXV. figs. 6, 7, & 7 *a*," *for* " Dr. Gwyn Jeffreys " *read* Mr. Herman Friele.

[A. C.]

INDEX.

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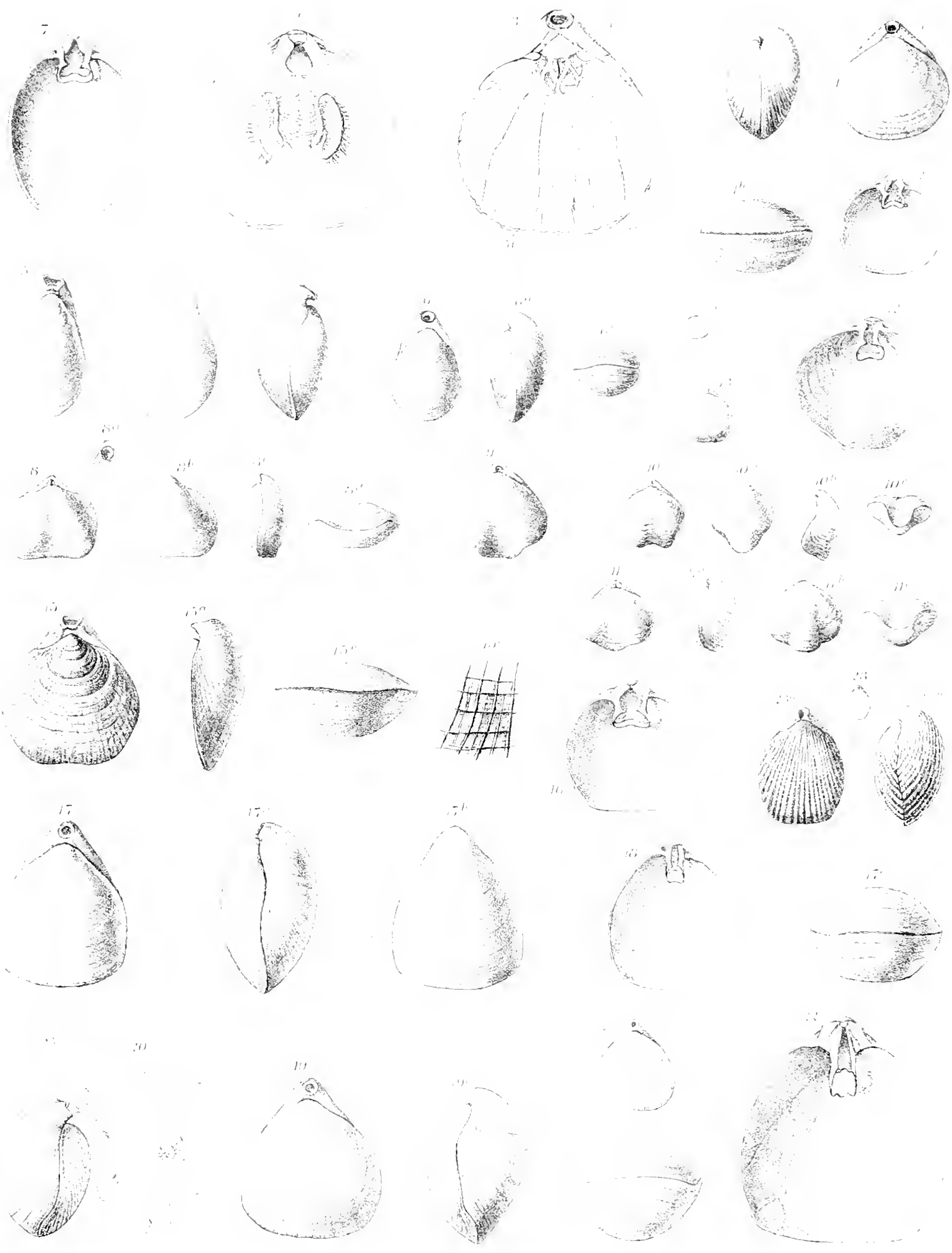
Tho. Davidson

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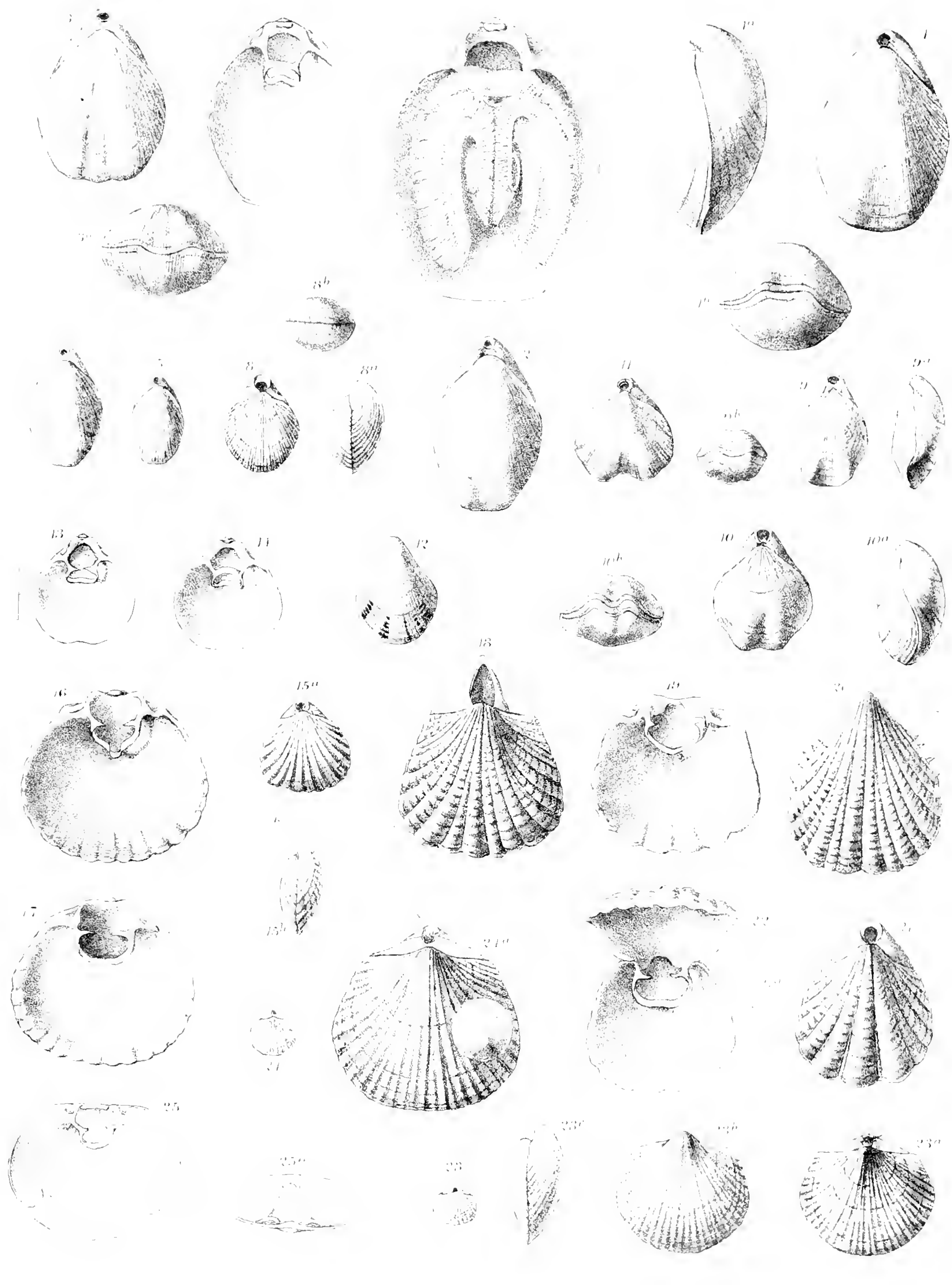
Thos Davidson [illegible]

TEREBRA[illegible]LINA

1-31[a] & 43-52 TEREBRA[illegible]INA [illegible] NTRICOLA [illegible]

32-34[a] T CAP[illegible] SERPENTIS 35-37[a] T CAP SERP var ME[illegible]TERRANEA 38-40 T CAP SERP var [illegible] ATA

Hammond lith. 41-42[a] T CAILLETI 53-53[b] T [illegible]M[illegible]C[illegible] [illegible] T ABYSSI[illegible]A [illegible] imp



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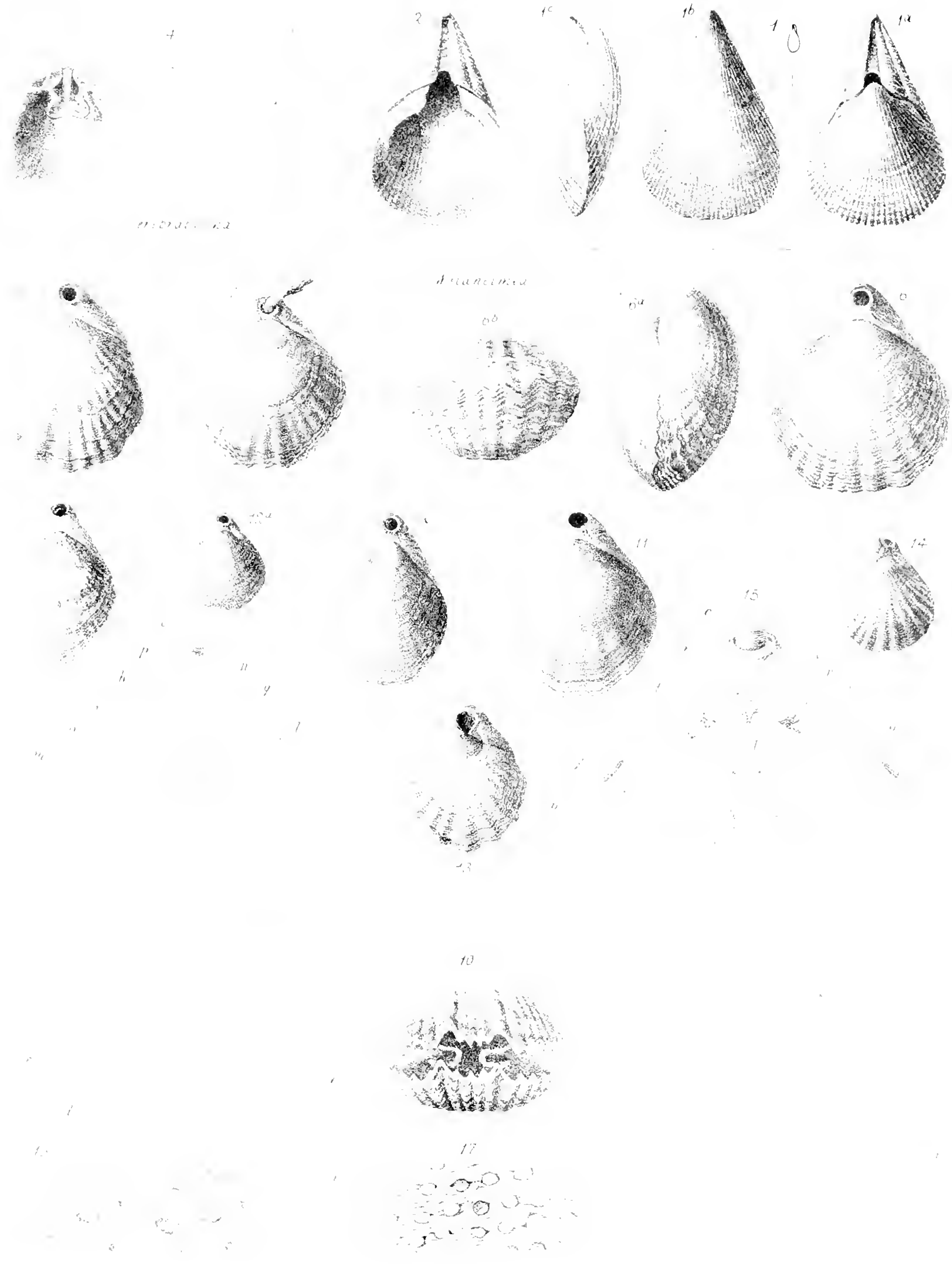

