Monographs of the Palaeontographical Society

ISSN: 0269-3445 (Print) 2576-1900 (Online) Journal homepage: https://www.tandfonline.com/loi/tmps20

A Monograph of the British Carboniferous Lamellibranchiata. Part IV. Edmondidæ, Cyprinidæ, Crassitellidæ. Pages 277–360; Plates XXVI–XXXIX

Wheelton Hind

To cite this article: Wheelton Hind (1899) A Monograph of the British Carboniferous Lamellibranchiata. Part IV. Edmondidæ, Cyprinidæ, Crassitellidæ. Pages 277–360; Plates XXVI–XXXIX, Monographs of the Palaeontographical Society, 53:250, 277-360, DOI: 10.1080/02693445.1899.12035488

To link to this article: https://doi.org/10.1080/02693445.1899.12035488

Published online: 31 Oct 2018.

A MONOGRAPH

OF THE

BRITISH CARBONIFEROUS LAMELLIBRANCHIATA.

BY

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PART IV.

EDMONDIDÆ, CYPRINIDÆ, CRASSITELLIDÆ.

Pages 277—360; Plates XXVI—XXXIX.

LONDON:
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.
1899.

PRINTED BY ADLARD AND SON,
BARTHOLOMEW CLOSE, E.C., AND 20, HANOVER SQUARE, W.

Genus—SEDGWICKIA, *M'Coy*, 1844.

Synonyms :

SEDGWICKIA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 61.
DOLABRA (pars), *M'Coy*, 1844. Ibid., p. 66.
LYONSIA (pars), *d'Orbigny*, 1850. Prodrome de paléont., p. 128.
SEDGWICKIA, *Morris*, 1854. Cat. Brit. Foss., p. 224.
— ? (SANGUINOLITES), *Meek and Worthen*, 1865. Proc. Acad. Nat. Sci. Philad., p. 251.
— *Meek and Hayden*, 1865. Pal. of the Upper Missouri, Smithsonian Cont. Knowledge, p. 38.
— (SANGUINOLITES ?), *Meek and Worthen*, 1868. Pal. of Illinois, vol. iii, p. 537.
— ?, *Hall and Whitfield*, 1872. Pal. Ohio, vol. ii, p. 89.
— *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 310.
— *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 290.
— *Miller*, 1889. N. Amer. Geol. and Pal., p. 511.

Generic Characters.—Shell equivalve, inequilateral, more or less ovate and gibbose. The anterior end is rounded, the posterior obliquely subtruncate, umbones pointed and raised, dorsal slope much compressed and broad. Hinge edentulous, or with a single small cardinal tooth in the left valve. Muscle-impressions very faint; pallial line entire. Surface ornamented by regular, well-marked, concentric small ridges in the anterior part, which gradually become obsolete, so that the posterior two thirds of the valve is smooth.

Observations.—The genus was founded by M'Coy, who described and figured six species, two of which I am able to retain, but unfortunately the types of the others are not preserved or are too fragmentary for identification. To these must be added *Venus centralis*, M'Coy, and *Dolabra securiformis*, M'Coy, which doubtless belong to the genus; unfortunately, however, the type specimen of the former has decomposed, and that name can no longer be retained, and the latter is evidently the interior of *S. gigantea*.

M'Coy says, "The genus *Sedgwickia* (M'Coy) is composed of a very elegant little group of shells, having analogies which place them, as it were, between the so-called *Cypricardiæ* of the older strata, the *Axini* (Sow.), and the *Leptodomi* (M'Coy)."

The genus *Schizodus*, to which the *Axini* are now referred, certainly has a very close resemblance to *Sedgwickia*, but the latter genus is distinguished by its characteristic surface-markings, the edentulous hinge or single small cardinal tooth, smaller degree of obliquity, and the fact that the umbones are not at all prosogyrous.

I have pointed out *antea*, p. 228, the unsatisfactory nature of M'Coy's genus

Leptodomus, but am in agreement with that author in acknowledging the propinquity to *Sedgwickia* of some of the shells originally referred to that genus.

Messrs. Meek and Hayden have given an exhaustive summary of the characters and affinities of *Sedgwickia* (*op. sup. cit.*); the shells which they, however, refer to this genus are much more transverse than any British examples; and these authors are inclined to refer to the genus several shells of widely different affinities, such as *Leptodomus costellatus*, M'Coy, *Sanguinolites variabilis*, M'Coy, and *Leptodomus truncatus*, M'Coy. With regard to the first two of these, at any rate, there are no grounds whatever for extending the genus to receive them.

I have grave doubts whether any of the three species included by these authors in the genus really belong to it; and it would appear that they were themselves in doubt, for their shells are named "*Sedgwickia Topekoensis?*" "*Sedgwickia ? concava*," and "*Sedgwickia ? altirostrata.*" The former of these is shown in the figure to have a well-marked escutcheon and lunule, characters which are not present in *Sedgwickia*.

According to M'Coy, the hinge in *Sedgwickia* is edentulous, and in several species I can see no indications of hinge-teeth in casts, though I must confess that my material was not very suitable for the demonstration of teeth if these were very small; but in a specimen of *Sedgwickia ovata*, Pl. XXVII, fig. 2, there is an unmistakable cardinal tooth, which is directed obliquely backwards, in the right valve.

The presence of a small cardinal tooth in at least one species of the genus emphasises the relationship between *Schizodus* and *Sedgwickia* which I have referred to above, and may indicate the lines along which these forms evolved; but more accurate knowledge must be known about the Lamellibranchs of the earlier palæozoic rocks before anything can be definitely stated on this subject.

M'Coy does not advance any evidence for his statement *re Sedgwickia*, "They are entirely without hinge-teeth, their hinge resembling that of *Thracia*," all the figures being those of exteriors. The statement itself, too, seems contradictory, as the hinge of *Thracia* possesses a large cartilage socket and ossicle, which are certainly not to be seen in *Sedgwickia*.

SEDGWICKIA GIGANTEA, *M'Coy*, 1844. Plate XXVI, figs. 1—3; Plate XXVII, fig. 10.

SEDGWICKIA GIGANTEA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 62, pl. xi, fig. 40.
DOLABRA SECURIFORMIS, *M'Coy*, 1844. Ibid., p. 66, pl. xi, fig. 15.
LYONSIA SECURIFORMIS, *d'Orbigny*, 1850. Prodrome de paléont., p. 128.
— — — — Ibid., p. 129.

SEDGWICKIA GIGANTEA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 224.
DOLABRA SECURIFORMIS, *Morris*, 1854. Ibid., p. 202.
SEDGWICKIA GIGANTEA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 311.
CUCULLÆA SECURIFORMIS, *Bigsby*, 1878. Ibid., p. 305.
SEDGWICKIA GIGANTEA, *Kirkby*, 1880. Quart. Journ. Geol. Soc., vol. xxxvi, p. 586.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 290.
DOLABRA SECURIFORMIS, *Etheridge*, 1888. Ibid., p. 283.

Specific Characters.—Shell large, ovately rhomboidal, convex, slightly inequilateral. The anterior end is well developed, and its border is elliptically curved, and is continuous with the upper and lower margins. The inferior border is markedly convex in front, but becomes almost straight behind, where it rises to meet the posterior border. The latter is narrowed by the approximation of the upper and lower margins, and is almost straight, obliquely truncate from above downwards and backwards, making obtuse angles with the upper and lower margins. The hinge-line is curved, produced and depressed posteriorly. The umbones are large, subcentral, raised, tumid, pointed, incurved, and contiguous. The umbones rise gradually from the surface of the valve, which appears to have been evenly convex over its greater extent, but compressed posteriorly. Passing from the posterior edge of the umbo downwards and backwards obliquely towards the posterior inferior angle is a ridge, which soon becomes lost on the surface of the shell.

Interior.—The anterior adductor scar is of moderate size, pear-shaped with the apex prolonged upwards, and situated immediately within the antero-superior angle of the shell; the posterior adductor is elongate and rough, situated in the dorsal slope near the upper margin of the valve. The hinge-plate is edentulous, small, and narrow, formed by a thickening of the free edge after the manner of *Edmondia*, but less developed. The pallial line is entire.

Exterior.—The anterior portion of the shell is ornamented with numerous fairly large concentric ridges, separated by shallow sulci, which become entirely obsolete about the junction of the middle and anterior thirds of the valve, from which point posteriorly the valve is perfectly smooth except near the margin, where faint lines of growth may at times be distinguished. Shell very thin.

Dimensions.—The type specimen, Pl. XXVI, fig. 1, figured by M'Coy, measures—

Antero-posteriorly	61 mm.
Dorso-ventrally	40 mm.

A large crushed example, Pl. XXVI, fig. 2, from the Calciferous series of Randerstone, Fife, measures—

Antero-posteriorly	77 mm.
Dorso-ventrally	52 mm.

As both specimens are crushed, it is impossible to obtain an idea of the convexity of the valves.

Localities.—Scotland: Limestone No. 6, Randerstone, Fife, Calciferous Sandstone series; and Magazine, Midlothian, Carboniferous Limestone series. Ireland: Carrowmacrory, Templeboy; and in arenaceous shale, Rahan's Bay, Dunkinealy.

Observations.—The type specimen is very imperfect and much crushed, as are also all the specimens I have been able to examine from Randerstone, but there can be little doubt that M'Coy's species was well established. I have fortunately procured a fine cast of the interior of a pair of valves from Magazine, Pl. XXVI, fig. 3, which enables me to give details of the interior, and also gives a good idea of the shape of the shell. The hinge is represented in this specimen by a hollow groove, showing that M'Coy was correct in asserting that certain species of this genus were edentulous.

Mr. Kirkby, referring to the Randerstone shells, says (*op. supra cit.*), "I have several specimens of a large *Schizodus*-shaped shell from Limestone No. 6, Randerstone, which evidently came very close to the *Sedgwickia gigantea*, M'Coy. The specimens which are all more or less crushed are thin-shelled, from three to three and a quarter inches long, two inches wide, and have the anterior side marked with the regular strong ridges parallel with the margin that are characteristic of the genus, the remainder of the surface being comparatively smooth." I think there is no doubt that this reference is correct, for although much larger, as far as may be judged from their crushed condition, they are identical in character with the type.

It would appear that M'Coy's figure of *S. gigantea* is largely ideal; the type specimen preserved in the Griffith Collection of the Royal Museum of Science and Art, Dublin, is very much crushed and imperfect. I have been kindly permitted by the authorities to re-figure this specimen, Pl. XXVI, fig. 1.

I have placed the *Dolabra securiformis*, M'Coy, as a synonym of *S. gigantea*, of which it is an internal cast, and its figure, Pl. XXVII, fig. 10, is seen to be identical with the very perfect specimen from Magazine, near Edinburgh, which is represented on Pl. XXVI, fig. 3. The casts of *S. gigantea* do not exhibit any marked traces of the peculiar external ornament, and are therefore somewhat difficult to separate from specimens of *Protoschizodus* in a similar state of preservation, especially if no trace of the hinge of the latter genus be visible.

SEDGWICKIA OVATA, sp. nov. Plate XXVI, figs. 8—11; Plate XXVII, figs. 1—4.

? LEPTODOMUS COSTELLATUS, *Kirkby*, 1880. Quart. Journ. Geol. Soc., vol. xxxvi, p. 563.

Specific Characters.—Shell transversely and triangularly ovate, gibbose, much narrowed posteriorly by the approximation of the superior and lower borders. The anterior border is semicircularly curved, passing without a break in the hinge-line above and the inferior border below. The latter is gently convex, rising behind to meet the posterior border at a well-marked obtusely blunted angle. The posterior margin is narrow, obliquely truncate, and meets the hinge-line above at an obscure obtuse angle. The hinge-line is arched in front, but extended and compressed posteriorly. The umbones are swollen, pointed, incurved, contiguous, and directed slightly forwards, elevated above the hinge-line, and situated about the junction of the anterior and middle thirds of the valve.

The greater part of the valve is regularly swollen, and the umbo arises gradually from the valve in front, but posteriorly it is limited by a well-marked rounded ridge which passes downwards and backwards to the postero-inferior angle of the valve; behind this line, the valve is rapidly compressed, so that the dorsal slope is hollowed and wide, and the postero-superior angle slightly expanded. Valves closed all round. Ligament external, contained in a narrow elongated groove parallel with the edge of the valve.

Interior.—The anterior adductor muscle-scar is round and shallow, situated near the margin at the antero-superior angle, marked off from the cavity of the umbo by a ridge, and there are small linear accessory muscle-scars immediately above it. The posterior adductor scar is elongate and almost obsolete, and placed in the hollow of the dorsal slope. The hinge of the right valve contains a single small cardinal tooth. Pallial line entire, remote from the margin.

Exterior.—The anterior part of the valve is ornamented with many regular concentric ridges and grooves, which soon become obsolete, so that the posterior two thirds of the shell is smooth, and the lines of growth only faintly indicated. Shell very thin.

Dimensions.—Pl. XXVI, fig. 10, measures—

Antero-posteriorly	38 mm.
Dorso-ventrally	31 mm.
Elevation of valve	13 mm.

Localities.—England: the Redesdale Ironstone Shale, Redesdale, Northumberland. Scotland: the Scorpion-beds of Glencartholme, Eskdale, Dumfriesshire; Tweeden Burn, Cement Stone series, Roxburgh; Encrinite-bed, east of Pittenweem Harbour, Fife.

Observations.—None of the species of *Sedgwickia* described by M'Coy seem to possess the characters of the shells from Redesdale. I have therefore been obliged to establish a new species for them. More gibbose and less transverse than *S. gigantea*, *S. ovata* is even less like the subquadrate form of *S. scotica*, and it is easily separated from *S. suborbicularis* by its larger size and its characteristic contour.

S. ovata is fairly plentiful at Redesdale, but is often badly preserved: figs. 8—10, Pl. XXVI, are from this locality, and fig. 11, Pl. XXVI, from the famous Scorpion-beds of Glencartholme, Dumfriesshire; the latter locality is supposed to be at a much lower horizon than the Redesdale Ironstone, and is placed in the Calciferous Sandstone series. It is interesting to note that the species also occurs in the same series of the east of Scotland.

I have been able to isolate the hinge in one specimen, and this shows distinctly that the right valve has a small single cardinal tooth, fig. 1 *a*, Pl. XXVII. M'Coy states that the genus *Sedgwickia* is edentulous, but figures no specimens; and although I cannot affirm that any other species of the genus has a tooth in its hinge, it is possible that, owing to its very small size, this character may have been overlooked, and it would appear from the cast of *S. gigantea*, Pl. XXVI, fig. 3, that that species at least was edentulous. *S. ovata* is much more ovate and transverse than *S. scotica*, and appears not to attain to so large a size. The diagonal ridge is not so well marked, and the posterior end is narrower and less truncate.

Mr. Kirkby has, I think, identified specimens of this species which occur in the Encrinite-bed of Mr. Brown, east of Pittenweem Harbour, with *Leptodomus costellatus*, M'Coy (*op. supra cit.*). I have myself collected from this bed, and have found *Sedgwickia ovata* there, but not the other shell. If only the anterior part of the shell be seen the mistake is easily made. I am strengthened in this opinion by drawings of the shell in a MS. book, kindly lent me by Mr. Kirkby, in which a very typical example of *Sedgwickia ovata* is called *Leptodomus costellatus*.

S. ovata has somewhat the shape of *S. bullata*, M'Coy, but the elevated ridges on the front of the shell are very few and far apart in the latter species. The figure shows only half a dozen; and I think that this shell may possibly be the *Edmondia Josepha* of the West of Scotland; but I hesitate yet to give it as a synonym. None of the other species of *Sedgwickia* which I have been able to examine have so few concentric ridges anteriorly.

The original description of *S. bullata* is as follows:—"Transversely oblong, very gibbous, length about two thirds the width; anterior side short, rounded; hinge-line nearly as long as the shell is wide, posterior end slightly oblique, subtruncate; beaks very large, tumid; an obtusely rounded ridge from the beak to the posterior angle; anterior side with strong rounded distinct ridges; middle of the shell and posterior side smooth."

SEDGWICKIA SCOTICA, sp. nov. Plate XXVI, figs. 4—7.

Specific Characters.—Shell of moderate size, inequilateral, quadrately ovate, tumid in the anterior two thirds, but compressed behind. The anterior portion of the valve is short but deep, its border regularly and broadly rounded, forming a continuous curve with the upper and lower margins. The inferior border is extended, convex, more so at each extremity. The posterior border is narrow, obliquely truncate from above downwards and backwards, making obtuse angles with the upper and lower margins. The hinge-line is arched, but is extended, erect, and nearly straight behind. The umbones are large, gibbose, elevated, contiguous, and not twisted forwards, and situated in front of the centre of the hinge line.

The umbonal swelling rises gradually from the convexity of the shell in front, but is limited behind by a line which passes downwards and backwards obliquely to the postero-inferior angle. Behind this line the shell is rapidly compressed and somewhat expanded.

There is neither lunule nor escutcheon.

The greatest gibbosity of the valves is subumbonal.

Interior.—The anterior adductor muscle-scar is small and shallow, situated just within the margin of the shell at the antero-superior angle. The posterior adductor scar, shallow and almost obsolete, is placed in the hollow of the dorsal slope. Hinge as yet unknown. Pallial line entire, situated near the margin of the valve.

Exterior.—The anterior third of the valve is ornamented with many regular, fine, concentric ridges, which soon become obsolete, so that the posterior two thirds of the valve including the umbones is perfectly smooth. Shell very thin.

Dimensions.—Pl. XXVI, fig. 4, a specimen in the possession of Mr. Adam Whyte of Muirkirk, from the McDonald Limestone of that district, measures—

Antero-posteriorly	44 mm.
Dorso-ventrally	37 mm.
From side to side	25 mm.

Localities.—Scotland: the Lower Limestone series of Beith, and the McDonald Limestone, Muirkirk, Ayrshire.

Observations.—This species is founded upon a number of specimens in the cabinets of Mr. J. Neilson, Mr. R. Craig, and Mr. Adam Whyte, and bears a closer resemblance to the general form of *Schizodus axiniformis*, Phillips, sp., than any other species of the genus; the posterior end is more truncate and less pointed, the umbones less prosogyrous than in this species, which possesses a totally distinct ornamentation to that which obtains in *Sedgwickia scotica*, and in casts there appear to be no indications that the hinge possessed teeth.

At present this species has only been obtained from the horizon of the Lower or Beith Limestone, of which the McDonald Limestone at Muirkirk is the equivalent, the shells occurring in the shales which are found in connection with the beds of limestone, and not in the limestones themselves.

SEDGWICKIA SUBORBICULARIS, sp. nov. Plate XXVII, figs. 5—8.

Specific Characters.—Shell transversely suborbicular, compressed, very slightly oblique, inequilateral. The anterior end is short but deep, compressed, its margin regularly rounded, passing without a break into the superior and inferior borders. The lower margin is only slightly convex, the posterior regularly convex, passing into the hinge-line above and the lower margin below with an uninterrupted curve. The hinge-line is gently curved, subparallel with the lower border. The umbones are broad, flattened, raised above the hinge-line, and placed in the anterior third of the shell. The posterior part of the shell is compressed and somewhat expanded. The general curvature of the valve is regular, but slight in amount.

Interior unknown.

Exterior.—The surface is ornamented with about twenty-five regular raised lines, which separate as they pass backwards, but become obsolete about the junction of the anterior and middle thirds of the valve. Posteriorly the shell is almost smooth, or with a few obsolete flattened sulci. If the outer layer of shell be removed, the inner portion shows obscure radiating lines. Shell very thin.

Dimensions.—Fig. 6, Pl. XXVII, a left valve, measures—

Antero-posteriorly	36 mm.
Dorso-ventrally	28 mm.
Elevation of valve	4 mm.

Localities.—Scotland: Inverteil Quarry, Linktown, Kirkcaldy; and Potmetal Plantation, Kirkcaldy; Hope Quarry, Pathhead, Haddingtonshire.

Observations.—I have founded this species on four specimens in the Collection of the Geological Survey of Scotland, one of which, Pl. XXVII, fig. 7, is that of a very young example. All the specimens have the shell preserved, so that it is impossible to say anything about the interior of the valve.

None of the six species described by M'Coy resemble *S. suborbicularis*, which is at once distinguished by its blunt, obtusely rounded posterior end, which is larger from above downwards than the anterior. The species is also much more compressed than any other member of the genus.

Both the specimens from Inverteil, figs. 5 and 6, Pl. XXVII, have the

umbones and upper part of the centre of the shell eroded, so that the lower layers of the shell are exposed; but it is doubtful whether any definite opinion as to the habitat of this species can be based on the fact, *Edmondia*, sp., and *Pecten*, sp., occurring at the same locality. I think that there is no doubt, however, that the erosion of the valves is in this case due to the usual cause, that is the presence of CO_2 in the water, and that possibly this is an indication of a strong admixture of fresh with salt water, but a careful research into the fauna of the bed is necessary to settle the question.

SEDGWICKIA ATTENUATA, *M'Coy*, 1844. Plate XXVII, figs. 9, 11—14.

SEDGWICKIA ATTENUATA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 62, pl. xi, fig. 39.
LYONSIA ATTENUATA, *d'Orbigny*, 1850. Prodrome de Paléontol., p. 128.
SEDGWICKIA ATTENUATA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 224.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 311.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 290.
— — *Barnes and Holroyd*, 1897. Trans. Manch. Geol. Soc., vol. xxv, p. 187, fig. 14, 3rd pl.

Specific Characters.—Shell of less than medium size, transversely ovate, moderately convex, inequilateral. The anterior end is short, convex, deep from above downwards, and has a well-rounded border, somewhat elliptically curved. The inferior margin is almost straight except at the extremities. The posterior border is obliquely truncate from above downwards, almost straight, and narrowed, the postero-inferior angle being bluntly rounded, the postero-superior being a well-marked obtuse angle. The hinge-line is curved in front; produced, depressed, and straight posteriorly. The umbones are tumid, not marked off from the shell by folds, elevated, and situated in the anterior third of the valve. The valves are regularly convex, but there is a well-marked ridge which extends from the umbo to the postero-inferior angle, above which the shell is compressed and flattened.

Interior.—The anterior adductor muscle-scar is shallow, elongate, situated just within the antero-superior angle. The posterior is rounded, shallow, and situated near the postero-inferior angle in the hollow of the dorsal slope. The pallial line is entire and remote from the margin. The hinge is edentulous. The interior exhibited obsolete concentric folds in the anterior part of the valve, and very faint radiating striæ over the middle and posterior portions.

Exterior.—The surface seems to be ornamented with fine concentric lines of growth, strong anteriorly but becoming obsolete posteriorly.

Dimensions.—Pl. XXVII, fig. 12, a cast, measures—

Antero-posteriorly	23 mm.
Dorso-ventrally	14 mm.
Laterally	8 mm.

Localities.—England:—In a calcareous grit in the Millstone-grit series of Pule Hill, Marsden. Ireland: in arenaceous shale, river Bannagh, Drumcurren.

Observations.—The type specimen, fig. 9, Pl. XXVII, of M'Coy's *Sedgwickia attenuata*—a left valve, not, as shown in his figure, a right valve—is preserved in the Museum of Science and Art, Dublin, and is a very poor example on which to found a species. However, the description seems to do very well for a shell which is very plentiful in a curious ochreous, calcareous grit on Pule Hill. This shell occurs generally in the form of casts, but some idea of the exterior can be obtained from hollow casts. I have referred this shell to *Sedgwickia* on account of its edentulous hinge, truncate posterior end, and oblique ridge.

The fauna of this bed is a curious one; the following species occur in it, all in the form of casts:

Myalina Flemingi, M'Coy.
— *Verneuilii*, M'Coy.
Schizodus antiquus, Hind.
Bellerophon Urei (very common).
Lingula, sp.
Gonitites, sp.
Many species of Gasteropoda.

I think that the bed is somewhat low down in the grit series of Pule Hill.

Sedgwickia attenuata is more transverse than any other species of the genus, and is not likely to be confounded with any of them.

Genus EDMONDIA, *de Koninck*, 1843.

CORBULA ?, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209.
LUCINA ?, *Phillips*, 1836. Ibid., p. 209.
ISOCARDIA (pars), *Phillips*, 1836. Ibid., p. 209.
EDMONDIA, *de Koninck*, 1843. Desc. des Anim. foss., p. 66.
CARDIOMORPHA (pars), *de Koninck*, 1843. Ibid., p. 109.
LUTRARIA, *Portlock*, 1843. Rep. Geol. Co. Londonderry, p. 441.
EDMONDIA, *Morris*, 1843. Cat. Brit. Foss., p. 88.
LUCINA ?, *Morris*, 1843. Ibid., p. 89.
LUTRARIA, *Morris*, 1843. Ibid., p. 91.
— *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 52.
ASTARTE, *M'Coy*, 1844. Ibid., p. 55.
EDMONDIA ?, *M'Coy*, 1844. Ibid., p. 52.
VENERUPIS, *M'Coy*, 1844. Ibid., p. 67.
SANGUINOLITES (pars), *M'Coy*, 1844. Ibid., p. 48.
CARDIOMORPHA, *de Verneuil*, 1845. Géol. Russie, p. 303.
ALLORISMA (pars), *de Verneuil*, 1843. Ibid., p. 298.
SCALDIA (pars), *de Ryckholt*, 1847. Mél. paléontol., pl. x, figs. 27, 28.

EDMONDIA (pars), *King*, 1849. Permian Fossils, p. 162.
— *Brown*, 1849. Illust. Foss. Conch., p. 198.
SANGUINOLITES (pars), *Brown*, 1849. Ibid., p. 219.
CARDIOMORPHA (pars), *d'Orbigny*, 1850. Prodrome de paléont., p. 132.
EDMONDIA (pars), *d'Orbigny*, 1850. Ibid., p. 133.
— — *M'Coy*, 1851. Ann. and Mag. Nat. Hist., ser. 2, vol. vii, p. 190.
CARDIOMORPHA (pars), *de Ryckholt*, 1852. Mél. paléontol., pt. 2, p. 93.
PANOPÆA (pars) — 1852. Ibid., p. 29.
SOLENOPSIS (pars) — 1852. Ibid., p. 64.
SOLEMYA (pars) — 1852. Ibid., p. 51.
CARDIOMORPHA, *Eichwald*, 1853–61. Lethæa Rossica, p. 1034.
EDMONDIA (pars), *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 202.
— *M'Coy*, 1855. Brit. Pal. Rocks and Foss., p. 499.
— *Shumard and Swallow*, 1858. Trans. Acad. Sci. St. Louis, vol. i, p. 209.
— *Swallow*, 1860. Ibid., vol. i, p. 635.
— *Salter*, 1861. Iron Ores Gt. Brit., pt. 3, p. 221, pl. i, fig. 29.
— *Winchell*, 1862. Proc. Acad. Nat. Sci. Phil., p. 414.
— — 1863. Ibid., p. 12.
— — 1865. Ibid., p. 127.
— *Meek and Worthen*, 1866. Rep. Geol. Surv. Illinois, vol. ii (Pal.), p. 364.
— *Dawson*, 1868–78. Acadian Geology, p. 303.
— *Young and Armstrong*, 1871. Trans. Geol. Soc. Glas., pt. 3, p. 51.
— *Stoliczka*, 1871. Pal. Indica, vol. iii, p. 66.
— *Meek*, 1872. Rep. Pal. Eastern Nebraska, p. 213.
— *Etheridge, jun.*, 1873. Geol. Mag., vol. x, p. 299.
— — 1876. Ann. Mag. Nat. Hist., ser. iv, vol. xviii, p. 99.
— *Young and Armstrong*, 1876. Cat. Foss. West Scotland, p. 53.
— *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 307.
? — *Barrois*, 1882. Recherches Terr. anciens des Asturies, p. 345.
— *Walcott*, 1884. Mon. U.S. Geol. Surv., Pal. Eureka Dist., p. 245.
BROECKIA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belge, tom. xi, p. 19.
EDMONDIA, *de Koninck*, 1885. Ibid., p. 28.
— *Etheridge*, 1885. Brit. Foss., pt. 1, Palæozoic, p. 283.
— *Miller*, 1889. North Amer. Geol. and Pal., p. 478.
— *Worthen*, 1890. Geol. Surv. Illinois, vol. viii, p. 121.

Generic Characters.—Shell transversely ovate, equivalve, close all round, convexly swollen. Hinge edentulous, simple and erect, possessing a transverse, deeply situated, thickened ridge, separated from the edge of the valve by a smooth groove. This edge commences below the umbo and passes backwards till it becomes lost. Casts show that there existed, posterior to the hinge-plate, an internal ossicle, elongate, flattened, which was directed outwards and downwards into the cavity of the umbo. External ligament small, contained in a narrow groove at the margin of the valve; lunule and escutcheon absent. Pallial line entire, usually remote from the margin. External ornament consists of concentric striæ or rugæ.

Observations.—This genus was erected by de Koninck, who professed to take the *Isocardia unioniformis* of Phillips as his type, but the shells which he figured as belonging to this species are quite different, being almost orbicular, as he says, "à peu près ronde;" but fortunately Phillips's shell undoubtedly belongs to the genus *Edmondia*, and therefore may still be considered as the type of this genus. Part of the original generic diagnosis is as follows: "Lunule échancrée; charnière dépourvu de dents, remplacées par une lamelle transverse, étroite, profondément située et en partie recouverte par le crochet et ayant probablement servi à supporter un ligament interne d'une form à peu près analogue." The figures show conclusively that there is no lunule, and no mention is made of this character in the amended diagnosis of 1885 (*op. supra cit.*), which states that the hinge is "dépourvue de dents, munie de grands plaques du cartilage, obliques, placées au-dessous des crochets."

Fortunately many specimens of different species showing the hinge have been obtained from Tournai, one of which I figure, Pl. XXVII, figs. 16 *a*, *b*, but none of these show any indications of cartilage-plates; but there is, however, as is stated in the first description, a curved transverse lamella, situated deeply, and separated from the edge of the shell by a groove parallel to it, which does not extend forward in front of the umbo. Probably, as de Koninck observed, this groove did contain some structure of the nature of an internal ligament. In casts this ridge is represented by a well-marked groove between the umbo and the edge of the valve; but external to it in the hollow of the umbo is a deep groove, which extends forwards in front of the umbo and also passes backwards, becoming wider and broader, to within a short distance from the postero-superior angle, in which lodged a process of shell; from the splendid way in which in many specimens this groove is preserved, I should incline to the view that it had originally contained an ossicle and not cartilage.

Professor King referred a shell to this genus, under the name *Edmondia sulcata* ('Monog. Permian Fossils,' pp. 163–4, pl. xx, figs. 1—4), which has somewhat similar well-marked internal ossicles; but the arrangement, shape, and the whole structure of this shell and process differ from that which is found in the more ovate smooth-shelled group of *Edmondia*. That the process was of shelly structure, and not cartilaginous, is evident from the preservation of this portion of the hinge in a specimen of *E. Pentonensis*. M'Coy placed *Edmondia* with the *Mytilidæ;* but King erected a new family, *Edmondidæ*, which he placed immediately after the *Mytilidæ*. The valves are, however, always equal, and there is a well-marked but small external ligament, and no constriction of the valves or other indications of a byssus in *Edmondia*.

De Verneuil confounded *Edmondia* and *Allorisma*. His specimen on pl. xix, figs. 6 *a*, *b*, agrees undoubtedly with the *Allorisma* of King; but the shell figured

under the same name in pl. xxi, figs. 11 *a*, *b*, is certainly an *Edmondia;* for the specimen depicted is a cast showing the groove for the shelly processes of the hinge. This author mentioned this fact in an appendix to his observations, and stated that he only provisionally united the latter specimen to *Allorisma.*

Fischer thought that *Edmondia*, de Koninck, comprised two genera,—one typified by *E. Josepha*, which possessed no external ligament; and another which he calls *Pseudedmondia*, which possessed this character. De Koninck, however, gives in his diagnosis the following statement:—"Sillons du ligament étroits, externes," and *E. Josepha* does possess a very small external ligament. Fischer erroneously quotes de Koninck as the authority for the presence "d'un osselet calcaire (de Koninck)," but I cannot ascertain that he ever made use of such a term; indeed, de Koninck is quite silent on the subject, and does not even refer to King's observations, probably because he does not appear to have examined many specimens in the condition of casts. As de Koninck points out, Morris placed a great many shells of widely different characters in this genus, and de Ryckholt referred many species to *Cardiomorpha* which should be more correctly placed in *Edmondia*.