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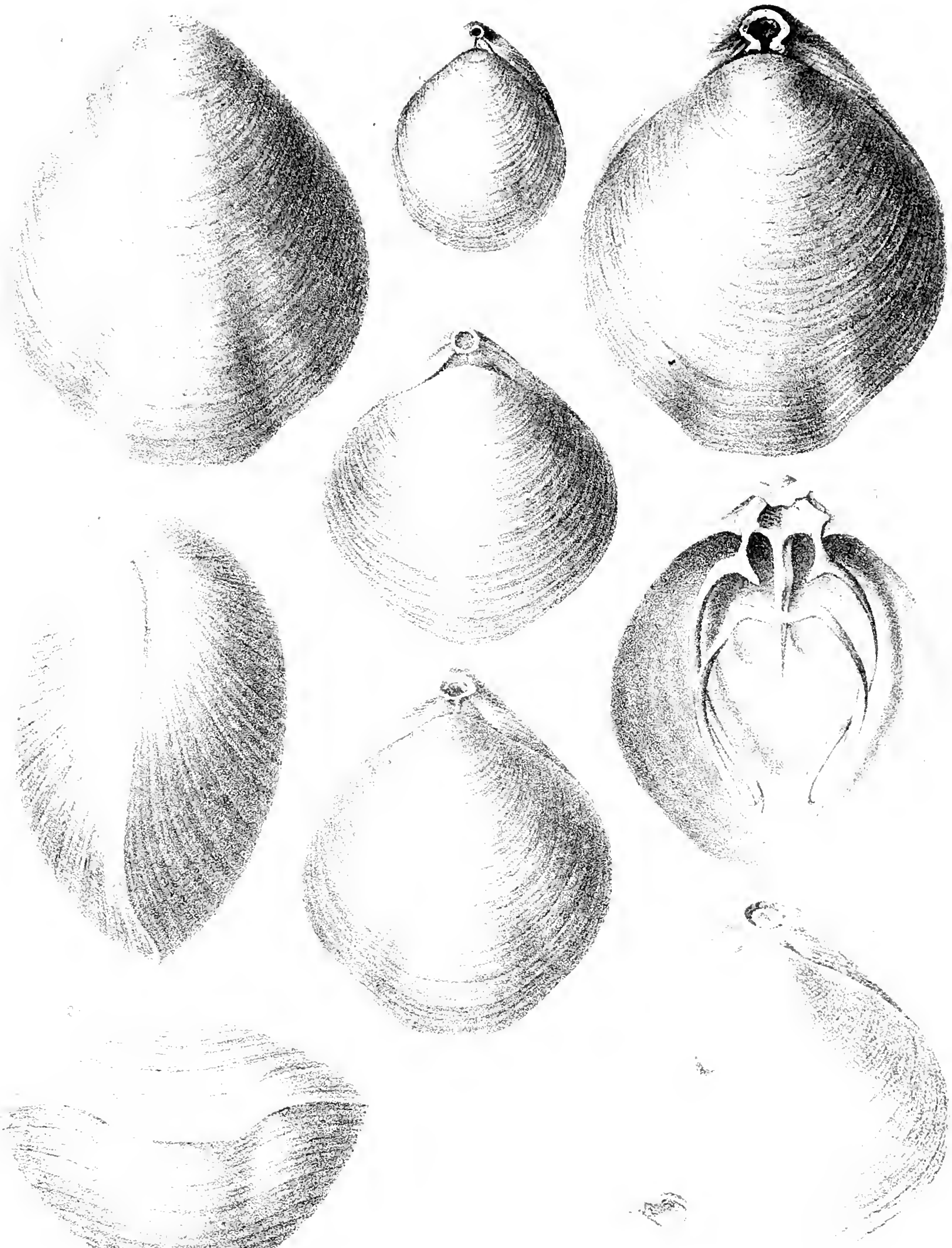