I am unable to discover any character of specific value to distinguish de Koninck's genus *Broeckia* from *Edmondia* except that of size. Curiously enough, although he compares his new genus to *Cardiomorpha*, and admits that they possess analogous hinges, he does not contrast this genus with *Edmondia* further than stating that he considered Morris was wrong in referring the *Lutraria prisca*, M'Coy, to *Edmondia*, because it was much less globular and less rugose on the surface than the majority of species of which the genus was composed.

De Koninck described ten species of *Broeckia*, nine of which were supposed to be new; but most of them I believe will prove to be synonymous, the species being founded on shells of different stages of growth, and on imperfect specimens.

Sixty-eight species of *Edmondia* are described in the same work, twenty-six being doubtfully referred to the genus; and fifty-four are new. De Koninck says of the group to which he affixes the ?, "Le second group est formé d'espèces ordinairement moins épaisses, plus longues que larges, dont la forme rapelle celles des anciennes *Venus*, reunis actuellement sous le nom générique de *Tapes*, dont les plis de la surface sont ordinairement mieux marqués et plus saillants, et dont je ne suis pas encore parvenu à isoler la charnière. Ce n'est dont qu'avec doute que les espèces de ce dernier groupe peuvent être introduites dans le genre *Edmondia*." Some of these species certainly should be removed from the genus, *e. g. E. minima*, *E. sublamellosa*, which do not possess the simple erect hinge-line posteriorly, characteristic of the genus, but which have a well-marked escutcheon. These two forms are not regarded as questionable *Edmondiæ*, and I am of opinion that the greater part if not all of those species referred with a ? to this genus are

correctly placed. On the other hand, I regard a large number of the species as synonymous, either representing individuals in different stages of growth, or being founded on merely small varietal characters which are not of specific value.

I have mentioned the fact above, p. 255, that many specimens of *E. Kickxiana*, in the fine series possessed by the Royal Natural History Museum of Brussels, show the rudiments of a cardinal tooth, which is so characteristic of the genus *Scaldia*, de Ryckholt. This first appears as a little irregularity of the surface of the lamellar ridge; in other specimens there is a distinct rounded nodule, with a depression for the corresponding tooth of the opposite valve.

The genus *Edmondia* is known from Devonian rocks; but *Scaldia*, according to de Koninck, at present has not been recognised below the Carboniferous series.

With regard to the function of the shelly process, the ossicle, which in *Edmondia* occupies the cavity of the umbo, it probably maintained the shells in contact, acting as a fulcrum for the attachment of either an internal cartilage or some special muscles. An edentulous hinge and shallow muscle-scars show that some special apparatus was necessary, which probably could not, owing to the great thinness of the shells in this genus, be satisfactorily placed on the surface of the valve.

The genus *Edmondia* appears to be subdivided into two well-marked groups; (*a*) those with fine regular concentric lines of growth, and (*b*) those with well-marked concentric ridges and sulci. *E. unioniformis* may be regarded as the type of the former, *E. sulcata* as characteristic of the latter. I have been for some time undecided whether or no to subdivide the genus on these lines; but it seems to me that intermediate forms exist, *e. g. E. rudis*, which connects the two groups. Each group comprises suborbicular forms. Moreover all the species which I have included within the genus possess the peculiar process from the back of the hinge-plate which I have termed the ossicle, and which King and previous authors called "cartilage plaques." It appears that the transverse and sulcated shells had this characteristic feature more highly developed and differentiated than the suborbicular forms, and consequently, as de Koninck had made his observations on the hinge-plates chiefly on the species belonging to the latter group, his descriptions obviously are hardly broad enough to apply to the group of sulcated species. It is due to the perspicacity of Professor King that he perceived that the genus *Edmondia* really contained such diverse forms as *E. unioniformis* and *E. sulcata*. In M'Coy's earlier work this genus, like many others, was misunderstood; but in his later work (*op. supra cit.*) he seems to have recognised that the genus included forms with very diverse external characters, and of the nine species described by him as coming from Carboniferous rocks I am able to retain eight in the genus; and the other, *E. Egertoni*, belongs to the family Edmondidæ, but to another genus, closely allied, however, to *Edmondia*.

A very large number of species of *Edmondia* have been described from American Carboniferous rocks, and these are divisible into two groups, the smooth forms and the sulcated. It is difficult to decide, in the absence of material for exact comparison, whether or no any species are common to the Eastern and Western Hemispheres; but with a single exception, *E. unioniformis*, American authors have come to the conclusion that the species found in the Carboniferous rocks of the West are distinct from those which occur in Europe.

Waagen does not describe any representatives of the genus *Edmondia* from the Salt Range of India; but, as he entirely misconceives the characters of *Allorisma*, which he figures ('Palæontologica Indica,' sect. 13, pl. xvii, figs. 3, 4, and 9) as not possessing an escutcheon, it is not impossible that he may have mistaken species of *Edmondia* and designated them as belonging to that genus.

Benshausen figures as *Paracyclas proavia*, Goldf., sp. (*op. supra cit.*, p. 169), an orbicular shell which has a well-marked, elongate, internal groove in a cast, internal to the umbones, exactly like that which obtains in *Edmondia*. He says, p. 166, under his generic description, "Ligament von aussen nicht sichtbar, innerlich in einer kürtzeren oder längeren ausgehöhlten Grube dicht hinter den Wirbeln gelegen."

This genus possesses hinge-teeth of an orbicular shape, and does not resemble *Edmondia* in any other character than the possession of the groove for the long narrow process at the back of the hinge-plate, which was evidently not a ligament but a shelly process. The possession in common of such a highly differentiated character, a peculiarity at present known only to be found in these two genera and in *Scaldia*, seems to me to throw some important light upon the relationship of these two palæozoic genera.

EDMONDIA UNIONIFORMIS, *Phillips*, sp., 1836. Plate XXVIII, figs. 1—7.

ISOCARDIA UNIONIFORMIS, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209, pl. v, fig. 18.
EDMONDIA UNIONIFORMIS, *de Koninck*, 1842. Desc. des Anim. foss., p. 67, pl. i, figs. 4 *a—c*.
— — *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 88.
— — *de Verneuil*, 1845. Russia and the Ural Mts., vol. ii, p. 299, pl. xix, fig. 18.
— — *Keyserling*, 1846. Reise Petschoraland, p. 259.
— — *Bronn*, 1848. Nomencl. Pal., p. 452.
— — *Brown*, 1849. Illust. Foss. Conch., p. 198, pl. lxxxi, fig. 15.
— — *d'Orbigny*, 1850. Prod. de Pal., p. 133.
CARDIOMORPHA RETROSECTA, *de Ryckholt*, 1852. Mél. Pal., 2e partie, p. 100, pl. xiii, figs. 15, 16.
PHOLADOMYA VAULXIANA, *de Ryckholt* 1852. Ibid., p. 23, pl. xi, figs. 1, 2.

	EDMONDIA UNIONIFORMIS,	*Morris*, 1854.	Cat. Brit. Foss., 2nd edit., p. 202.
	— —	*M'Coy*, 1855.	Brit. Pal. Foss., p. 503.
	— —	*Eichwald*, 1860.	Lethæa Rossica, vol. i, p. 1034.
Non	— —	*Salter*, 1861.	Mem. Geol. Surv. Gt. Brit., Iron Ores Gt. Brit., pt. 3, pp. 221, 222, pl. i, fig. 29.
	— —	*Meek and Worthen*, 1866.	Geol. Surv. Illinois, vol. ii, Pal., p. 346, pl. xxvii, figs. 6 *a*, *b*.
	— —	*Young and Armstrong*, 1871.	Trans. Geol. Soc. Glasg., vol. iii, Suppl., p. 51.
	— —	— 1876.	Carb. Foss. West of Scotland, p. 54.
	— —	*R. Etheridge, jun.*, 1876.	Ann. Mag. Nat. Hist., ser. 4, vol. xviii, p. 99, pl. iv, fig. 3.
	— —	*Miller*, 1877.	Amer. Pal. Foss., p. 191.
	— —	*Bigsby*, 1878.	Thesaurus Devonico-Carboniferus, pp. 306, 307.
Non	— —	*de Koninck*, 1885.	Ann. Mus. Roy. d'Hist. Nat., tom. xi, p. 29, pl. xi, figs. 32—36; pl. xiii, figs. 42, 43.
	— PRÆLATA, *de Koninck*, 1885.		Ibid., p. 36, pl. xiii, fig. 26.
	— — *Etheridge*, 1888.		Brit. Foss., pt. 1, Palæozoic, p. 284.
Comp.	— ? DECORATA, *de Koninck*, 1885.		Ibid., p. 48, pl. x, figs. 15—20.
—	— ? PRÆCOX, *de Koninck*, 1885.		Ibid., p. 48, pl. x, figs. 31, 32.
—	— TENUILINEATA, *de Koninck*, 1885.		Ibid., p. 44, pl. x, figs. 23, 24.
—	— ? PULCHELLA, *de Koninck*, 1885.		Ibid., p. 52, pl. x, figs. 21, 22.
—	— ? ANODONTA, *de Koninck*, 1885.		Ibid., p. 49, pl. iv, figs. 7, 14.

Specific Characters.—Shell transversely broadly ovate, gibbose. The anterior end is small, convexly curved, but comparatively deep in a dorso-ventral direction. The anterior border is semicircularly rounded, passing without a break into the inferior border, which is much less convex and extended. The posterior border is obtusely rounded without any approach to angulation at its junction with the superior and inferior borders. The hinge-line is nearly as long as the shell, and slightly arched. The umbones are obtuse, twisted forwards and incurved, somewhat raised, close, and situated in the anterior quarter of the hinge-line. There is no lunule and no escutcheon. The posterior end is somewhat narrowed in its dorso-ventral diameter by the approach of its upper and lower borders. The valves are regularly and convexly swollen, there being no oblique line, but the dorsal slope is somewhat flattened. The cardinal margin is simple and sharp, coming immediately into contact with its fellow. External ligament-groove short and narrow.

Interior.—The anterior adductor muscle-scar is shallow, and situated just within the antero-superior angle; the posterior is situated within the dorsal

slope, remote from the margin. The hinge-plate is edentulous, with a deep, thick, curved vertical ridge of shell, and the flat expanded ossicle seen as a groove in casts. Pallial line entire.

Exterior.—The surface is ornamented with concentric lines and fine ridges, very conspicuous in the anterior part of the shell. Posteriorly the shell is almost smooth, but the linear ridges are more apparent again near their termination as they curve round to pass into the superior border. Shell moderately thick.

Dimensions.—Fig. 1, Pl. XXVIII, the type of *Isocardia unioniformis*, Phillips, measures—

Antero-posteriorly	49 mm.
Dorso-ventrally	36 mm.
Laterally	26 mm.

Localities.—England: the Carboniferous Limestone of Bolland, Withgill, and Hill Bolton, Yorkshire; Castleton, Thorpe Cloud, Derbyshire; the Redesdale Ironstone shale and limestone of Lowick and the Coombs, Northumberland. The Upper Carboniferous Limestone of Poolvash, Isle of Man. Scotland: The Lower Limestone series of Beith; Hind og glen, Dalry; Inverteil, Kirkcaldy; Tweeden burn, Cement stone Series, Roxburgh; Encrinite-bed, St. Andrews, Fife. Ireland: Rochfort Lodge, Bundoran, co. Donegal; Tomdeely, Ballygarrane, and Ballyshonickbane, co. Limerick.

Observations.—This species was described by Phillips under the genus *Isocardia*, and de Koninck subsequently thought that he founded the genus *Edmondia* on Belgian shells which were identical with the British species. This, however, was not the case, for, as M'Coy pointed out, the Belgian examples were "too nearly orbicular, the anterior end being too long and the ventral margin too much arched to agree with the present species." The same criticism can be applied to the shells referred to *Edmondia unioniformis* in de Koninck's later work, which certainly do not belong to that species. The shells named by de Koninck *E. prælata* belong, I think, undoubtedly to the species under discussion, probably also *E. decorata* and *E. præcox*. Phillips makes the following statement:—"Surface wrinkled on the posterior slope," the accuracy of which M'Coy questioned I think that this mistake arose from the absence of the shell in the anterior portion of the type specimen; for on reference to fig. 1, Pl. XXVIII, it will be seen that the posterior portion of the shell has its markings more apparent.

M'Coy describes the "anterior lunette" as "very large, oval, deep;" but in common with all other members of the family there is no lunule, the concentric lines of growth curving round the antero-superior angle to terminate in the hinge-line.

I am of opinion that most of the species in lists named *E. unioniformis* are erroneously referred to this species. I have been able to find only very few examples which agree in character with the type.

The shell referred to *E. unioniformis* by Salter as occurring in a marine bed in the South Wales coal-field is much too quadrate posteriorly, and should be more correctly named *E. oblonga*.

There are several species described by de Koninck which I think should be more correctly referred to Phillips's shell,—*E. ? præcox*, *E. tenuilineata*, *E. ? pulchella*, *E. ? decorata*, and *E. ovata*. These are all transversely ovate in shape, and have a similar external ornament, comparatively smooth and regular, but becoming more marked in large examples towards the lower border, and all come from the same horizon, Étage II of Pauquys and Waulsort, with the exception of *E. ovata* and *E. prælata*, which are from the lowest division, Tournai.

E. ? anodonta, de Koninck, is another of this author's species which I should place as a synonym of *E. unioniformis*. This species is stated to be founded on a single specimen, but two are figured, and the specific character is the comparatively compressed condition of the valves.

Mr. R. Etheridge, jun., figured a specimen of *E. unioniformis* from the Encrinite-bed of St. Andrews (*op. supra cit.*), and remarks on the wide distribution of the species, which is said to occur in Russia.

Struvé ('Mém. Acad. Imp. des Sci. de St. Pétersbourg,' tom. xxxiv, No. 6, p. 104) quotes *E. unioniformis* as occurring in the *Productus giganteus* zone, and the coal-bearing beds below, of the Moscow coal-basin.

EDMONDIA JOSEPHA, *de Koninck*, 1842. Plate XXXIII, figs. 10—14.

EDMONDIA JOSEPHA, *de Koninck*, 1842. Foss. Carb. Belg., p. 68, pl. i, fig. 5.
— — *Bronn*, 1848. Nomencl. palæontol., p. 452.
— — *d'Orbigny*, 1850. Prodrome de Paléontol., p. 133.
Non — — *M'Coy*, 1855. Brit. Pal. Foss., p. 500.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 307.
— RUDIS, *Kirkby*, 1880. Quart. Journ. Geol. Soc., vol. xxxvi, p. 560.
— JOSEPHA, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., tom. xi, p. 30, pl. xi, figs. 30—32.
— ASTARTOIDES, *de Koninck*, 1885. Ibid., p. 36, pl. vii, figs. 33, 34.
— JOSEPHA, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 283.
Compare SCALDIA KICKSIANA, *de Ryckholt*, 1847. Mél. pal., 1e partie, pl. x, figs. 27, 28.
CARDIOMORPHA LACORDAIREANA, *de Ryckholt*, 1853. Ibid., 2e partie, p. 95, pl. xiii, figs. 5, 6.
EDMONDIA KICKSIANA, *de Koninck*, 1885. Ann. Mus. d'Hist. Nat. Belge, tom. xi, p. 32, pl. viii, figs. 7—9.
— LACORDAIREANA, *de Koninck*, 1885. Ibid., p. 33, pl. ix, figs. 1—4.
— PIRETI, *de Koninck*, 1885. Ibid., pl. ix, figs. 17—22; pl. xii, figs. 23—25, 32—34.