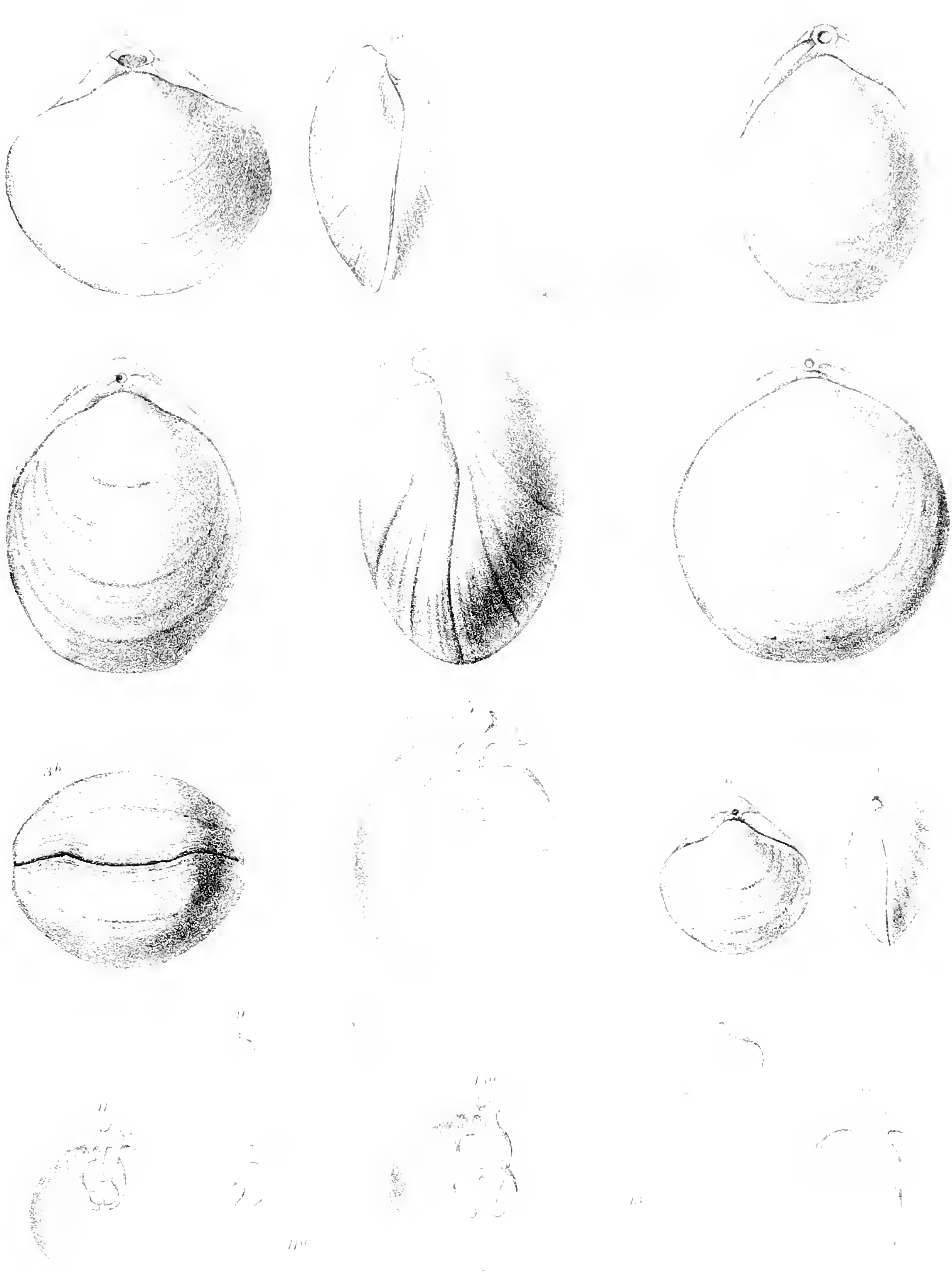

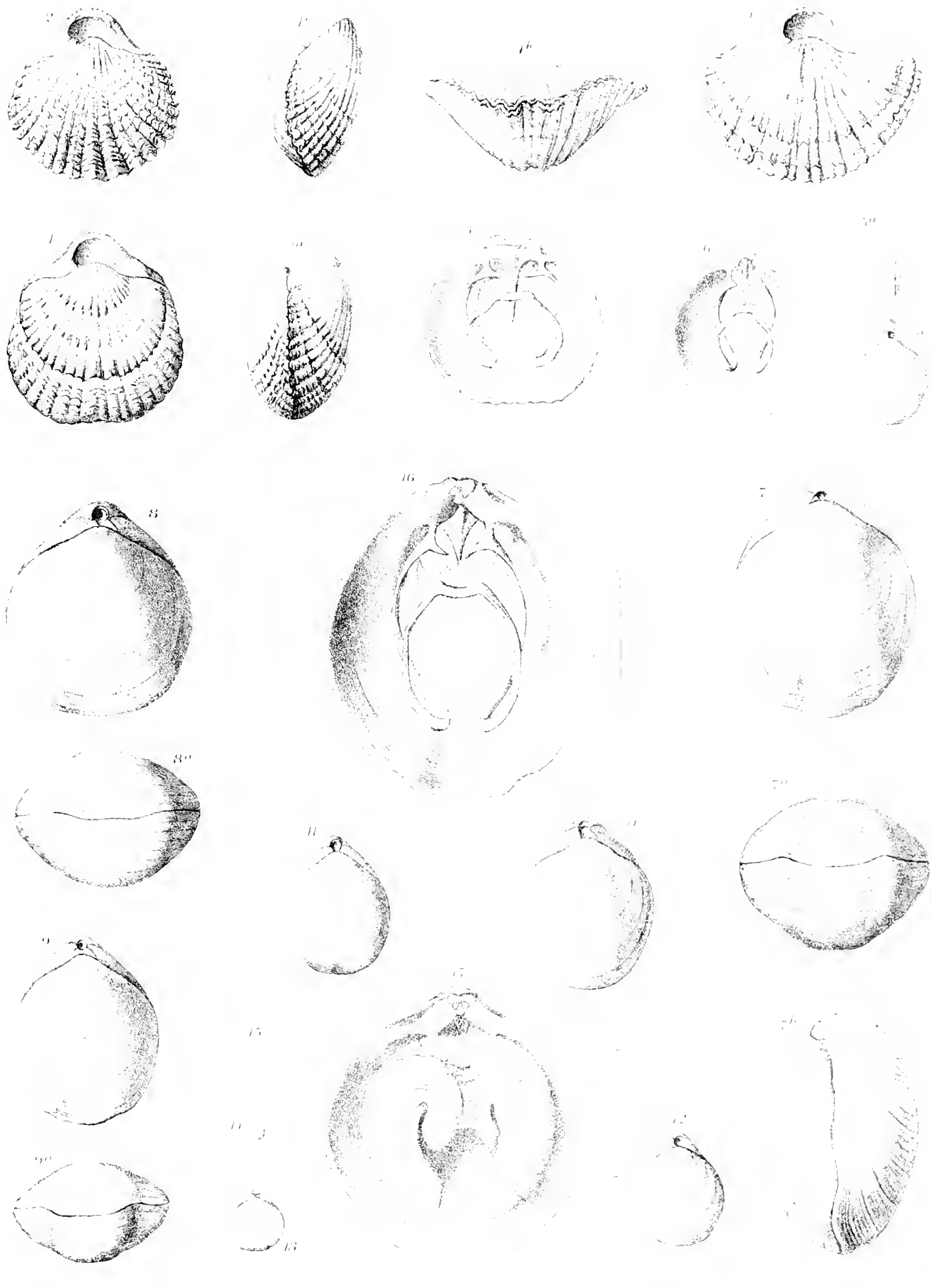

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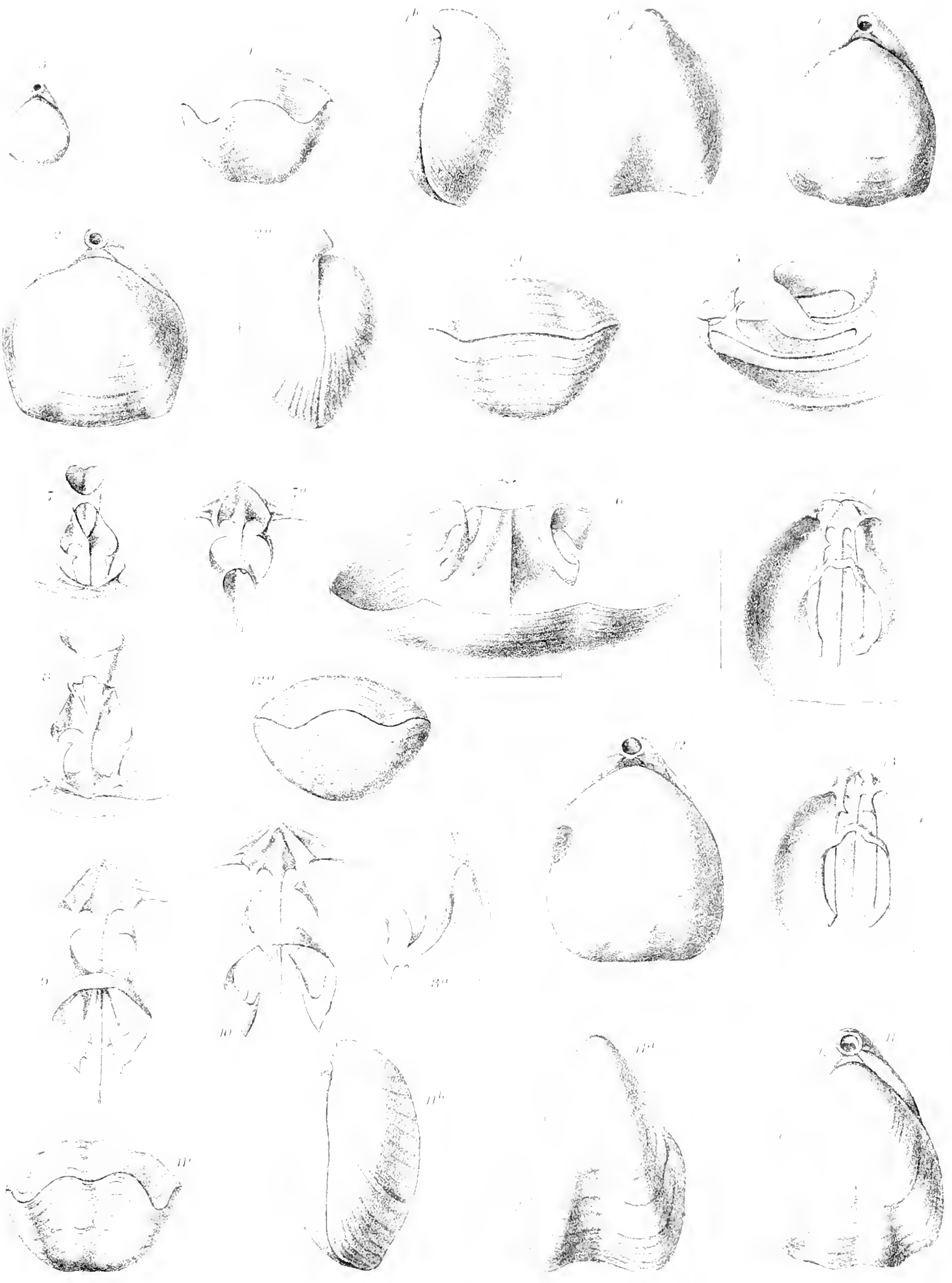
Thos. Davidson



...WALDHEIMIA ... RAPHAELI

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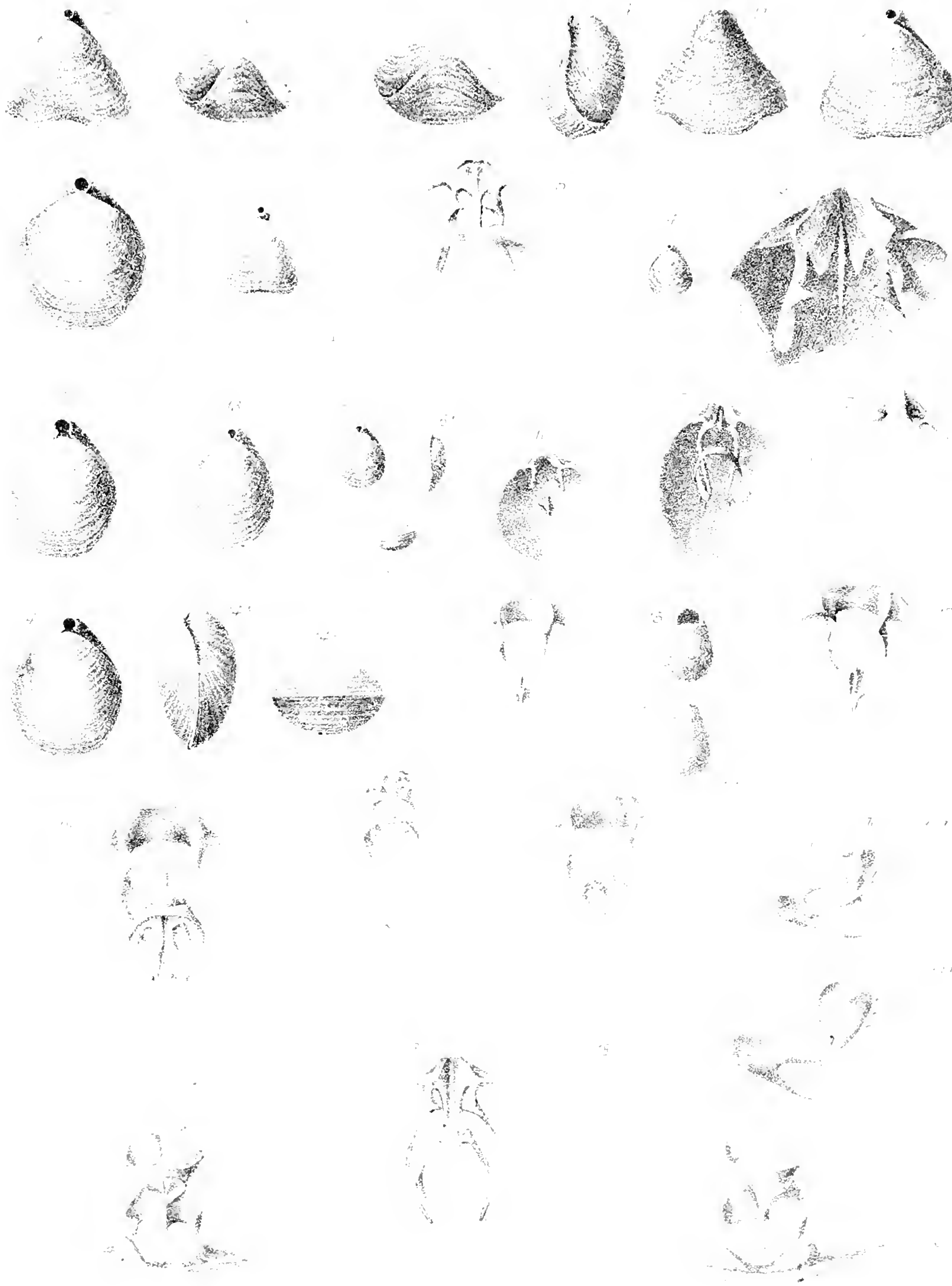