Specific Characters.—Shell of medium size, suboval, inequilateral, somewhat oblique, moderately gibbose. The contour—anterior, inferior, and posterior borders—of the shell forms an unbroken curve, which becomes less convex along the lower margin. The cardinal border is only slightly arched, and is relatively short. The umbones are inclined obliquely forwards, pointed, with the beaks twisted forwards and contiguous, raised above the hinge-line, excavated anteriorly, and situated in the anterior third of the hinge-line. The anterior end is much narrower from above downwards than the posterior, and is compressed. The rest of the valve is regularly and gradually curved with a moderate convexity, from which the umbones arise very gradually. The ligament is internal, small, and lodged in a narrow groove of small extent close to the edge of the hinge.

Interior.—The anterior adductor muscle-scar very large, shallow, and smooth, occupies a large portion of the anterior part of the valve. The posterior adductor scar is inconspicuous. The hinge is edentulous. Pallial lines entire, deep, and near the margin. The internal surface is smooth, with here and there indications of concentric sulci, crossed by very obscure, almost obsolete, but regular radiating lines.

Exterior.—The surface is ornamented with very fine concentric lines, some of which are elevated at equal intervals, and very distinct near the anterior margin, but become less marked towards the middle of the valve. Here and there are irregular, broad, very shallow, concentric sulci, but there is much individual variation. Shell thin.

Dimensions.—Pl. XXXIII, fig. 12, measures—

Antero-posteriorly	31 mm.
Dorso-ventrally	23 mm.
Laterally	18 mm.

Localities.—Scotland: the Upper Limestone series of Garngad Road, Glasgow; the Lower Limestone series of Langside and Dockra, Beith, Ayrshire; Lugton Water; the Calciferous Sandstone series of Fife, Bed No. 1 Limestone, east of St. Monans. Ireland: the Carboniferous Limestone of Firog, co. Limerick, and Carnteel, co. Tyrone.

Observations.—*Edmondia Josepha* was one of the two species originally referred to the genus by its author, de Koninck. The description was extremely meagre, but the external characters are described as "surface unie, recouverte d'un grand nombre de petites stries d'acroissement." Later on (*op. supra cit.*) de Koninck described several species which appear to me to differ in no characters of specific value from *E. Josepha*, which was re-described and figured in the same work. I have seen on several occasions the fine series of these shells in the Royal Natural History Museum of Brussels, and possess some well-preserved specimens in my own collection, and am of opinion that the five species, *E. Josepha*, *E. Kicksiana*,

E. Lacordaireana, *E. Pireti*, and *E. astartoides*, do not differ from each other more than one finds to be the case in a long series of examples of any species. De Koninck has, I think, made a mistake in his conception of *E. unioniformis* (*vide antea*, p. 293), and consequently his remarks on the differences between that species and *E. Josepha* cannot be accepted.

In *E. unioniformis* the anterior end is deeper from above downwards than the posterior, and the umbones are not much raised above the hinge-line; but in *E. Josepha* the anterior part of the shell is much narrower than the posterior, and the umbones in consequence appear to be much raised above it, and in addition *E. unioniformis* is less oblique and relatively more transverse than *E. Josepha*.

M'Coy gave a description, without figures, of some shells from the limestone of Lowick, Northumberland, under the name *E. Josepha*, but states in his remarks, "It is doubtful whether this species be perfectly identical with that of de Koninck, as it is concentrically ridged as well as striated." I have examined the specimens in the Woodwardian Museum, Cambridge, from Lowick which are labelled *E. Josepha*, and can see no ground for referring them to that species. One is very imperfect, but the other specimen is, I think, an example of *E. rudis*. The specimens are casts, and are too rugose, and have well-marked concentric grooves and ridges well marked, which is a character belonging to that species, while the interiors of *E. Josepha* are almost smooth (Pl. XXXIII, fig. 11).

I have obtained two specimens of this species from the No. 1 Marine Limestone of Mr. Kirkby, east of St. Monans, which he considers to be ninety-seven feet below the base of the Hurlet Limestone, and therefore belonging to the Calciferous Sandstone series. Mr. Kirkby has stated the presence of *E. rudis* in this bed, but I cannot find that species there myself.

EDMONDIA LOWICKENSIS, sp. nov. Plate XXXIII, figs. 1—4.

EDMONDIA PHASEOLINA, *M'Coy*, 1855. Brit. Pal. Foss., p. 502.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 283.

Specific Characters.—Shell of only very moderate size, transversely hatchet-shaped; narrowed anteriorly, expanded and truncate behind, oblique, moderately gibbose. The anterior end is produced forwards; narrowed by the approach of the inferior and superior margins; its border elliptically curved, passes below into the inferior margin, which is gently but regularly convex. The posterior border is obliquely cut from above downwards and backwards, nearly straight, making a well-marked obtuse angle with the hinge-line, and a rounded obtuse angle with the inferior border. The hinge-line is well curved in front, but nearly straight posteriorly. The umbones are small, tumid, pointed, incurved, and slightly twisted forwards, contiguous, elevated, and situated in the front part of the

middle third of the valve. Passing downwards from the umbo to the posterior inferior angle is an obscure rounded ridge, posterior to which the valve is rapidly compressed into the margin. Elsewhere the valve is regularly and evenly convex, the point of greatest curvature being high up about the centre of the transverse diameter. The dorsal slope is much compressed.

Interior.—The anterior adductor muscle-scar is round, shallow, deeper internally, where it is separated from the umbonal hollow by a slight ridge, and situated just within the margin of the antero-superior angle. The posterior scar is almost obsolete. The pallial line is entire and marginal. The hinge-plate has attached to it the elongate flattened ossicle which is placed in the hollow of the umbo, and represented in the cast by a narrow elongate slit. The interior of the shell is marked by shallow grooves and obsolete ridges, crossed by very fine regular radiating lines.

Exterior.—The surface is covered by very fine, regular, close, concentric lines of growth, with here and there an approach to sulcation.

Dimensions.—Fig. 1, Pl. XXXIII, from Thornliebank, measures—

Antero-posteriorly	32 mm.
Dorso-ventrally	23 mm.
Laterally	16 mm.

Localities.—England: one of the Limestones of Lowick and the Four Laws Limestone at the Coombs, Northumberland. Scotland: the Upper Limestone series of the Girtle quarry near Dalry, and Thornliebank; Index Limestone, Hullerhirst.

Observations.—This species was referred by M'Coy to Goldfuss's *Sanguinolaria phaseolina* from the Eifelian of the Continent. I cannot see any reason for such an opinion on comparing the suite of British specimens with the figure; and although the meagre description does to a certain extent coincide with that given by M'Coy, I have thought it wiser to give a new name to the species. Goldfuss says that his species has "striæ radiantes," which is not the case with the external shell of *E. Lowickensis*. Giebel gives the stage for Goldfuss's *S. phaseolina* as "Grauwachenformation," in his 'Repertorium zu Goldfuss's Petrefakten Deutschlands,' p. 84. The species is retained by Benshausen in his work 'Die Lamellibranchiaten des rheinschen Devon,' under the name *Janeia phaseolina*, and his figures amply demonstrate that Goldfuss's and M'Coy's shells are entirely different. The specimens on which M'Coy founded his description are from Lowick, and are in the Woodwardian Museum, Cambridge. They are all casts, and exhibit the internal characters very well. Fortunately a very fine example has been obtained by Mr. J. Neilson at Thornliebank, which has the test preserved (fig. 1, Pl. XXXIII), and I have obtained a small suite of specimens from the Girtle quarry near Dalry. Mr. J. Dunn has obtained a small fragment from the limestone at the Coombs, south of Redesdale village, which I regard as the Four Laws limestone,

which at this place is very fossiliferous, and the fauna, as far as has been ascertained at present, contains a very large percentage of the fossils collected at Lowick by the Rev. E. Jenkinson. The identical bed where the Lowick fossils were obtained is not now exactly known, but it is an important fact that the limestone at the Coombs, which lies about forty miles S.S.E. of Lowick, from its relation to the Redesdale limestone below and the Four Laws coal above, must be the Four Laws limestone; and this may lead to the identification of the fossil-bearing bed at Lowick.

The narrow extended anterior end and the squarely cut posterior border are very characteristic of the species; and in addition I regard the approach to an oblique ridge from the umbo to the posterior inferior angle, a feature very rare in the *Edmondidæ*, as an important specific character.

EDMONDIA OBLONGA, *Portlock*, sp., 1843. Plate XXIX, figs. 1—3 and 5.

SANGUINOLARIA OBLONGA, *Portlock*, 1843. Geol. Rep. Londonderry, p. 434, pl. xxxvi, fig. 2.
— — *Brown*, 1849. Illustr. Foss. Conch., p. 219, pl. xc, fig. 43.
? PANOPÆA COYANA, *de Ryckholt*, 1853, Mélanges paléontol. p. 31, pl. xi, figs. 7 and 8.
SANGUINOLITES OBLONGA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 223.
EDMONDIA OBLONGA, *M'Coy*, 1855. Brit. Pal. Foss., p. 501, pl. 3 F, fig. 10.
— UNIONIFORMIS, *Salter*, 1861. Mem. Geol. Surv. Gt. Brit., Iron Ores Gt. Brit., pt. 3, p. 221, pl. i, fig. 29.
— OBLONGA, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasg., vol. iii, Suppl., p. 51.
— — — 1876. Carb. Foss. West of Scotland, p. 54.
— — *Roemer*, 1876. Lethæa Palæoz., pl. xliv, fig. 5.
— — *Bigsby*, 1878. Thesaurus Devonico-Carb., p. 307.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 283.

Specific Characters.—Shell of moderately large size, transversely oblong, tumid, very inequilateral, slightly oblique, margins subparallel. The anterior end short and gibbose, and narrower in the dorso-ventral direction than the posterior. The anterior border is curved, its junction with the hinge-line above often approaching to a rounded right angle; below, the curvature sweeps broadly round into the inferior border, which is convex at each extremity, but nearly straight for the greater part of its extent. The posterior border is very bluntly rounded, approaching to angulation at the junction with the upper and lower borders, so that the posterior end is subquadrate. The hinge-line is very nearly straight and prolonged posteriorly. The umbones are moderately large, tumid, curved, slightly

raised, the beaks being twisted forwards and inwards, contiguous, and situated in the anterior quarter of the shell. Lunule and escutcheon absent. The valves are regularly and convexly swollen, but in very large specimens there is an obscure approach to angulation along the line where the shell becomes compressed to form the posterior slope.

Interior.—The anterior adductor muscle-scar is large, shallow, and round, and is situated within the antero-superior angle of the valve, encroaching largely upon the umbonal hollow; the posterior is large and rounded, shallow, situated on the hollow of the dorsal slope, remote from the margin. Above this and at the extreme end of the hinge-plate, and just within the margin of the valve, is a small round scar for an accessory muscle. The pallial line is entire and very remote from the margin. The hinge consists of a plate thickened on its external border, which is placed at right angles to the valve, and formed by the valve being bent acutely on itself. This leaves, in casts, two parallel grooves, which become shallower as they pass backwards, and terminate at some distance from the posterior end. The hinge-plate is apparently edentulous. The internal surface as seen in casts shows numerous concentric ridges and sulci, which become broader and further apart as they approach the lower margin.

Exterior.—The surface is ornamented with bundles of fine concentric striæ, separated into groups by well-marked concentric folds and ridges, which are broader near the lower margin.

Dimensions.—Pl. XXIX, fig. 5, the type of *Sanguinolaria oblonga*, Portlock, measures—

Antero-posteriorly	56 mm.
Dorso-ventrally	38 mm.
Elevation of valve	15 mm.

Locality.—England: in one of the beds of limestone, Lowick; the Coombs limestone, Redesdale, Northumberland. Wales: below the Farewell Rock of Glan Rhymney and Beaufort, South Wales. Scotland: the Lower Limestone series of Beith, Ayrshire. Ireland: in black limestone, Errigle Keerogue, co. Tyrone.

Observations.—When M'Coy described his new species of *E. oblonga* he was aware of the close similarity of his shell to that described by Portlock. He states (*op. sup. cit.*, p. 501), "The *Sanguinolaria oblonga*, Portlock, . . . seems to be more compressed, to have a more defined posterior slope, and to have large regular imbrications in addition to the small concentric markings. They may, however, be identical."

A close comparison of the types of each author, which I am fortunately able to figure through the kind permission of Sir A. Geikie and Professor McKenny Hughes, shows the identity of *Sanguinolaria oblonga*, Portlock, Pl. XXIX, fig. 5, with *Edmondia oblonga*, M'Coy, Pl. XXIX, fig. 1, the differences noted by M'Coy

being largely due to the fact that M'Coy's specimens were all casts of the interior, and Portlock's specimen is a cast of the exterior. The greater definition of the posterior slope in the latter example is due to age and condition.

M'Coy gave the name var. *B. brevis* to a shorter form of this species. He says, "The var. *B. brevis* differs in nothing but the shorter figure above given, and I have seen most of the intermediate grades." I do not, however, propose to retain the variety.

E. oblonga might be in a few cases mistaken for *E. grandis*, but the former is less orbicular, less oblique, and has its borders almost parallel, and the posterior end more produced and oblong. It is much less orbicular and more regularly oblong than *E. Lyellii*.

EDMONDIA LYELLII, sp. nov. Plate XXIX, fig. 4; Plate XXXI, figs. 1—5.

Specific Characters.—Shell of moderately large size, gibbose, triangularly ovate, inequilateral. The anterior end is depressed, and narrowed from above downwards, gradually compressed, the border elliptically curved, passing with regular sweep into the lower margin, which is extended and only slightly convex, for the greater part of its extent, but becomes more curved behind, where it passes evenly into the posterior border. The latter is blunt, almost straight, and somewhat narrowed by the depression of the upper border, which it meets at an obtusely rounded angle. The hinge-line is arched and extended behind. The umbones are large, gibbose, incurved and twisted forwards, contiguous, elevated above the hinge-line, and situated in the front part of the middle third of the valve. The valves are regularly convexly curved, but there is some flattening along the dorsal slope and towards the posterior end of the valve. There is a well-marked groove above and parallel with the hinge-line for the external ligament.

Interior.—The anterior adductor muscle-scar is large, ovate, placed well within the margin of the shell, in the hollow of the valve, at a level with the antero-superior angle. The posterior adductor scar is large, shallow, and oval, situated near the greater superior angle, remote from the margin. The pallial line is remote from the margin and entire. The hinge-plate is thick; to the inner edge of it was attached a plate, represented in casts by a narrow groove, which was directed downwards and outwards. This groove is deep and wide in front, but becomes narrow and shallower behind.

Exterior.—The surface is covered with fine concentric lines of growth, which are elevated into fine ridges in front and at the margin, which may appear at times almost subimbricate. Here and there over the surface of the shell are

irregularly placed concentric ridges or depressions; above these was a finely punctate periostracum. Shell thick.

Dimensions.—Fig. 4, Pl. XXXI, a perfect right valve, measures—

Antero-posteriorly	65 mm.
Dorso-ventrally	58 mm.
Elevation of valve	18 mm.

Localities.—England: Northumberland, the limestone of Lowick. The Middle limestone, West Witton, Wensleydale; the limestone of Poolvash, Isle of Man. Scotland: Lower Limestone series of Newfield, High Blantyre; of Craigenglen, Campsie; Swinlees; Auchenskeith; Dalry; Broadstone, Beith; McDonald Limestone series, Muirkirk; Craighall, Fife. Ireland: the Carboniferous Limestone of Galway.

Observations.—This species is founded on numerous very fine examples from the localities named above, and has externally a strong resemblance to the genus *Cardiomorpha*, but the possession of an ossicle attached to the hinge-plate and the different position of the anterior adductor muscle-scars separate it from that genus, the position of the anterior adductor muscle being lower down and more remote from the margin than obtains in *Cardiomorpha;* the shell is also thicker, and the surface-markings stronger than in that genus. Fig. 5, Pl. XXXI, is a very fine example from Craighall, Fife, and is in the Museum of Science and Art, Edinburgh, and I am indebted to Dr. Traquair for permission to figure the specimen. Fig. 1, Pl. XXXI, a specimen from the limestone of Beith, Ayrshire, in the possession of Mr. R. Craig, shows that the species possessed a periostracum with spotted markings, of which a view is given, Pl. XXXI, fig. 1 *a*. At least one other species of the genus, *E. sulcata*, has the same character; but owing to the fact that specimens of any of the species rarely occur which have the periostracum preserved, indeed the majority are found in the condition of internal casts, this character cannot be yet stated to be universal in the species of this genus.

Fig. 3, Pl. XXXI, a specimen from Beith, is in the cabinet of Dr. John Young, of the Hunterian Museum, Glasgow, and shows the very thick and deep groove for the ossicle, and the adductor muscle-scars and pallial line.

Fortunately, I have been able to isolate the hinge in the specimen, fig. 2, Pl. XXXI, belonging to the Geological Survey of Ireland; and fig. 4 *a*, Pl. XXXI, a shell belonging to the Geological Society of Glasgow, also shows this portion of the shell very well. Compared with other species of *Edmondia*, the shell of *E. Lyellii* was very thick, very much thicker than that of *E. primæva*, a much larger shell.

From *E. oblonga*, *E. Lyellii* is easily distinguished by its greater obliquity and longer, narrower anterior end, and the orbicular shape of the shell.

Dr. Traquair informs me that the specimen from Craighall, Fife, bears a label, in Fleming's handwriting, *Venerupis Lyellii*. I have, therefore, adopted this specific name.

EDMONDIA RUDIS, *M'Coy*, 1851. Plate XXVIII, figs. 8—14.

? CORBULA? SENILIS, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209, pl. v, fig. 1.
— ? — *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 83.
LEPTODOMUS SENILIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 67.
CARDIOMORPHA SENILIS, *d'Orbigny*, 1850. Prodrome de Paléontol., p. 132.
EDMONDIA RUDIS, *M'Coy*, 1851. Ann. Mag. Nat. Hist., ser. 2, vol. xii, p. 190.
— — *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 202.
LEPTODOMUS? SENILIS, *Morris*, 1854. Ibid., p. 206.
EDMONDIA RUDIS, *M'Coy*, 1855. Brit. Pal. Foss., p. 502, pl. 3 F, fig. 9.
— — *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 51.
— — *Armstrong, Young, and Robertson*, 1876. Cat. Western Scottish Fossils, p. 54.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 307.
LEPTODOMUS SENILIS, *Bigsby*, 1878. Ibid., p. 307.
EDMONDIA RUGATA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. xi, p. 31, pl. ii, figs. 1, 2.
— UNIONIFORMIS, *de Koninck*, 1885. Ibid., p. 29, pl. ii, figs. 32—36.
— RUDIS, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 283.
LEPTODOMUS SENILIS, *Etheridge*, 1888. Ibid., p. 284.

Specific Characters.—Shell subquadrate, somewhat transverse, gibbose, inequilateral, slightly oblique. The anterior side is very short, abruptly compressed, and its margin almost straight in the upper portion, but becoming curved in the lower to pass into the inferior border, which is only very gently convex. The posterior end is broader than the anterior, and is obliquely and very bluntly curved, the upper and lower angles being obtusely rounded.

The hinge-line is somewhat arcuate in front, but nearly straight and somewhat produced posteriorly.

The umbones are comparatively large and obtuse, their apices incurved and twisted forwards, contiguous, raised above the hinge-line, and situated at about the anterior fourth of the hinge-line. Passing backwards from the apex of the umbo, and almost parallel to the hinge-line, is a well-marked ridge, becoming lost near the posterior end, which separates a smooth, narrow, elongate hollow from the dorsal slope.

The valve is regularly convex from above downwards and strongly curved. From before backwards the convexity is a little less than in the vertical diameter, but there is an obscure approach to angulation along two lines before and also behind, which pass from the umbo towards the antero-inferior and postero-inferior angles respectively. The greatest convexity of the valve is a little above the median transverse diameter.

Interior.—The anterior adductor muscle-scar is large and shallow, situated remote from the margin in the hollow of the umbonal swelling. The posterior, even more obscure, is situated in the hollow of the dorsal slope. There is an accessory posterior muscle-scar placed at the posterior extremity of the narrow elongate groove, parallel to the edge of the valve. The pallial line is almost obsolete, but entire. The hinge is shown by casts to be edentulous. There is an elongate flattened ossicle which is directed outwards and downwards into the umbonal cavity. The internal surface shows obscure concentric grooves and rounded ridges, but is on the whole smooth.

Exterior.—The surface is ornamented with well-marked, unequal concentric, rugose folds and grooves, which are, however, less marked in front and behind, where the shell has a tendency to become smooth.

Dimensions.—Fig. 8, Plate XXVIII, measures—

Antero-posteriorly	33 mm.
Dorso-ventrally	28 mm.
From side to side	19 mm.

Localities.—England: one of the Limestones of Lowick, the Coombs Limestone, near Redesdale, and Lewisburn, Northumberland; the Carboniferous Limestone of Thorpe Cloud and Castleton, Derbyshire; the Cayton Gill beds, near Harrogate, Millstone-grit series; the Pennystone Ironstone, Coalbrookdale; the Upper Carboniferous Limestone of Poolvash, Isle of Man. Scotland: Lower Limestone series of Newfield, High Blantyre; Langside, Beith; Craigenglen; and Hind Og Glen, Dalry; Archerbeckburn, Canonbie, Roxburgh.

Observations.—Since the type specimen of *Corbula ? senilis*, Phillips, has disappeared, and the figure is poor and the description meagre, I think there may be some little doubt of the species being identical with that described later by M'Coy as *Edmondia rudis*. Under the circumstances, however, I am compelled to adopt the later name, and to place Phillips's shell as a doubtful synonym, since this species has never been redescribed or apparently adopted, except in mere catalogues, probably on account of the loss of the type.

This species is characterised by its rugose appearance and quadrate gibbose form even in casts. In the West of Scotland, in the nodules of the shales of the Lower Limestone series, it is perhaps the most common species of the genus; but it also is found in the upper beds of the Carboniferous Limestone of Derbyshire and the Isle of Man, and as a dwarfed form in the Pennystone Ironstone of the Coal-measures of Coalbrookdale. De Koninck seems always to have misunderstood the characters of Phillips's *E. unioniformis*, and I am of opinion that the shells figured by him in his latter work as specimens of that species are small examples of *E. rudis*, and I have no hesitation whatever in placing *E. rugata* of the same author as a synonym of M'Coy's species. Speaking of his *E. rugata*,

de Koninck says "Cette espèce a de grands rapports avec l'*Edmondia rudis*, F. M'Coy, qui s'en distingue par la situation antérieure de ses crochets et la forme beaucoup plus arrondie des extrémités de son bord cardinal." A large series of specimens of *E. rudis* show that the actual position and degree of elevation of the umbone is variable and depends largely on the stage of growth. In old shells the umbones are less anterior and more elevated than when young. M'Coy's type specimen is one which had only attained to medium growth, while the type of de Koninck's *E. rugata* is much more fully grown.

The Scotch examples are nearly all in the condition of internal casts. These show the elongate narrow groove in the umbonal cavity which lodged the internal ossicle, and other details of the interior. The internal surface was often as rugose as the external, owing to the extreme thinness of the shell; but the fine, sharp lines of growth which are placed all over the rugged external surface are, of course, wanting.

The wide horizontal and vertical distribution of this species is to be noted. While few of the Lamellibranchs which occur in Carboniferous Limestone series of Scotland are found in the Carboniferous Limestone of Yorkshire and Derbyshire, *E. rudis* seems to have flourished equally well during the different conditions under which each deposit was laid down, for it attains a full degree of development in each locality, and only becomes dwarfed when it is found at a much higher horizon, the Coal-measures.

EDMONDIA COMPRESSA, *M'Coy*, 1844. Plate XXXIII, figs. 5—9.

EDMONDIA ? COMPRESSA, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 52, pl. xiii, fig. 10.
CARDIOMORPHA COMPRESSA, *d'Orbigny*, 1850. Prodrome de Paléontol., p. 133.
EDMONDIA COMPRESSA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 202.
— — *M'Coy*, 1855. Brit. Pal. Foss., p. 500.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 307.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 283.
Compare — ? PRÆLONGA, *de Koninck*, 1885. Ann. Mus. d'Hist. Nat. Belgique, p. 50, pl. vii, fig. 21.

Specific Characters.—Shell transversely ovate, very inequilateral, compressed, slightly oblique. The anterior end is very short, but deep, and only slightly convex. The margin which forms a right angle with the hinge-line, descends at first almost in a straight line, and then becomes very convex, sweeping round into the inferior margin without a break. The inferior border is produced and convex, especially behind, where it rises to join the posterior end, which is bluntly rounded. The hinge-line is long and gently arched.

The umbones are of moderate size, elongate, tumid, twisted inwards and forwards, only slightly raised above the hinge-line and situated very far forwards, and excavated in front. The valves are evenly and gently convex, except in front, where there is a rapid compression. The dorsal slope is very gentle, and the posterior end is narrowed by the approach of the dorsal and ventral border.

Interior.—Few details have been yet observed. The interior of casts is almost smooth. The hinge-plate is furnished with the internal, elongated, expanded ossicle which obtains in other species of the genus.

Exterior.—The surface is covered with numerous very fine regularly arranged concentric lines of growth. Shell thin.

Dimensions.—Pl. XXXIII, fig. 7, M'Coy's type specimen, measures—

Antero-posteriorly	50 mm.
Dorso-ventrally	33 mm.
Elevation of valve	6 mm.

Localities.—England : the Carboniferous Limestone of Thorpe Cloud and Castleton, Derbyshire ; Carboniferous Limestone, Isle of Man (M'Coy). Ireland : Cork.

Observations.—*E. compressa* differs from *E. unioniformis*, being more transverse, less gibbose, and more oblique, having the umbones more anterior and more prosogyrous, and the surface-markings much finer than in the latter species.

E. compressa was described twice by M'Coy, *op. supra cit.* The type which served for description is preserved in the Griffith Collection of the Science and Art Museum, Dublin ; and I am fortunately able to refigure this specimen, Pl. XXXIII, fig. 7. The second description was evidently based on a specimen from the Carboniferous Limestone of the Isle of Man, but was accompanied by no figure. In the later description, a much fuller one than the former, the dorsal margin is said to be nearly straight, but in the original account it was described as " obtusely rounded." The latter is correct, for although the type specimen is incomplete posteriorly, observation shows that the lines of growth representing the contour of the shell in a young state are distinctly rounded. Allusion is also made to a lunette, but no lunule occurs in the genus *Edmondia*.

E. compressa more closely resembles *E. transversa* than any other species of the genus. The latter is more convex ; its upper and lower margins are subparallel and the posterior end is truncate, and even in casts have well-marked concentric ridges and sulci. The umbones are somewhat less anterior, and the shell only attains to about half the size of *E. compressa*.

Edmondia (?) *prælonga*, de Koninck, has somewhat the general character of *E. compressa*, but it has its dorso-ventral diameter much shorter ; but this is the case in young specimens of the latter species, as may be noted by observing some of the earlier lines of growth in the type specimen.

EDMONDIA PRIMÆVA, *Portlock*, sp., 1843. Plate XXIX, figs. 6—8; Plate XXX, figs. 1—3.

LUTRARIA PRIMÆVA, *Portlock*, 1843. Geol. Rep. Londonderry, p. 441, pl. xxxvi, fig. 5.
— PRISCA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 52, pl. xii, fig. 4.
— PRIMÆVA, *Morris*, 1845. Cat. Brit. Foss., p. 90.
CARDIOMORPHA PRISCA, *d'Orbigny*, 1850. Prodrome de Paléontol., p. 133.
EDMONDIA PRISCA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 202.
MYACITES? TENUILINEATA, *Etheridge*, 1873. Geol. Mag., vol. x, p. 299, pl. xii, fig. 7.
EDMONDIA TENUILINEATA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 307.
CARDIOMORPHA TENUILINEATA, *Bigsby*, 1878. Ibid., p. 301.
LUTRARIA TENUILINEATA, *Etheridge*, 1885. Brit. Foss., pt. 1, Palæozoic, p. 285.
MYACITES PRIMÆVA, *Etheridge*, 1885. Ibid., p. 286.
BROECKIA PRISCA, *de Koninck*, 1885. Ann. Mus. d'Hist. Nat. Belgique, tom. xi, p. 20, pl. ii, figs. 14, 15.
— LATISSIMA, *de Koninck*, 1885. Ibid., p. 20, pl. ii, fig. 13.
— KAYSERI, *de Koninck*, 1885. Ibid., p. 25, pl. v, figs. 13, 14.
— NORMALIS, *de Koninck*, 1885. Ibid., p. 22, pl. v, figs. 3, 15, 16.

Specific Characters.—Shell ovate, transverse, moderately convex, very inequilateral. The anterior end is small, but deeper in the dorso-ventral diameter than the posterior, its border regularly rounded, passing with a continuous sweep into the inferior margin, which is convex and extended. The posterior border is narrowed by the approach of the upper and lower margins, and is bluntly rounded. The hinge-line is long and gently arched, somewhat depressed posteriorly. The umbones are large, elongated, incurved, and slightly twisted forwards, contiguous, elevated, and situated in the anterior fourth of the valve; well marked off in front from the compressed antero-superior angle, but behind they are continuous with the general curvature of the valve. The dorsal slope is not marked off from the rest of the shell. The upper margin is simple and erect, and comes in contact with its fellow. There is a small elongate groove for the external ligament for a short distance between the umbonal swellings. No escutcheon or lunule.

Interior.—The anterior adductor muscle-scar is shallow and placed high up. The posterior is oval and is situated within the dorsal slope, remote from the posterior end. The pallial line is entire. The hinge is edentulous, with a curved ridge of shell situated some little distance within the margin, represented in casts by a groove.

The Exterior.—The surface is ornamented by concentric lines, fine, distinct in

front, but becoming less well marked posteriorly, with here and there a deeper concentric groove. Shell of moderate thickness.

Dimensions.—Fig. 2, Plate XXX. The type of M'Coy's *Lutraria prisca* measures—

Antero-posteriorly	97 mm.
Dorso-ventrally	64 mm.
Elevation of valve	20 mm.

Localities.—England: the Carboniferous Limestone of Castleton and Thorpe Cloud, Derbyshire. Scotland: Lower Limestone series of Langside, Beith; Cousland, near Edinburgh. Ireland: the Carboniferous Limestone of Millicent, Clane, co. Cork; Doohybeg, co. Limerick.

Observations.—The original specimen of *Lutraria primæva,* Portlock, has disappeared, but the figures and description afford sufficient evidence of the characters of the species. Apparently another shell has been placed in the collection under the name, which belongs to quite a different genus, and this quite accounts for the fact that Mr. Etheridge (*op. supra cit.*) refers Portlock's shell to the genus *Myacites.*

M'Coy considered that his *Lutraria prisca* was less transverse that *L. primæva,* and that the ventral margin was more convex, which is true for the type, which was a much larger example than that of Portlock. When, however, the lines marking the several stages of growth are examined in the shells with a flattened ventral border, it is seen that when young and in the immature stage the ventral border was very much rounded, and the flattening only occurs later on; and it is to be noted also that this flattening of the ventral border is accompanied by a compression of the valves, as if regular growth had been in some way interfered with. Unfortunately, I have not a large number of examples to study, but specimens with and without a flattened lower border occur together in the same beds, and the latter never exhibit the irregularities of growth. I have, therefore, considered M'Coy's species to be synonymous with the *Edmondia primæva,* Portlock, sp.

De Koninck has adopted M'Coy's specific name without any reference to Portlock's specimen. He describes three other species which I think must be regarded as synonymous. *Broeckia latissima* is said to differ from *B. prisca* "par sa moindre épaisseur, par sa différence dans les rapports entre la hauteur et la largeur et par ses crochets plus antérieurs."

The dimensions of *B. latissima* are given as: length 106 mm., height 71 mm.; that of *B. prisca,* from a very imperfect example: length 95 mm., height 64 mm.; which are at once seen to be very fairly identical. *B. Kayseri* is said to differ in the same character from *B. latissima,* the dimensions of the former being; length 95 mm., height 60 mm. Of *B. normalis* he remarks, "Le *Broeckia normalis* a une

grande ressemblance avec le *Broeckia Kayseri*, dont les crochets sont plus petits, le côté postérieur plus allongé, et les bords plus arrondis." I do not think that the characters here relied upon for specific determination and for the erection of four species are more than the normal amount of variation to be found in a species which attains a large size. It may be mentioned that de Koninck states that the whole four species occur at one horizon, that is, in his étage II. With the exception of *B. prisca*, all the others are said to be rare.