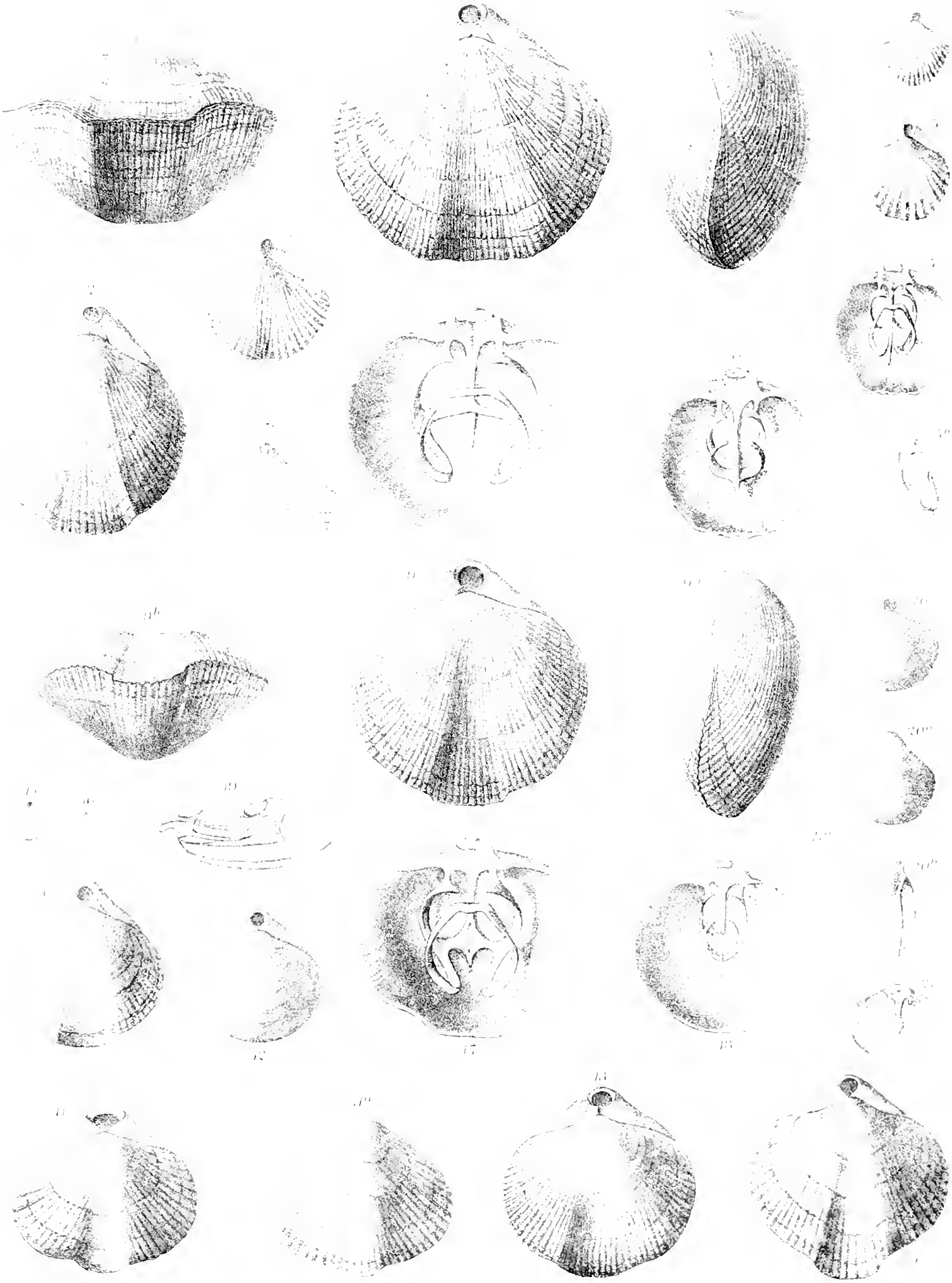

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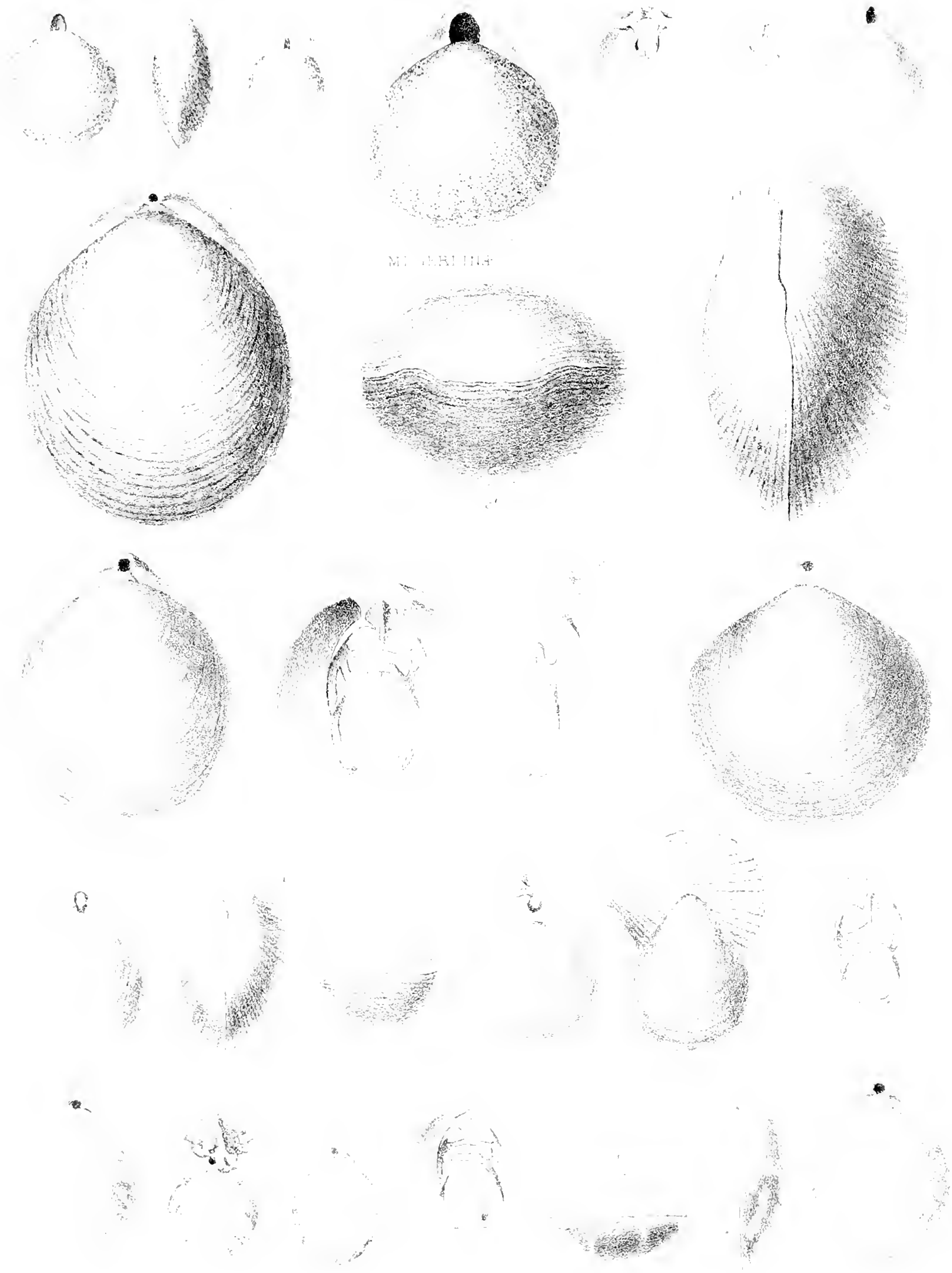

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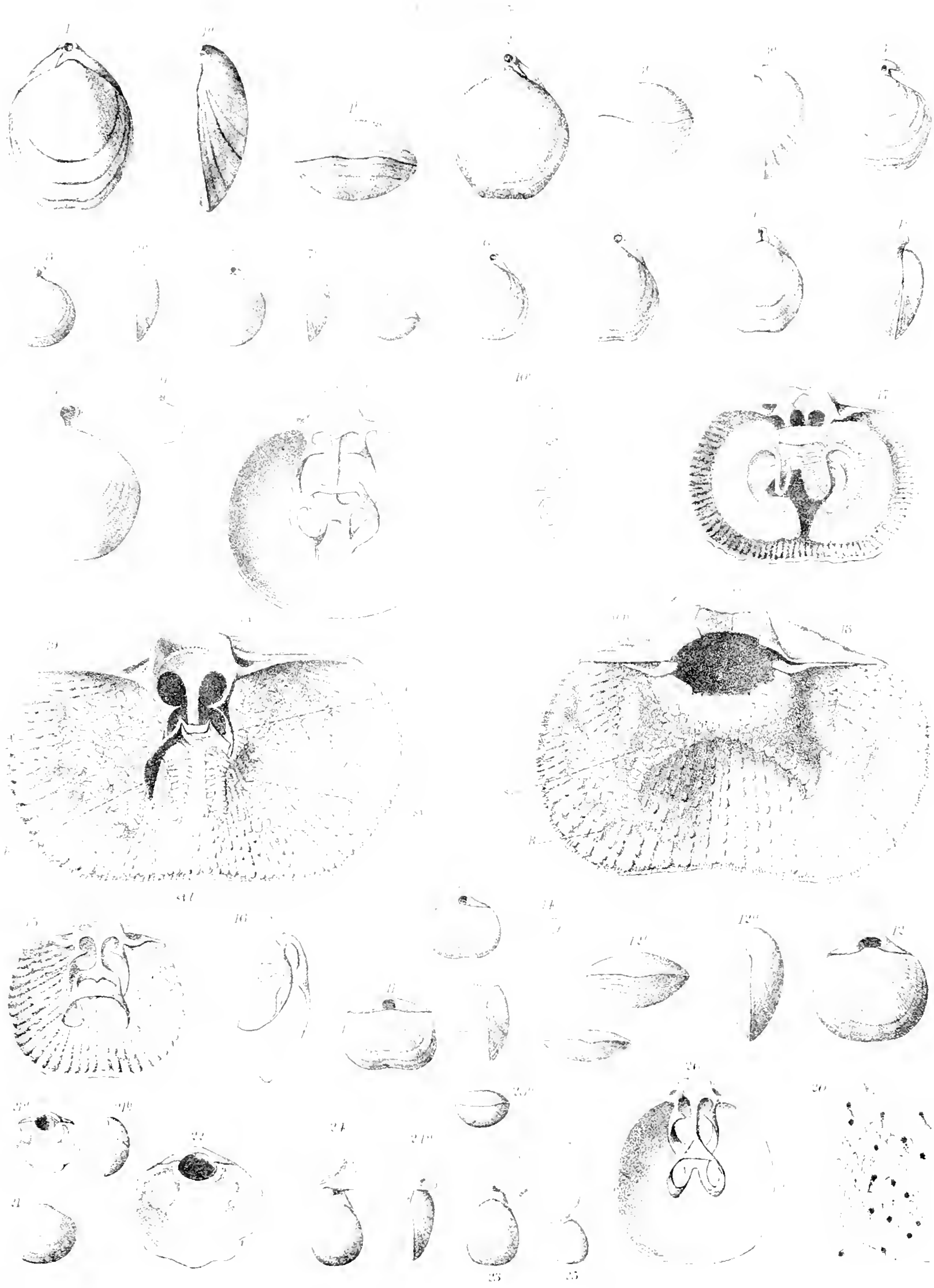

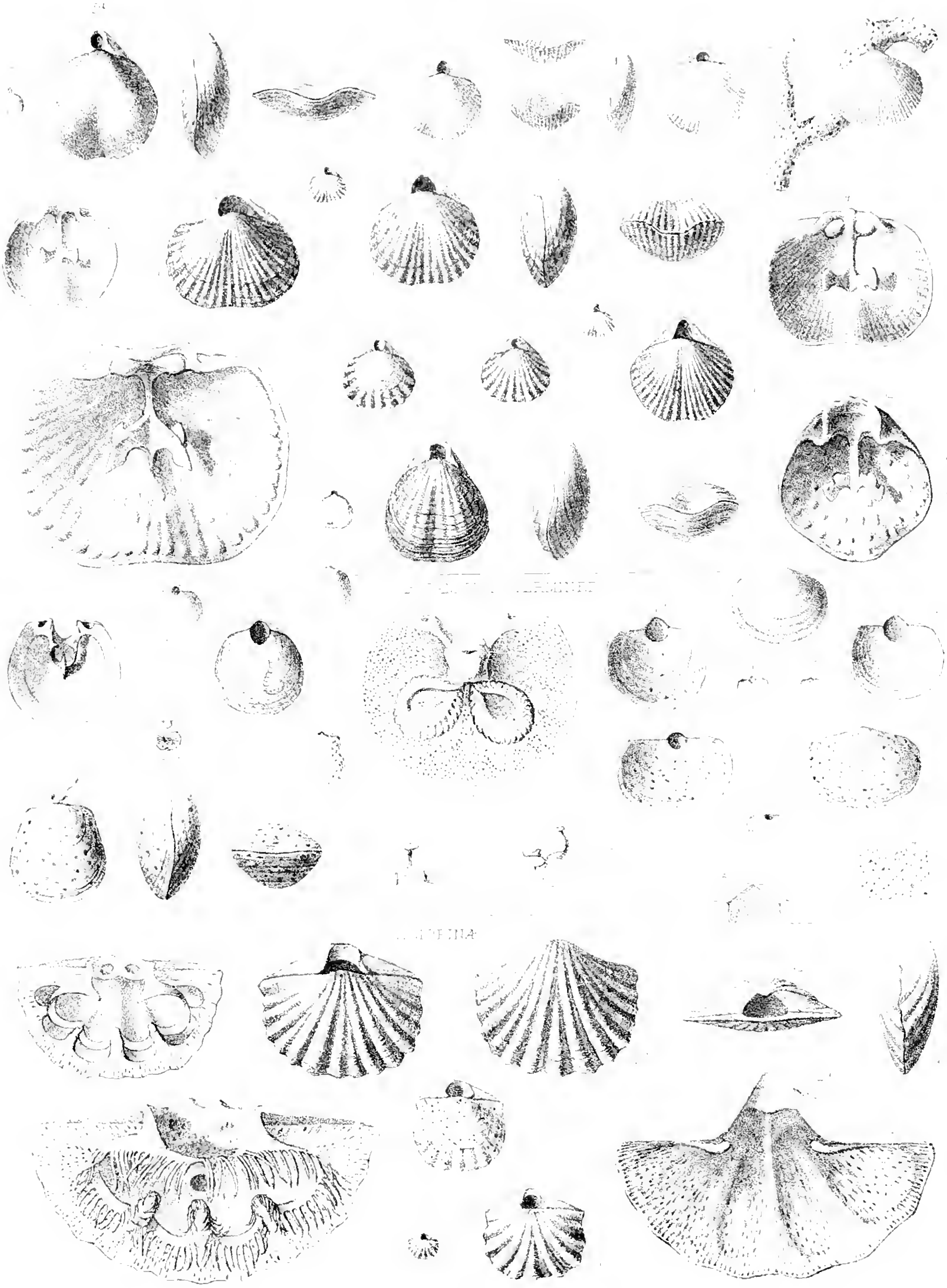

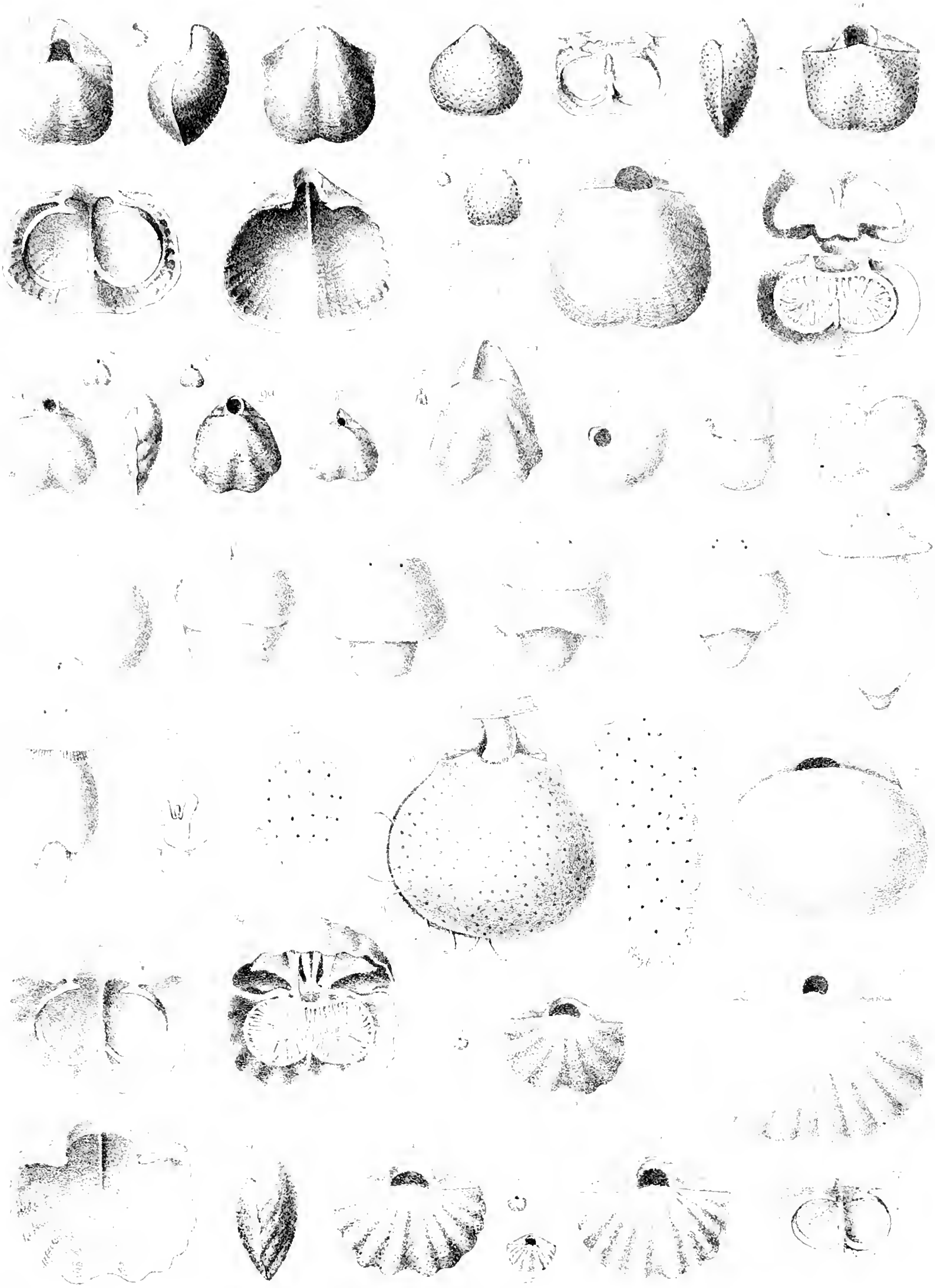

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