For such a large shell the groove for the external ligament is very small, and it is very probable that, as in other members of the family *Edmondidæ*, there was some internal ligament, for the muscle-scars are very shallow and inconspicuous, and do not show any indications of great strength.

I have no doubt that the shell described as *Myacites? tenuilineata* by R. Etheridge, jun., is a somewhat undergrown example of Portlock's species. This is the only Scottish example of the species that I know. Mr. Etheridge states, "Surface with numerous close, thin, concentric lines, which here and there show traces of granulation." Further on he says, "With a good lens traces of the granulation can be detected. This would still further tend to ally it with *Myacites*." This author was probably not aware that this character had been shown to be present in *Edmondia* by King.

EDMONDIA GIGANTEA, *de Koninck*, sp., 1885. Plate XXX, figs. 4, 4 *a*.

BROECKIA GIGANTEA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. xi, p. 22, pl. v, figs. 1, 2.
— DEPRESSA, *de Koninck*, 1885. Ibid., p. 22, pl. v, figs. 7, 8.
— SUBÆQUALIS, *de Koninck*, 1885. Ibid., p. 21, pl. iii, figs. 19, 20.

Specific Characters.—Shell large, ovately rhomboidal, compressed, only slightly convex, inequilateral; the anterior end is small but deep, rapidly compressed into the edge of the valve, especially at the antero-superior angle, which is erect and bluntly angular. The anterior border is regularly rounded, and passes with a sweep into the ventral edge, which is only slightly convex, and subparallel with the dorsal border. The posterior border is almost truncate and subquadrately rounded at each extremity. The hinge-line is long and gently arcuate. The umbones are elongate, compressed, small, strongly incurved, and twisted on themselves, contiguous, and situated in the anterior quarter of the valve. They are raised above the hinge-line, and are well marked off from the valve in front, where they are on a much higher level than the front part of the hinge-line; but behind they form a compressed elongated swelling on each side of and above the

hinge-line, but continuous below with the general convexity of the valve. The valves are gently and regularly convex from before backwards and from above downwards. Internal to the umbonal swelling is a narrow, depressed, elongated trench, in the anterior part of which was placed the external ligament.

Interior.—Unknown.

Exterior.—The surface is ornamented with groups of fine concentric lines of growth, separated by somewhat deeper grooves and more conspicuous in the lower and newer portion of the valve; the umbonal region is almost smooth. The greatest convexity is about the centre of the valve; shell thin.

Dimensions.—Fig. 4, Pl. XXX, measures antero-posteriorly (estimated) 95 mm., dorso-ventrally 71 mm., side to side 39 mm.

Localities.—Ireland: the Carboniferous Limestone of Little Island, co. Cork.

Observations.—This species does not seem to have been described before from Great Britain. Fig. 4, Pl. XXX, is in the cabinet of Mr. J. Wright, of Belfast, and was obtained from Little Island, co. Cork.

De Koninck has described three species under the names *Broeckia gigantea*, *B. depressa*, and *B. subæqualis*, the two former of which I have no hesitation in regarding as one species. Of *B. depressa* that author says, "Cette grande et belle espèce se distingue facilement de ses voisines, et particulièrement du *Broeckia gigantea*, par sa forme moins ovale et par sa faible épaisseur relativement à sa longeur." *B. gigantea* is said to have the following proportions, but a large part of the posterior end is absent: "longeur 114 mm., hauteur 75, épaisseur 60 mm. *B. depressa*, l. 115, h. 72, é. 40."

E. gigantea is less convex, more quadrate, and much deeper in the dorso-ventral diameter than *E. primæva;* it wants the transverse sulcations which characterise *E. expansa.*

EDMONDIA GOLDFUSSI, *de Koninck.* Plate XXXII, figs. 7—11.

EDMONDIA GOLDFUSSI, *de Koninck*, 1885. Ann. Mus. d'Hist. Nat. Belgique, tom. xi, p. 31, pl. xii, figs. 11, 12.

Specific Characters.—Shell of medium size, broadly ovate, slightly oblique, convex, inequilateral. The anterior end is deep from above downwards, short, compressed, with its border almost straight above, but the curvature below is that of an arc of a circle, where it sweeps round into the ventral margin, which is much less convex in its median portion, but behind curves upwards to pass into the posterior border, which is regularly rounded, almost semicircular. The hinge-line is arched, forming more or less of an angle with the anterior edge, but behind

forms a continuous curve with the posterior border. The umbones are tumid, short, somewhat twisted forwards, forming the highest part of the shell, and are placed in the anterior quarter of the valve.

The valves are regularly convex from above downwards and before backwards, the point of greatest convexity being about the centre of the antero-posterior diameter, which passes through the junction of the upper and middle thirds of the valve. There is a small, narrow groove above the hinge-edge for the external ligament.

Interior.—The muscle-scars are normal in position, and the hinge-plate is furnished with a comparatively large ossicle, which projects outwards into the cavity of the umbo. The pallial line is entire. The internal surface is for the great part smooth, but there are some irregular concentric sulci towards the lower margin.

Exterior.—The surface is covered by very fine concentric lines of growth, best marked at the anterior edge of the valve, but becoming almost obsolete over the posterior half of the shell. Here and there towards the lower margin are irregular, shallow, concentric grooves. Shell thin.

Dimensions.—Pl. XXXII, fig. 7, measures—

Antero-posteriorly	33 mm.
Dorso-ventrally	25 mm.
Elevation of valve	10 mm.

Localities.—England: the Carboniferous Limestone of Thorpe Cloud and Castleton, Derbyshire.

Observations.—This species occurs in fair abundance at Castleton and Thorpe Cloud, and is characterised by the regularly rounded form of its posterior end and its broad anterior extremity, and the fineness of the concentric striæ on the surface.

It is much shorter and comparatively more oblique than *E. unioniformis*, to which species it appears to me to have a closer affinity than to any other.

De Koninck gives the comparative dimensions of his type specimens as: "longeur 36 mm., hauteur 16 mm., épaisseur 22 mm." It will be seen on referring to his figure that hauteur 16 mm. is a misprint for 22 mm. This species was obtained from the Upper or Viséan beds of the Carboniferous Limestone of Belgium.

EDMONDIA ARCUATA, *Phillips*, sp., 1836. Plate XXXV, figs. 1—4, 6—10.

SANGUINOLARIA ? ARCUATA, *Phillips*, 1836. Geol. York., pt. 2, p. 209, pl. v, fig. 4.

— ? — *Morris*, 1843. Cat. Brit. Fossils, 1st edit., p. 100.

SANGUINOLITES ARCUATUS, *M'Coy*, 1844. Syn. Carb. Foss. Ireland, p. 48.

EDMONDIA ARCUATA, *King*, 1849. Monogr. Permian Foss., p. 164.
SANGUINOLITES ARCUATUS, *Brown*, 1849. Illustr. Foss. Conch., p. 219, pl. xc, fig. 16.
LYONSIA ARCUATA, *d'Orbigny*, 1850. Prodrome de Paléontol., p. 128.
SANGUINOLITES ARCUATUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 223.
EDMONDIA ARCUATA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 307.
— — *Lebour*, 1878. Outlines Geol. Northumberland and Durham, p. 121.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 283.

Specific Characters.—Transversely elongate, elliptically almond-shaped, very inequilateral, gibbose, slightly oblique. The anterior end is very short, depressed, compressed much below the level of the umbones, and has its border erect, almost semicircular in curvature, passing into the inferior margin, which is elongate, and almost straight for the greater part of its extent, but is curved upwards at the posterior end. The posterior margin is bluntly but regularly rounded. The hinge-line is long and gently arched. The umbones are small, elongate, incurved, contiguous, not much raised above the body of the shell, and placed in the anterior fifth of the valve, much excavated anteriorly. The valves are regularly convex from before backwards and above downwards, so much hollowed out anterior to the umbones as to be concave. The dorsal slope is broad but only slightly depressed, and in old specimens there is the slightest approach to obtuseness along a line passing from the umbo to the postero-inferior angle. Owing to the narrow anterior end and the obliquity of the valve, the posterior end has a false appearance of being somewhat expanded from above downwards.

Interior.—The anterior adductor muscle-scar is large, triangularly ovate, and situated remote from the margin in the hollow at the base of the anterior limb of the umbo, bounded behind by a shallow groove. Immediately above this, and in the hollow of the anterior limb of the umbo, are some deep accessory muscle-scars. The posterior adductor is large, shallow, and placed close to the postero-superior angle. In casts, external to the hinge-plate, is an elongate narrow groove, expanding and becoming shallower posteriorly, in which lodged the ossicle peculiar to the genus. In well-preserved casts there is also, posterior to the umbones, an elongate depression, marked off by a curved line, which starts immediately behind the umbo, and, turning outwards at first, returns to the edge of the ridge, which is above the slit for the ossicle and probably represents a thickening of the roof of the umbo for the support of this process. Hinge edentulous. The interior of the shell has markedly shallow concentric grooves and ridges. Pallial line entire.

Exterior.—The surface of the valve is covered by numerous, distinct, fine concentric lines of growth, with here and there a deeper sulcus, all of which commence and end in the upper margin of the shell, curving completely round each end. Shell very thin.

Localities.—England: the Redesdale Ironstone of Redesdale and Bellingham, Northumberland.

Dimensions.—Pl. XXXV, fig. 3, a medium-sized example, measures—

Antero-posteriorly	42 mm.
Dorso-ventrally	20 mm.
From side to side	16 mm.

Observations.—The type of this species, described under the name *Sanguinolaria ? arcuata* by Phillips, is stated to have come from Harelaw, Northumberland. There is a locality named Harelaw Hill Quarry in Scotland, just over the border, about a mile west of Penton, which yields Carboniferous Lamellibranchs, and which may possibly be the locality whence the original of this shell was obtained. Professor Lebour thinks that Harelaw may be a misprint for Hareshaw (*op. supra cit.*, p. 126), which is quoted by d'Orbigny as a locality for Carboniferous fossils in Northumberland. *E. arcuata* is a fairly common fossil at the old ironstone mines of Redesdale, occurring chiefly in the form of casts, which show the details of the interior very well, but casts of the exterior are also to be found in a band of shelly ironstone which occurs in the series.

This species differs from most of the others of the genus in the shape and position of the anterior adductor muscle-scar. This is very far inside the margin, large, surmounted by small accessory scars, and situated quite in the umbonal hollow. *E. scalaris*, a very different shell, is the only other species of the genus where this arrangement obtains.

The elliptically pointed end is very characteristic, being proportionally much longer than obtains in any other species of the genus, and this character serves at once to distinguish the shell from *E. Pentonensis*, which has a short but deep anterior end.

Pl. XXXV, fig. 7, is a fine cast of both valves, and shows the relation of the hinge-line to the slits on each side, *a* and *b*, which received the sharp extended ridge (ossicle) or outer edge of the hinge-plate, and *c c*, the hollows for the leaf-like thickening of the posterior part of the roof of the umbonal cavity. There was not any space between this process and the shell, and its function probably was merely to strengthen the base of origin of the hinge-plate and its peculiar process which projected outwards into the cavity of the umbo. How far these processes extended outwards from the hinge-plates of this species is well seen in this specimen, because, being a cast, the actual edge of the hinge occupied the grooves immediately on each side of the median line, which are seen to be internal to and below the ossicle. The depth of the process of shell in the roof of the umbonal cavity varies; in some specimens it is only just visible, though the line bounding its outer edge may be sharply defined, and in a few examples the line passes across the umbo to its anterior edge. I do not think that this space could

have served as an attachment for muscle or ligament; it is not roughened or punctate, but is the representative probably of the winged process described by King as present in *Edmondia sulcata* ('Mon. Permian Fossils,' p. 164, pl. xx, figs. 3 and 4).

The shape and contour of a great many of the specimens obtained at Redesdale are misleading. Very frequently the cast has not been completely filled, and the contours of the anterior and posterior extremities are often made to appear as if truncated and obtuse. This condition can be easily recognised by tracing the concentric markings which are present both on the exterior and anterior, which will be found to terminate abruptly on the anterior and posterior margins, instead of curving round, in each case, to end in the upper border of the valve. Occasionally good impressions of the exterior can be obtained from a bed of shelly calcareous ironstone which occurs in the series of the Redesdale Ironstone Measures.

EDMONDIA PENTONENSIS, sp. nov. Plate XXXV, figs. 12—16.

Specific Characters.—Shell of medium size, transversely oblong-oval, elongate, compressed, upper and lower margins sub-parallel, very inequilateral. The anterior end is short, compressed, but deep from above downwards, its border regularly and almost semicircularly curved. The inferior margin is long, very slightly convex; the posterior border is bluntly rounded below and curved above, but the curvature of its upper portion is the arc of a much larger circle than that of the lower part. The hinge-line is much shorter than the greatest length of the shell, and almost straight, slightly elevated posteriorly. The umbones are small, incurved, and twisted forwards, contiguous, raised above the anterior end of the shell, but not elevated above the hinge-line, and situated in the anterior fifth of the shell.

The valves are regularly but very slightly curved from above downwards and before backwards. The posterior end is somewhat expanded, being deeper than the anterior in a dorso-ventral diameter. There is a narrow elongate groove for the external ligament, parallel to and just above the hinge-line.

Interior.—The arrangement of the muscle-scars has not been seen. The hinge is edentulous, and has a long narrow ridge projecting outwards into the umbonal cavity.

Exterior.—The surface is covered with numerous fine lines of growth, arranged concentrically, with several shallow, broad, concentric sulci, more pronounced near the lower margin, and here and there a line much more apparent than the others. Shell very thin.

Dimensions.—Fig. 12, Pl. XXXV, measures—

Antero-posteriorly	64 mm.
Dorso-ventrally	30 mm.
Elevation of valve	7 mm.

Localities.—England: rare in the Redesdale Ironstone, Northumberland. Scotland: in a bed of shale between two limestones at Penton Linns, river Liddle, Dumfriesshire; in the *Schizodus Pentlandicus* bed, Randerston, Fife, Lower Limestone series.

Observations.—This species occurs at Penton Linns in a bed of shale lying between two thick limestones, associated with a very rich fauna. The following Lamellibranchs occur there:—*Nucula undulata*, *N. gibbosa*, *Nuculana attenuata*, *Ctenodonta Pentonensis*, *Protoschizodus axiniformis*, together with several species of *Murchisonia*, *Macrocheilus*, *Bellerophon*, *Orthoceras*, Brachiopods, Crinoids, *Fenestella*, &c. &c. From the fauna, I should certainly regard the bed as belonging to the Carboniferous Limestone series, and probably as representing the Beith, Hurlet, or Lower Limestone series of the west of Scotland; and it is probably the same as that which is exposed at Harelaw Hill and Peter's Crook quarries, about a mile E. and W. respectively.

I have been fortunate enough to obtain one specimen which has the external surface of the shell removed in the neighbourhood of the hinge-line, showing the outer edge of the process of the hinge-plate (*a*), which I have called the ossicle, present in all species of the genus *Edmondia*, fig. 12, Pl. XXXV. This shows that the plate was shelly and not cartilaginous. The outer edge of this ossicle is 4 mm. external to the hinge-line, and its use was probably, as Professor King suggested, as a fulcrum, but it is not clear that an internal cartilage was attached to it. A fair-sized shell, like *Edmondia*, with an edentulous hinge, would necessarily need some strongly-developed muscles and ligaments to keep the valves in contact; but, compared to the size of the shells, the muscle-scars are very shallow, hence the necessity for the development of some special form of closing apparatus.

I have been unable to refer the Penton specimens to any described species, but they approach to *E. arcuata* more nearly than to any other. From this species *E. Pentonensis* is easily distinguished by the absence of obliquity, the short but deep anterior end, and the flat oblong shape of the valves.