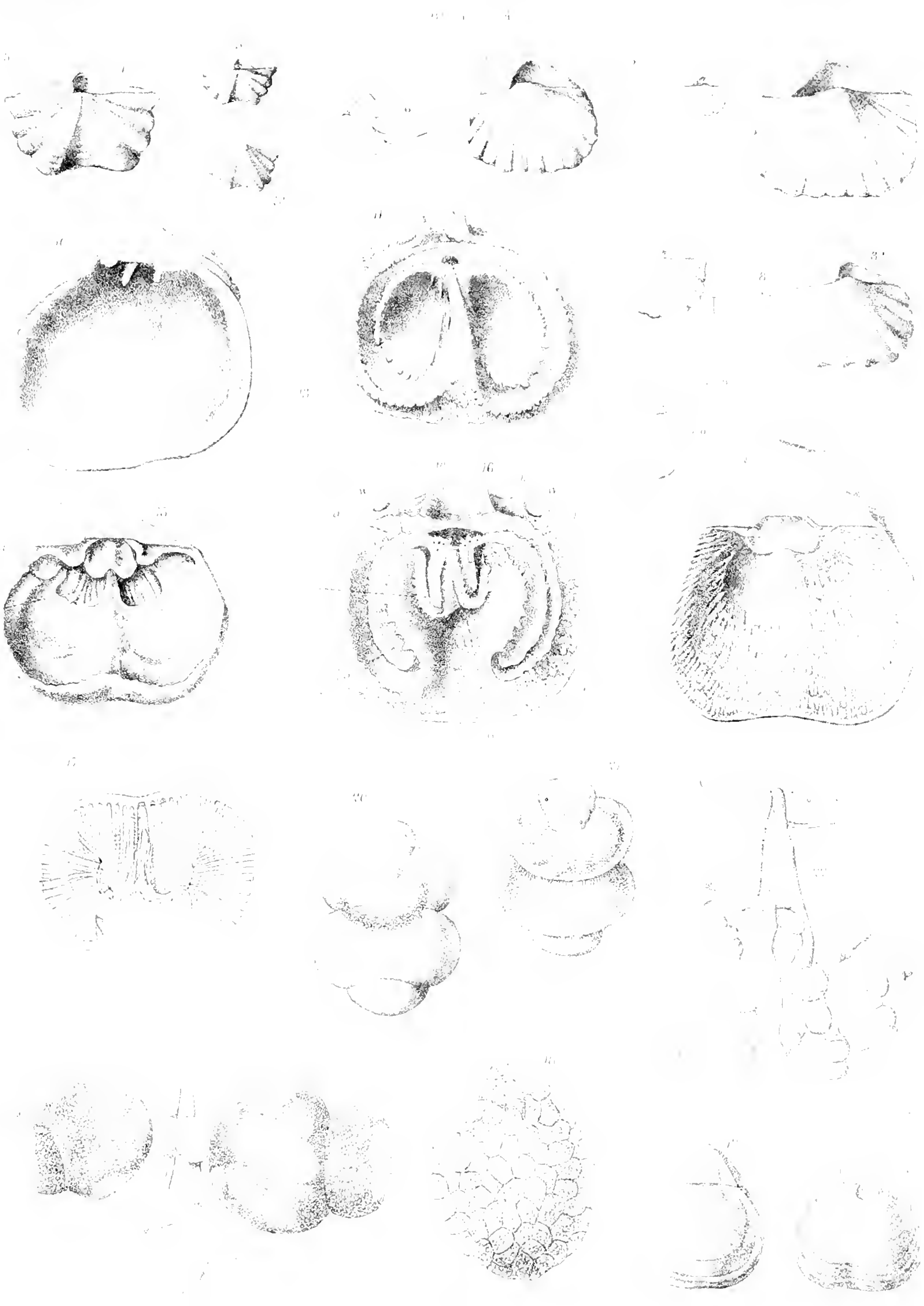
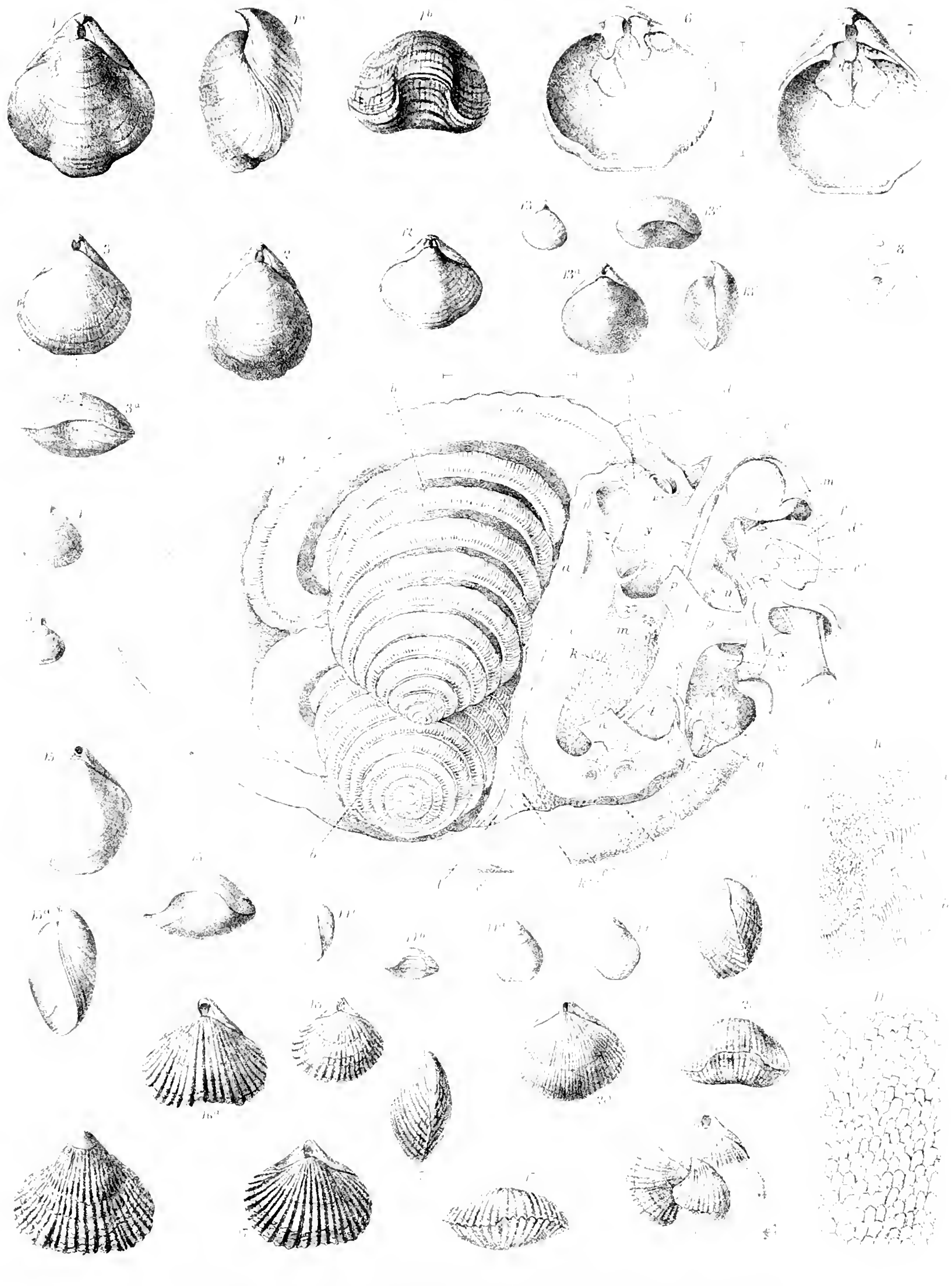
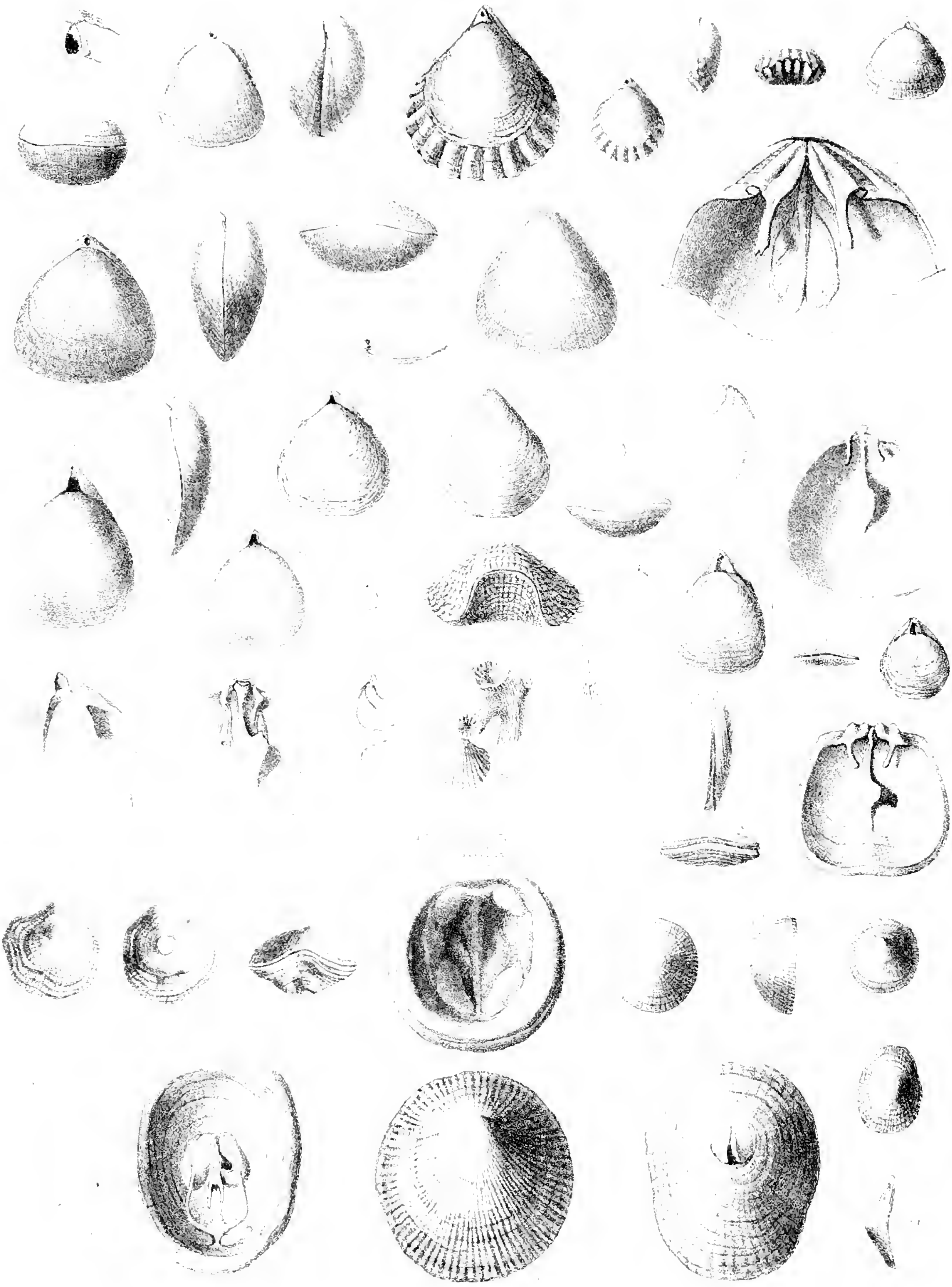
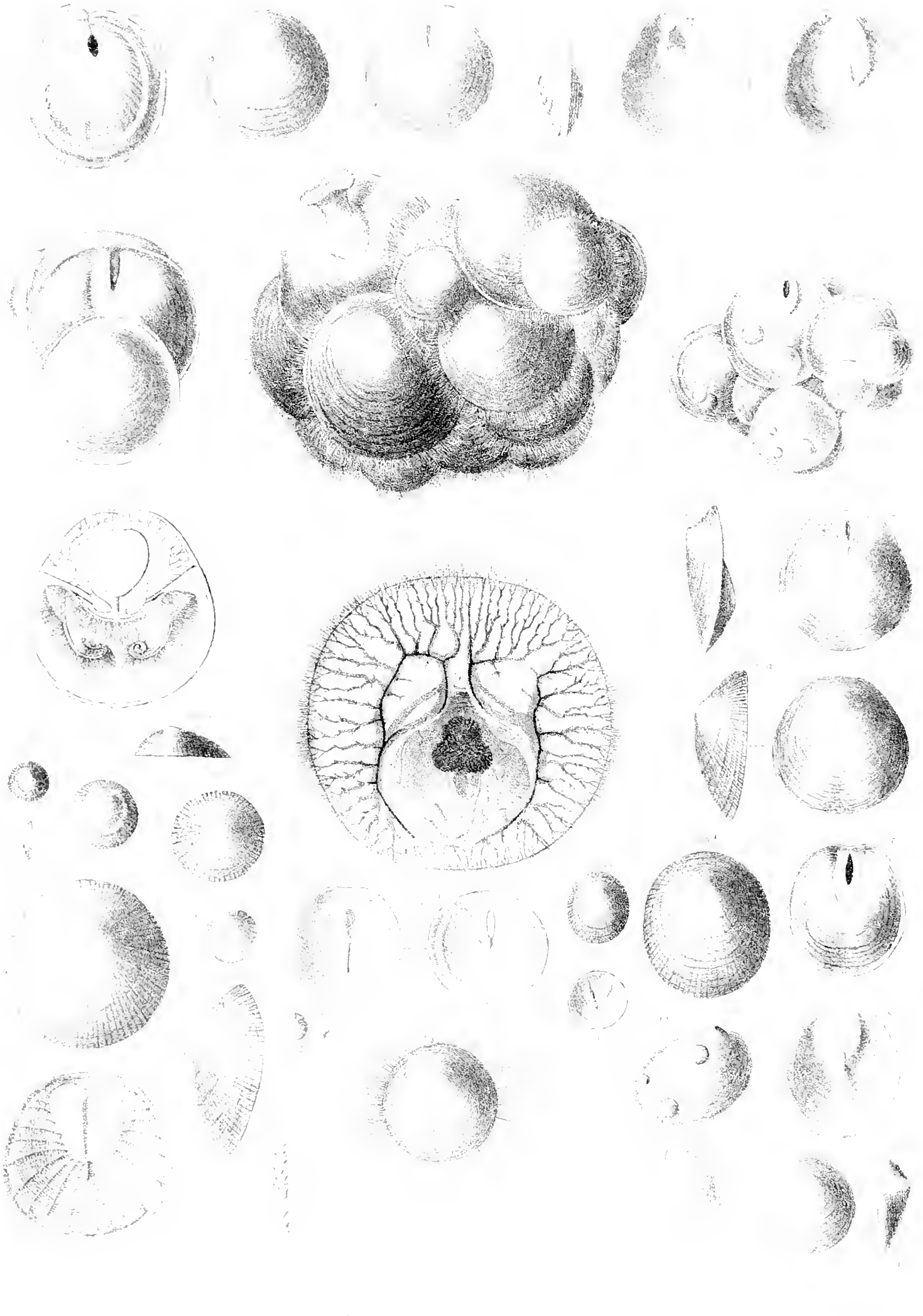
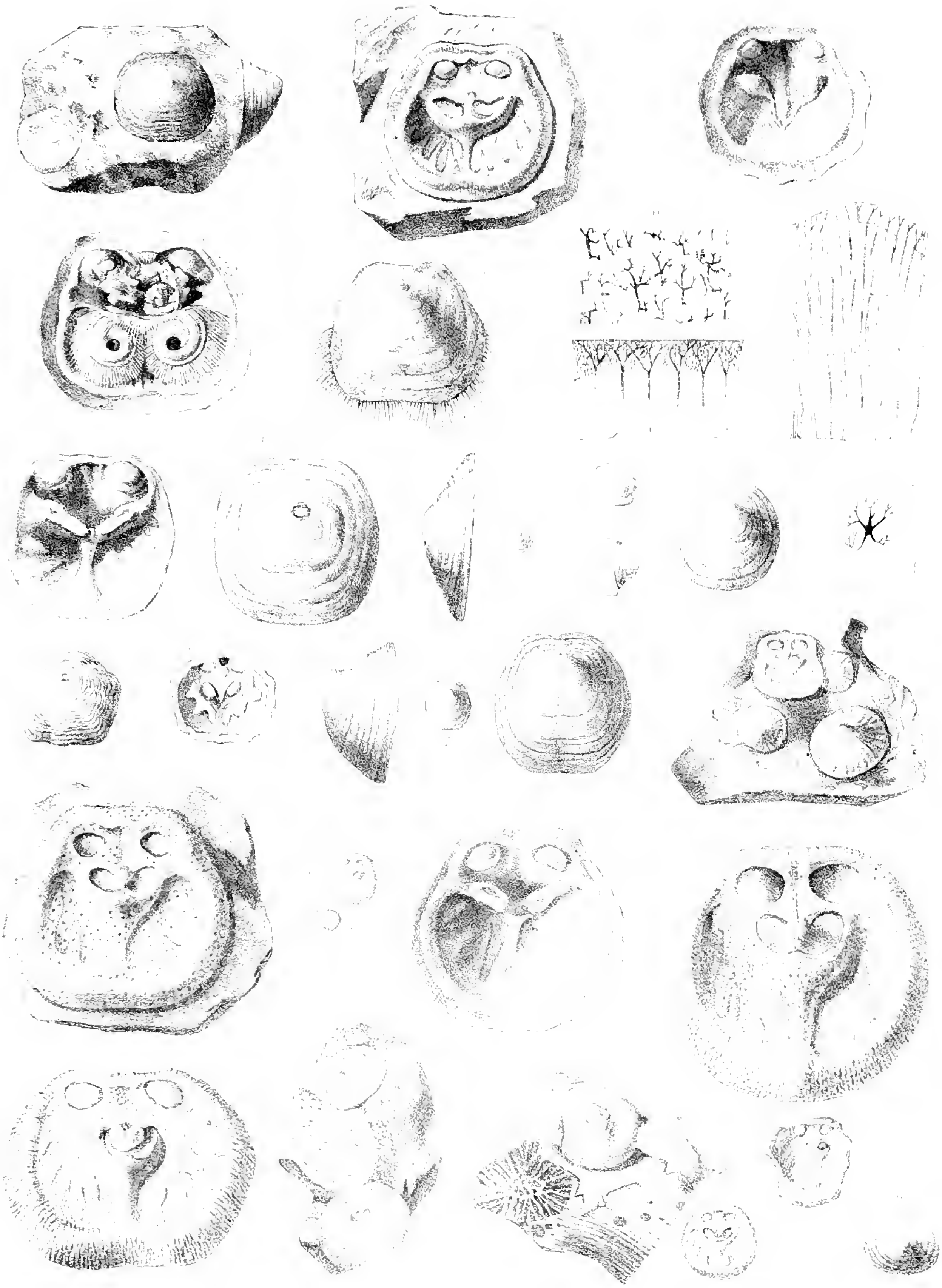
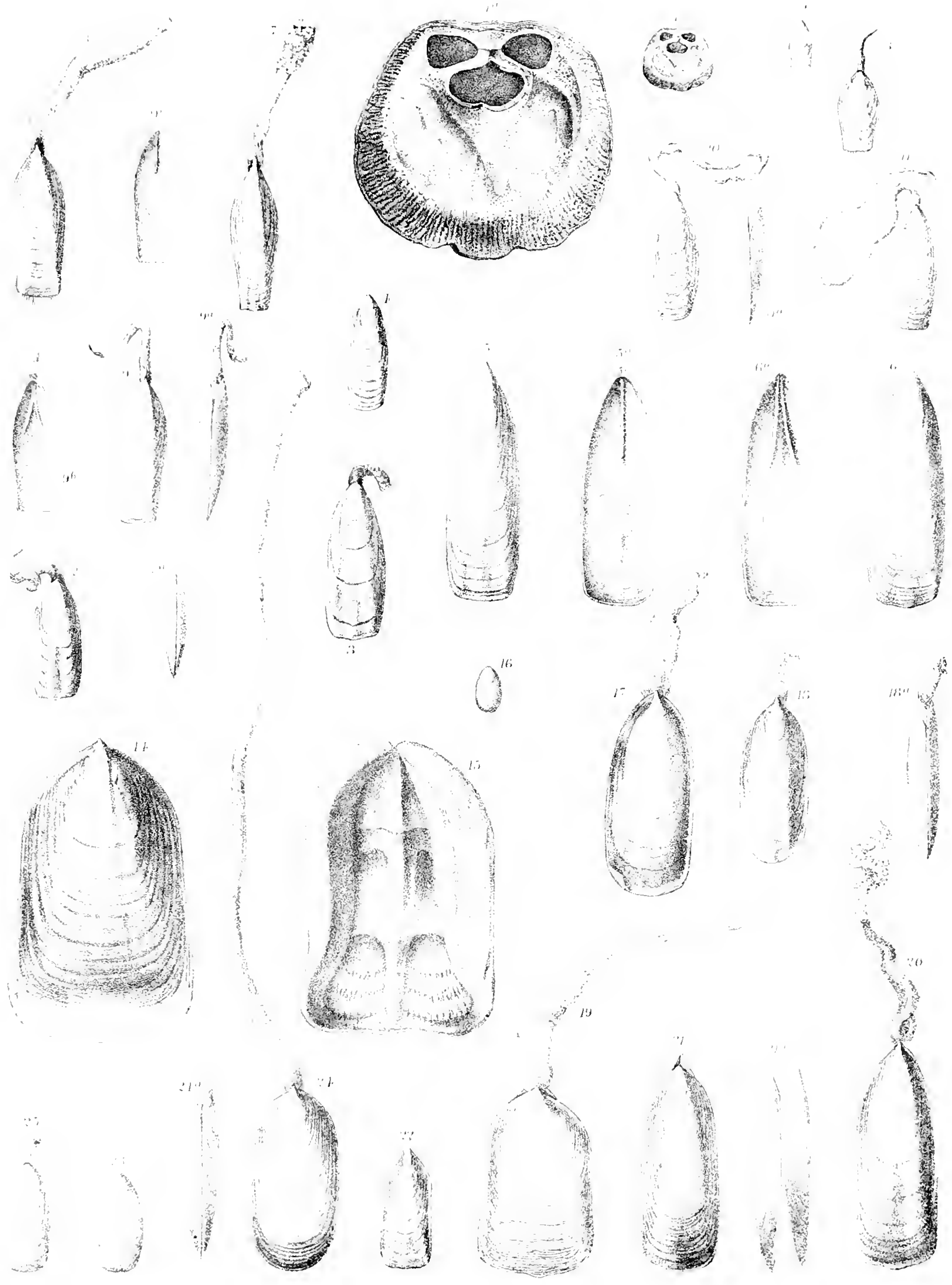