Three specimens from the Redesdale Ironstone I doubtfully refer to this species, but these are not perfect, and are only half the size of the Penton examples. They are without the obliquity of *E. arcuata*, which is very common at that locality, and have a deep and comparatively shorter anterior end, but it is possible that they are only aberrant forms of the latter species.

EDMONDIA SUBPLICATA, *Kirkby*, sp., 1880. Plate XXXVIII, figs. 1—5.

SANGUINOLITES SUBPLICATUS, *Kirkby*, 1880. Quart. Journ. Geol. Soc., vol. xxxvi, p. 586.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 290.

Specific Characters.—Shell much produced transversely, almost lanceolate, very feebly gibbose, markedly inequilateral, narrow in the dorso-ventral diameter. The anterior end is compressed and very short comparatively, but long compared to other species of the genus. It is much lower than the umbones, and has a well-marked antero-posterior angle. The border is elliptically curved. The inferior border is very long and almost straight, parallel with the hinge-line, hardly rising at all posteriorly, where it makes a blunted angle with the posterior border. The latter is obliquely truncate from above downwards and backwards, and forms an obtuse angle above with the hinge-line. The hinge-line is straight, much shorter than the inferior border. The umbones are small, compressed, not elevated, and situated in the anterior fifth of the shell. Passing downwards from the umbo to the postero-inferior angle is an ill-defined ridge, above which the valve is flattened and compressed. Elsewhere the valve is only very slightly convex. There is a narrow elongate groove at the upper edge of the valve from the external ligament.

Interior.—The anterior adductor muscle-scar is deep, circular, bounded behind by a ridge, and placed immediately within the antero-superior angle of the valve. The position of posterior scar is not known.

The hinge is edentulous. There is a rolled and thickened hinge-plate, bevelled at the expense of its lower border, which projects outwards and downwards. Between this plate and the umbo is a narrow elongate groove, which splits up and becomes irregular in front. Pallial line deep, entire, and remote from the margin.

Exterior.—The surface is covered with fine concentric lines of growth, which become stronger and subimbricating near the lower margin. Shell very thin.

Dimensions.—Pl. XXXVIII, fig. 1, measures—

Antero-posteriorly	50 mm.
Dorso-ventrally	15 mm.
Elevation of valve	4 mm.

Localities.—In shale below the limestone east of the Coal Farm, St. Monan's, Fife, and Randerston, Fife; in Limestone No. 5 of Mr. Kirkby (*op. supra cit.*), Calciferous Sandstone series.

Observations.—This species was founded by Mr. Kirkby (*op. supra cit.*) for some very elongate narrow shells, found in the *Schizodus Pentlandicus* bed at Randerston. I think, from a study of the hinge and from the general characters, that his reference of the shell to the genus *Sanguinolites* was a mistake, as it possesses far greater affinities with that group of *Edmondia* of which *E. arcuata*, Phillips, sp., is typical. I have fortunately been able to obtain a specimen which has the hinge-plate preserved, Pl. XXXVIII, fig. 2, which places the advisability of referring the species to *Edmondia* beyond all doubt.

Associated with this species at Randerston is *E. Pentonensis*, from which it is distinguished by its much narrower dorso-ventral diameter and obliquely truncate posterior end.

Mr. Kirkby thought that *E. subplicata* was limited to the lower part of the Calciferous Sandstone series of Fife, and gives its distribution as 3000 to 3800 feet below the Carboniferous Limestone. I have, however, obtained the shell from the bed of shale below the limestone at St. Monan's, Fife, which Mr. Kirkby takes as the base of the Carboniferous Limestone of Fife.

I have examined the type of Portlock's *Sanguinolaria plicata*, and am of opinion that it does not belong to the genus *Edmondia*, but has more affinity to the shells hitherto known as *Sanguinolites iridinoides*, M'Coy. Mr. Kirkby quotes *Sanguinolites plicatus* from the shales at St. Monan's, and probably he did not recognise that the species found there was the same as his *S. subplicatus* from Randerston, for in the shales the shell is less crushed, and has the external surface beautifully preserved. The *Schizodus Pentlandicus* bed, Mr. Kirkby's No. 5 Limestone, is most interesting. The upper surface is strewn with shells and shell débris, and evidently represents a beach, for much of the bed is made up of rolled shell fragments and shelly detritus. Large numbers of several genera of small Gasteropoda are strewn over the surface, and some of the best preserved shells have *Spirorbis* adhering to them. The limestone is a very hard band, 1 foot thick, but the waves wear away the cementing material quicker than the fossil shells, which consequently stand out in relief. The fauna of this bed is, I think, characteristic of littoral conditions. Below and separated from this limestone by a bed of shale 9 inches thick, probably of fresh-water origin, is another limestone, 1 foot thick, with plant remains, *Naiadites* and *Rhizodus Hibberti*, pointing out the rapid alteration of conditions which obtained during the deposit of the Calciferous Sandstone series of the Fifeshire coast.

Mr. Kirkby thinks it probable that the shell termed *Modiola* in the East of Fife sheet, No. 41 of the Geological Survey maps, is the same as *Edmondia subplicata*.

EDMONDIA TRANSVERSA, sp. nov. Plate XXXII, figs. 12—16.

Specific Characters.—Shell of moderate size, transversely ovate, very inequilateral, gibbose. The anterior end is extremely short and compressed, its border curved and narrowed from above downwards.

The inferior border is slightly convex and produced, passing into the posterior border with an increased curvature. The posterior margin is bluntly rounded, without any approach to angulation above or below. The hinge-line is arched in front, but prolonged and almost straight behind. The umbones are gibbose, prolonged transversely, pointed, twisted inwards and forwards, contiguous, somewhat raised, and situated quite in the anterior portion of the valve.

The valves are evenly and convexly curved, and have a long dorsal slope, not well marked off from the rest of the valve; the greatest convexity is in front and above the centre of the shell.

Interior.—The anterior adductor scar is small and shallow, placed within the antero-superior angle of the shell; the posterior scar is obsolete. The hinge-plate in casts leaves two grooves parallel with the edge of the valve. The pallial sinus is entire, and is represented by a well-marked groove not far from the margin. The interior shows well-marked concentric grooves and sulci, crossed by very fine decussating lines.

Exterior.—The surface is ornamented with concentric grooves and sulci, more or less regular, which are occupied by very fine concentric lines. Shell very thin.

Dimensions.—Fig. 12, Pl. XXXII, measures—

Antero-posteriorly	35 mm.
Dorso-ventrally	24 mm.
Laterally	12 mm.

Localities.—Scotland: the Upper Limestone series of Garngad Road, Glasgow; the Lower Limestone series of Beith and Auchenskeith, Ayrshire.

Observations.—This species is associated with *E. rudis* in nodules in the shales connected with the Beith Limestones in the Lower Limestone series of Ayrshire, and though fairly plentiful, is not so frequent as the latter. *E. transversa* seems to occupy a position midway between *E. unioniformis* and *E. rudis*. It is more transverse and less deep in front than the latter, and more oblique than either. At present I am unable to record the presence of this species, except at the horizon noted above.

It is probable that these are the shells referred to *E. Egertoni* in the catalogues

of Messrs. Young and Armstrong, as I find specimens of *E. transversa* bear this name in the cabinets of Scotch collectors. The former species now referred to *Cardiomorpha* is, as far as I can ascertain, not present in the Carboniferous series of the West of Scotland.

EDMONDIA SULCATA, *Phillips*, sp., 1836. Plate XXXIII, fig. 15; Plate XXXIV, figs. 3, 5, 6, 6 *a*; Plate XXXV, figs. 5, 11.

HIATELLA SULCATA (pars ?), *Fleming*, 1828. Hist. Brit. Anim., p. 461.
SANGUINOLARIA SULCATA, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209, pl. v, fig. 5.
— — *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 50.
— — (pars), *Morris*, 1845. Cat. Brit. Foss., p. 100.
ALLORISMA REGULARIS (pars), *de Verneuil*, 1845. Géol. Russie, vol. iii, p. 298, pl. xxi, figs. 11 *a*, *b*.
EDMONDIA SULCATA, *King*, 1849. Permian Foss., p. 164, pl. xx, figs. 1—4.
? SANGUINOLARIA SULCATA, *Brown*, 1849. Illustr. Foss. Conch., p. 220.
PHOLADOMYA SULCATA, *d'Orbigny*, 1850. Prodrome de Paléontol., p. 128.
? SOLEMYA PARALLELA, *de Ryckholt*, 1852. Mél. pal., 2e partie, p. 51, pl. xi, figs. 11, 12.
EDMONDIA SULCATA, *M'Coy*, 1855. Brit. Pal. Foss., p. 503.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 307.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 284.
Non — — *Tornquist*, 1896. Fossilführ. untercarbon sudvogesen, vol. ii, p. 142, pl. xix, figs. 2, 3.

Specific Characters.—Shell of medium size, inequilateral, oblong-oval, moderately convex, close all round. The anterior end is short, and narrower from above downwards than any other part of the shell, convexly curved into the edge, which is regularly and almost semicircularly rounded. The inferior border is extended and almost straight for the greater part of its extent, but is regularly and almost semicircularly rounded at each extremity, where it is continuous with the curvature of the anterior and posterior borders. The latter is convexly rounded, the upper part being the segment of a larger circle than the lower. The hinge-line is almost straight, much shorter than the greatest antero-posterior diameter of the valve. The umbones are small, pointed, elongate, incurved, and twisted forwards, close, not much raised above the hinge-line, and situated in the anterior fifth of the valve.

The valves are evenly curved from above downwards and before backwards; there is no ridge or constriction, but a certain amount of flattening or compression along the dorsal slope.

Interior.—The anterior adductor muscle-scar is small, shallow, rounded, and

situated just within the antero-superior angle of the valve, and surmounted by an excavated, elongate, pear-shaped accessory scar, which is deeper and narrower above, and is separated from the umbonal cavity by the process of shell (ossicle) which projects from the lower part of the hinge-plate, and from the edge of the shell by the thickened hinge-plate. The posterior adductor scar is large, shallow, and punctate, placed near the postero-superior angle in the hollow of the dorsal slope.

The hinge is simple and erect; but projecting from the back of the hinge-plate into the hollow of the umbo is a large, curved, thin, expanded process, which looks somewhat like a bivalve shell with umbones in front and a long, pointed process posteriorly, the ossicle. The interior of the shell was deeply marked by regular concentric grooves and ribs, the latter often bifurcating in front into two thin, narrow ridges, with a tendency to more or less irregularity. There are faint indications of radiating striæ over the body of the shell. Pallial sinus entire, deeply marked, remote from the margin.

Exterior.—The surface is ornamented with regular, broad, deep, concentric ribs and sulci. The former are narrow and double at first, but unite sooner or later, and towards the posterior end of the shell the ribs become thicker and further apart, all, however, passing round, to terminate in the upper edge of the valve. The periostracum is comparatively thick, and covered with fine, close, regular, radiating rows of small tubercles, which pass indiscriminately over both sulci and folds. Shell thin.

Dimensions.—Fig. 6, Plate XXXIV, measures—

Antero-posteriorly	52 mm.
Dorso-ventrally	26 mm.
Laterally	14 mm.

Localities.—England: the Middle Limestone of West Witton, Wensleydale, and from the neighbourhood of Richmond, Yorkshire; one of the Limestones of Lowick and the Redesdale Ironstone, the Lewisburn, near Plashetts, Northumberland; the Carboniferous Limestone of Kendal; the Upper Grey and Middle White Limestones of Llangollen, North Wales; Ballasalla quarry, Isle of Man; marine bed below the Millstone-grit of Congleton Edge, Cheshire; the Gannister beds, Snosterley, Durham. Scotland: the Lower Limestone series of Beith; Bathgate and Carluke; Brinston Colliery, Penicuik; Pot-metal, near Kirkcaldy; Lawston Linns, Liddlewater; Muirburn, Newcastleton, Harelaw Hill quarry, Roxburgh. Ireland: the Carboniferous Limestone of Rochfort Lodge, Bundoran; Kildare; Grange Blundel and Arghamont, Armagh; Derryloran and Caledon, Tyrone.

Observations.—In spite of the fact that Professor King pointed out that two perfectly distinct shells were generally referred to the *S. ? sulcata*, Phillips and

Fleming, sp., there has always existed considerable confusion between them. King was of opinion that the shells described by Phillips and Fleming were quite distinct, and referred Phillips's shell to *Edmondia sulcata* and Fleming's to *Allorisma sulcata*. But considerable doubt exists that such was the case, and, from the descriptions of both by Phillips and Fleming, I think it highly probable that each had specimens of both shells before him when writing the description. These shells certainly have a certain broad resemblance and may be easily mistaken, but careful examination shows that they hardly possess a single character in common. King described Fleming's shell under the name *Allorisma sulcata*, which perhaps belongs to the family *Grammysidæ*, for it has the typical hinge and constriction from the umbo to the lower margin characteristic of that family. The shell of *A. sulcata* is more oblique, has the umbones more anterior, and the anterior umbonal limb rises gradually from the anterior edge of the shell, and not by a distinct well-marked fold. The position of the anterior adductor scar is different from that of *E. sulcata*, and there is no large accessory scar; moreover the pallial line in *A. sulcata* is deeply sinuated, and there is no ossicle attached to the back of the hinge-plate, and the shell possesses a long escutcheon and fairly well-marked lunule. Externally the ribs are simple and not double in the anterior part of the valve. But with all the important differences, the general appearance of the two shells is so strikingly similar, that the question naturally arises as to what could have been the reason for such an external resemblance in two such differently constructed animals. Is it possible that this resemblance is due to protective mimicry, and that this factor of natural selection was already exerting its influence in Carboniferous times? Both species occur together, and I have an idea that in any given locality one or other species is rare and the other common. It is so at Lowick and Redesdale, but I have not sufficient evidence from other localities to make the statement absolute.

The descriptions given by Phillips and Fleming are so meagre that it has been largely a matter of conjecture and of external evidence to decide to which shell these authors were referring. King seems to have gone into the matter very carefully, and referred some specimens to Fleming for comparison. Phillips, however, thought that his and Fleming's species were identical; and it is quite possible that Fleming founded his species on specimens of both shells, for his description is as follows: "*Hiatella sulcata.*—Beak nearly terminal, both extremities rounded, concentrically sulcated, ridges large retrally, formed by the union of two or more ribs; closely and obsoletely striated longitudinally, striæ consisting of minute tubercles."

The beaks of *Edmondia sulcata* are not nearly terminal, but neither are the concentric ridges of *Allorisma sulcata* "large retrally, formed by the union of two or more ribs." Internal casts of *E. sulcata* have obsolete radiating striæ, which

casts of *A. sulcata* have not; *E. sulcata* has external radiating striæ formed of rows of minute tubercles, while *A. sulcata* also has this form of marking, rendering the mimicry more perfect. King quotes a letter from Fleming (*op. supra cit.*, p. 163) in which he says, "Two of the shells do certainly resemble my *Hiatella sulcata*. On one of the casts there are traces of the striæ, a character rarely to be met with, owing to the extreme thinness of the shell, and its usual imperfectly preserved state." Mr. Neilson has a fine series of *Allorisma sulcata* from the Garngad Road strata of Glasgow, which show the external markings very well, but the shells are at once distinguished from *Edmondia* by the well-developed elongate escutcheon and the presence of a definite lunule.

Phillips states that his *S. sulcata* came from Redesdale, and I cannot trace the original. In the York Museum there are four good examples which belonged to the Yorkshire Physical Society, and which are labelled "Richmond," one of which I think is very probably the type specimen. I figure it Pl. XXXIV, fig. 3.

Phillips's description is very meagre, and does not mention the bifurcation of the concentric folds in front, though the lower part of his figure shows them; and the umbones are not anterior enough for *A. sulcata*.

King, it appears, had originally placed both shells in the genus *Allorisma* ('Ann. Mag. Nat. Hist.,' Nov., 1844), but Morris pointed out that one of these did not possess a sinuated pallial sinus (Strzelecki's 'Physical Description, New South Wales,' p. 270); and therefore, in the 'Monograph of Permian Fossils,' King mentions that he considered the shell should be referred to *Edmondia*, de Koninck. Although no fresh description was given, there are good figures of the shell and its peculiar expanded ossicle; in fact, the generic character of this appendage is induced from this species. The ossicle is, however, apparently far better developed and more differentiated in *E. sulcata* than in any other species of the genus.