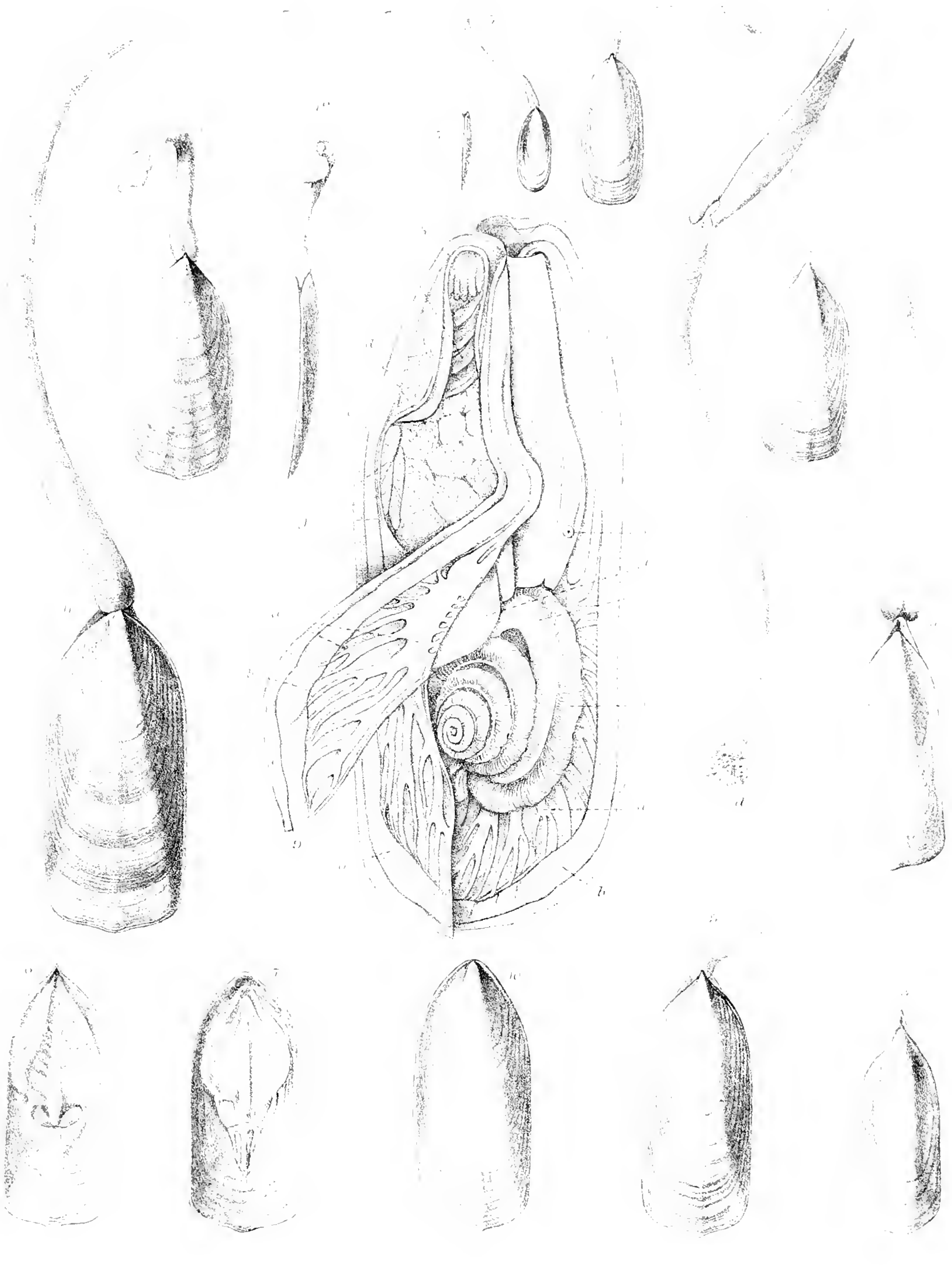






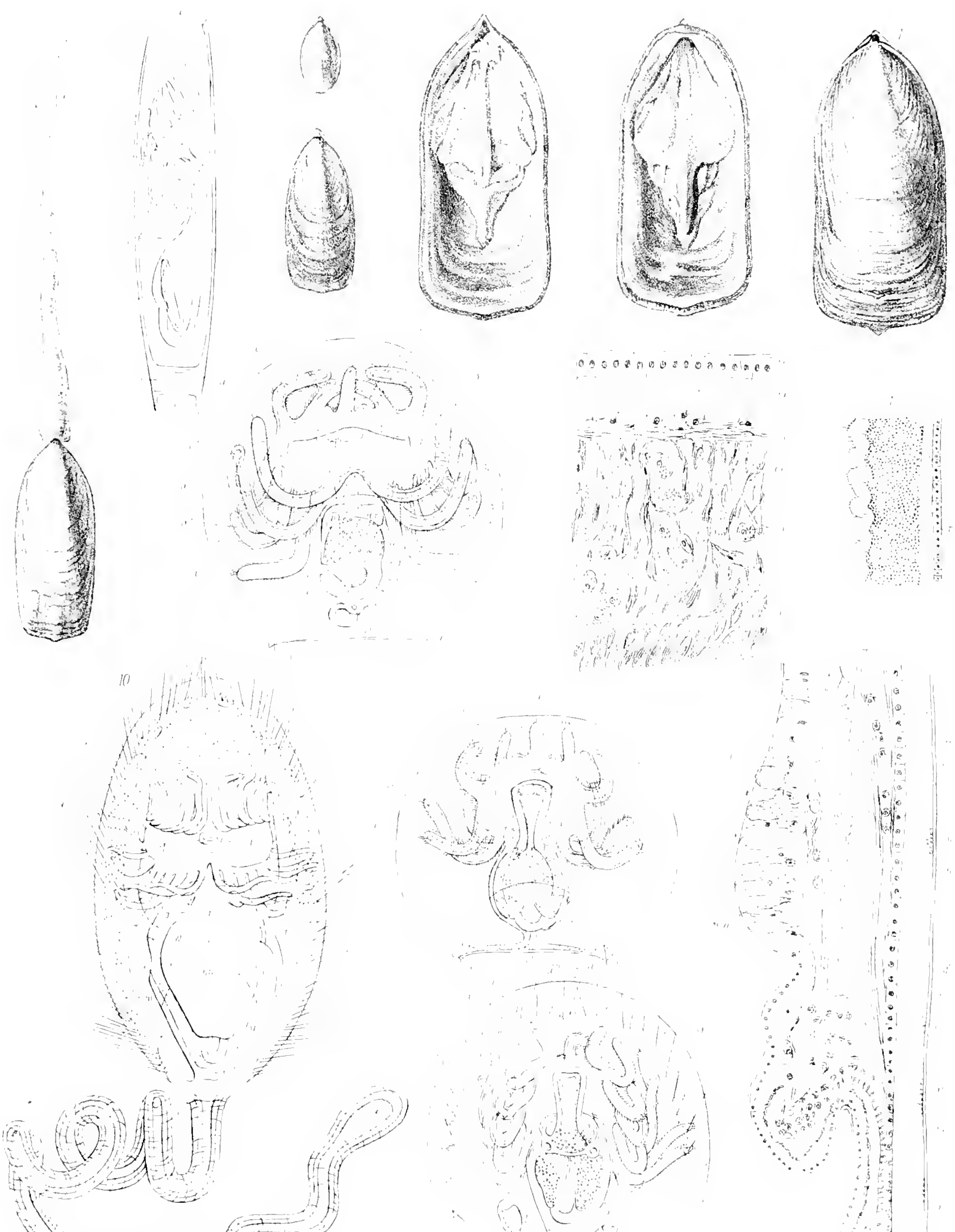






1–8. LINGULA ANATINA.
9–10. L. AFFINIS. 11, L. MURPHIANA

Petersen lith.



1–6 LINGULA MURPHIANA

7–11 Development

12–14

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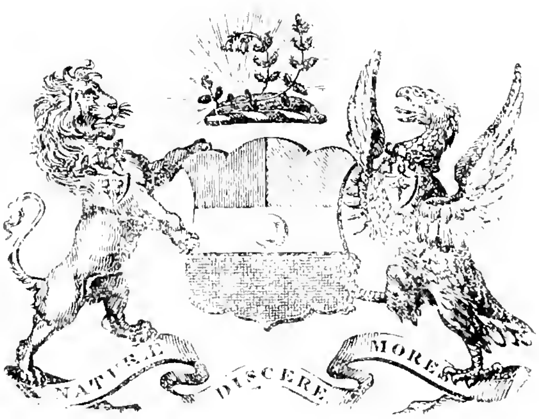

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