M'Coy gave a long description of the species (*op. supra cit.*), and described accurately the relation of the ossicle to the muscle-scars. He, however, seems to have misunderstood King, for he correctly describes the pallial line as "perfectly entire," as did that author ('Monograph of Permian Fossils,' p. 163), but M'Coy adds, "so that Mr. King must have been deceived in this respect." Perhaps, however, M'Coy had not taken the trouble to consult this work of King's, published several years before his own, and was basing his criticism on the preliminary notice in the 'Ann. and Mag. Nat. Hist.,' noted above.

The specimen of *E. sulcata* figured by King is preserved in the museum of Newcastle-on-Tyne, but I am unfortunately not permitted to refigure it. The umbones which King had knocked off, so as to expose the ossicle, have been cemented on, so that this feature is not visible to the visitor. I have fortunately been able to figure an example from the collection of Mr. Morton, of Liverpool,

which has the umbo of the left valve removed and the ossicle well exposed (fig. 5, Pl. XXXV). This specimen was obtained from the Middle White Limestone of Craig-Fawr, North Wales.

Fig. 6, Pl. XXXIV, is a specimen in my own collection, which shows the cast of the interior muscle-scars and a slit which corresponds to the ossicle. The strongly developed accessory muscle-scar is very well shown.

Figs. 11, 11*a*, Pl. XXXV, show portions of the exterior of the shell, with the peculiar punctate markings arranged in radiating rows. I have not been able to decide definitely whether these markings existed in the upper layer of the shell, or were confined to the periostracum only. Unfortunately, specimens which retain the shell are exceedingly rare.

The vertical range of this species seems to have extended up into the Gannister series in Durham. De Verneuil (*op. cit.*) has figured a very fine cast, showing the groove for the ossicle, from the Carboniferous Limestone of Stolobinskoi, Russia; and de Ryckholt a species from the Carboniferous shales of Tournai; but beyond these two records nothing is known of the distribution of this species in the Carboniferous beds of Europe. De Koninck does not describe the species in either of his great works.

Tornquist has evidently made a mistake in referring his specimens to this species; his figures have nothing in common with Phillips's species.

EDMONDIA EXPANSA, sp. nov. Plate XXXIII, figs. 16, 16*a*; Plate XXXIV, figs. 1, 2, 4, 7.

Specific Characters.—Shell large, transversely oblong-oval, inequilateral, compressed. The anterior end is short, deep, with a rounded border, the lower part being the arc of a much larger circle than the upper. The lower border is long, very convex in front, then becomes almost straight, till it becomes convex again, when it passes into the posterior border. The latter is extensive, almost semicircular. The hinge-line is much shorter than the antero-posterior diameter, and is curved in front, but is straight posterior to the umbo. The umbones are small, elongate, pointed, incurved, hardly raised above the rest of the shell, and placed in the anterior fourth of the valve. The valves are only slightly convex from before backwards, but a little more so from above downwards, and somewhat compressed along the dorsal slope.

Interior.—No details beyond the fact that the shell possesses the characteristic ossicle have been yet observed. The interior of the shell had strongly marked concentric rugæ and folds.

Exterior.—The surface is ornamented with regular close-set concentric folds

and rugæ, which become larger and further apart towards the lower margin. The folds commence close together in the anterior part of the upper border, and, following the contours of the shell, become split up into twos and threes, which reunite into a simple large fold terminating in the posterior part of the upper border. The rugæ become very greatly dilated and widely separated on the dorsal slope, and all over the rugæ and sinuses are close, fine, concentric lines of growth. Shell very thin.

Dimensions.—Plate XXXIII, fig. 16, a specimen in the Grosvenor Museum, Chester, measures—

Antero-posteriorly	100 mm.
Dorso-ventrally	57 mm.
Laterally	30 mm.

The specimen is somewhat too narrow in the last diameter owing to the overriding of the valves on each other.

Localities.—England : the Carboniferous Limestone, North Riding, Yorkshire (the specimens in the York Museum are labelled Wensleydale); and Halkyn Mountain, North Wales. [OM?]

Observations.—I have founded this species on four very fine examples, one of which, fig. 16, Pl. XXXIII, is in the possession of the Grosvenor Museum, Chester, and was obtained from Halkyn Mountain; one other, fig. 7, Pl. XXXIV, is in the collection of Mr. Joseph Wright, of Belfast, and is labelled North Riding, Yorkshire. It was presented to him by the late Mr. E. Wood, whose name was given to the genus of Crinoids, *Woodicrinus*. It is unfortunate that the exact bed of limestone whence it was obtained cannot, therefore, be located, but it most probably was obtained from one of the beds of the so-called Yoredale Limestones, which are, in my opinion, only the local representatives of the upper part of the Carboniferous Limestone of Derbyshire. Both specimens possess the two valves, and are fine casts of the exterior, but Mr. Wright's specimen is incomplete near the umbones, and shows the characteristic ossicle in section.

Two other specimens labelled Wensleydale are in the York Museum (Reed collection [Wood]). It appeared to me at first that possibly this species was only a giant form of *E. sulcata;* but, though in general characters coming closer to that species than to any other of the genus, *E. expansa* has, in the young stage even, the double ribs in the central part of the shell much closer than in that species, and it is also comparatively much less transverse.

In size *E. expansa* approaches *E. primæva*, but the latter species has not the well-marked ribs and sulci, and is comparatively much broader in its dorso-ventral diameter.

EDMONDIA LAMINATA, *Phillips*, sp., 1836. Plate XXXVI, figs. 1—7, 10—12, 31.

LUCINA? LAMINATA, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209, pl. v, fig. 12.
CARDINIA? LAMINATA, *de Koninck*, 1842. Carb. Foss., p. 78, pl. H, figs. 9 *a—c*.
CARDIOMORPHA SULCATA, *de Koninck*, 1842. Ibid., p. 109, pl. ii, figs. 18 *a*, *b*.
ASTARTE QUADRATA, *M'Coy*, 1844. Carb. Foss. Ireland, p. 55, pl. xi, fig. 4.
CARDIOMORPHA SULCATA, *de Verneuil*, 1845. Géol. de la Russie, vol. ii, p. 303, pl. xx, figs. 2 *a—c*.
LUCINA? LAMINATA, *Morris*, 1845. Cat. Brit. Foss., 1st edit., p. 89.
— — *Brown*, 1849. Illust. Foss. Conch., p. 217.
CARDIUM LAMINATUM, *d'Orbigny*, 1850. Prodrome de Paléontol., p. 131.
? CARDIOMORPHA GLEBOSA, *de Ryckholt*, 1852. Mélanges paléontol., 2e partie, p. 93, pl. xiii, figs. 1 and 2.
PHOLADOMYA TORNACENSIS, *de Ryckholt*, 1852. Ibid., p. 37, pl. x, figs. 3, 4.
LYONSIA QUADRATA, *d'Orbigny*, 1852. Prodrome de Paléontol., p. 129.
LUCINA? LAMINATA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 208.
CARDIOMORPHA LAMINATA, *Morris*, 1854. Ibid., p. 190.
EDMONDIA QUADRATA, *Morris*, 1854. Ibid., p. 202.
CARDIOMORPHA LAMINATA, *Bigsby*, 1878. Thesaurus Devonico-Carbonif., p. 301.
EDMONDIA QUADRATA, *Bigsby*, 1878. Ibid., p. 307.
— SCULPTA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. de Belgique, tom. xi, p. 42, pl. xi, figs. 20, 21, 44, 46.
— TORNACENSIS, *de Koninck*, 1885. Ibid., p. 44, pl. xli, figs. 4—7.
CARDIOMORPHA LAMINATA, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 280.
EDMONDIA QUADRATA, *Etheridge*, 1888. Ibid., p. 283.

Specific Characters.—Shell below medium size, transverse, subquadrately oval, inequilateral, moderately gibbose. The anterior end is very short, gradually curved to the margin, and has an almost semicircular border; but where it passes into the inferior margin the curve is the arc of a larger circle than the upper part. The lower border is regularly and very slightly convex, except at the extremities. The posterior margin is broader than the anterior, and is obtusely rounded. The hinge-line is somewhat arched produced posteriorly. The umbones are small, regularly gibbose, pointed, incurved, and twisted forwards, somewhat elevated above the rest of the valve, and situated in the anterior quarter of the shell.

The valves are regularly convex from above downwards and before backwards, the greatest convexity being about the centre of the dorso-ventral diameter, but in front of the centre of the antero-posterior diameter. Towards the posterior end and along the dorsal slope the valve is somewhat compressed. No escutcheon or lunule.

Interior.—Unknown.

Exterior.—The surface is ornamented with very regular, simple, erect, concentric, fine ridges, separated by smooth, regular grooves. These ridges are

crowded in front, and at the extreme anterior margin become obsolete, but they increase in definition, and are somewhat wider apart posteriorly.

Localities.—England: the Carboniferous Limestone of Thorpe Cloud and Chrome Hill, Derbyshire; Thorpe, near Grassington, and Settle, Yorkshire; the Upper Carboniferous Limestone of Poolvash, Isle of Man. Ireland: the Carboniferous Limestone of Kildare; Carboniferous Slate, Ballymeeny, Easky; shale in Carboniferous Limestone at St. Dooghlas quarry, co. Dublin.

Dimensions.—Fig. 3, Pl. XXXVI, measures—

Antero-posteriorly	35 mm.
Dorso-ventrally	25 mm.
Elevation of valve	8 mm.

Observations.—The type of Phillips's *Lucina laminata* is preserved in the Gilbertson Collection of the British Museum (Nat. Hist.), South Kensington, and I refigure it, Pl. XXXVI, fig. 11, by the kind permission of Dr. H. Woodward. This specimen is only imperfect at the umbo, and the greater part of the valve, with its characteristic markings, is well preserved. It represents a specimen in advanced growth, and was obtained from the Bolland district of Yorkshire. The type of M'Coy's *Astarte quadrata* is preserved in the Griffith Collection of the Science and Art Museum, Dublin, and Dr. Scharff has permitted me to refigure it, Pl. XXXVI, fig. 12. It is a somewhat imperfect example of a left valve of full size, not of the right valve, as M'Coy's figure would appear to show; and, although the greater part of the valve has been removed, quite sufficient remains to demonstrate the identity of this shell with *E. laminata*, Phillips, sp. The growth of this shell has been interrupted from some cause or other, and it will be noticed that the regularity of curvature was interfered with when the shell had attained about two thirds of its growth. This was doubtless an accident, but M'Coy seems to have regarded the condition as a specific character, for he says, "This shell has a thick and somewhat rugged appearance from the prominence of the few large wrinkles of growth (as distinguished from the transverse sulci)." Many specimens, however, as might naturally be expected, exhibit slight variations in the strength and extent of the concentric ridges and sulci. I have been fortunate enough to obtain numerous specimens of this shell at Thorpe Cloud, the conical hill at the entrance to Dovedale, and have no hesitation in referring them to Phillips's species, *E. laminata*. De Koninck described a medium-sized shell of this species under the name *E. sculpta*, and he seems to have satisfied himself that it possesses the characteristic internal characters of *Edmondia;* for, although he does not figure the hinge-plate, he places no ? after the genus, as is his custom when he has not seen the hinge. De Koninck says that "les ornaments de la surface de cette petite espèce ressemblent à ceux d'*E. globosa*, de Ryckholt, qui en differe par sa grande taille et par l'épaisseur relativement plus grand de sa coquille." From

the description of *Cardiomorpha glebosa*, de Ryckholt, I see no reason to think the shells distinct, and am of opinion that it is highly probable that the two species are the same. Unfortunately, de Ryckholt's specimens cannot be examined, and therefore some slight degree of uncertainty must remain. De Koninck's type came from Visé, de Ryckholt's from Tournai. The latter shell measured 37 mm. antero-posteriorly, 27 mm. from above downwards. I think that the *Pholadomya Tornacensis*, de Koninck, should also be placed under this species.

British specimens of *E. laminata* have, curiously enough, generally been referred to *Pullastra crassistria*, M'Coy, and not to *Astarte quadrata*, M'Coy, which has been shown to be identical with Phillips's species. The type of the former species is so very imperfect as to be quite unrecognisable, but enough of the external surface remains to render it certain that the *E. laminata*, Phillips, sp., and *Pullastra crassistria*, M'Coy, are quite distinct.

Fig. 31, Pl. XXXVI, a specimen from Park Hill in the Collection of the Geological Survey, Jermyn Street, is the largest example I have seen, being larger than Phillips's type, Pl. XXXVI, fig. 11. Specimens in the younger stages of growth are relatively more transverse than adults, and there seems to be a large amount of variation in the size and number of the concentric ridges. It seems to me to be probable that the *Solenopsis parallela*, de Ryckholt, may be a very large example of this genus.

I have procured a fair number of specimens from Thorpe Cloud, in all stages of growth, which demonstrate the gradual changes of contour with increasing age. Unfortunately, so far, I have not been able to collect examples exhibiting any details of the interior, nor to assure myself that the shell possesses the characteristic ossicle of the genus. There appears to have been some considerable amount of variation in the number and size of the concentric ridges and grooves, some half-grown examples showing much larger and more widely separated ridges than many of the more fully-grown examples.

De Koninck, in 1842 (*op. supra cit.*), figured a specimen from Tournai which he referred to the genus *Cardinia*? and which he thought to be identical with Phillips's shell, but he does not appear to have retained the species in his second work. I think that *Cardiomorpha sulcata*, 1842, of this author is also a synonym of the species under description. This species is also not mentioned in de Koninck's later work. A well-marked variety of *E. laminata* occurs in the same beds at Thorpe Cloud (see p. 327).

E. LAMINATA, var. SUBLÆVIS, var. nov. Plate XXXVI, figs. 13—18.

Description.—Shape as in *E. laminata*, but the external surface is covered with concentric striæ and sulci of unequal strength and size, and the regular markings of *E. sculpta* are absent.

Comparative dimensions as in *E. laminata*, but I have never met with specimens of as large size as obtains in the specific form.

Observations.—I possess a small series of shells from Thorpe Cloud which possess the general character of *E. sculpta*, but differ markedly in the ornamentation of the surface. As ornamentation is known to be altered by divers conditions, I have not thought it wise to found a new species on a single character. De Koninck does not seem to have met with any shells like mine, for he gives no figures to which I can in any way refer the specimens. The Geological Survey Museum, Jermyn Street, possesses two specimens, internal casts, from Thorpe (near Grassington ?), which show the details of the interior, and also demonstrate that the variety possesses the ossicle or lamelliform process projecting from the back of the hinge-plate into the umbonal cavity.

EDMONDIA SCALARIS, *M'Coy*, 1844. Plate XXXVI, figs. 9, 19—22.

VENERUPIS SCALARIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 67, pl. x, fig. 6.

CARDIOMORPHA SCALARIS, *d'Orbigny*, 1850. Prodrome de Paléontol., p. 133.

Non EDMONDIA SCALARIS, *M'Coy*, 1855. Brit. Palæozoic Foss., p. 502, pl. 3 H, p. 96.

VENERUPIS SCALARIS, *Griffiths*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 60.

CARDIOMORPHA SCALARIS, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 301.

VENERUPIS SCALARIS, *Bigsby*, 1878. Ibid., p. 315.

EDMONDIA SCALARIS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. de Belgique, p. 41, pl. x, figs. 25, 26.

— — (pars), *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 284.

Specific Characters.—Shell of moderate size, obliquely suboval, very gibbose, inequilateral. The anterior end is short and small, compressed, and produced forwards at the antero-superior angle, which is the most anterior point of the valve. The anterior border curves downwards and backwards rapidly from the angle, so that it appears to be almost obsolete, and in its place is a very extensive convex lower border. The posterior border is broad, bluntly curved, and joins the hinge-line at an obtuse angle. The hinge-line is not quite as long as the

greatest antero-posterior length of the valve, and is gently arcuate. The umbones are gibbose, incurved, and twisted forwards, much elevated above the anterior portion of the valve, contiguous and situated in the anterior third of the valve, and excavated in front. The whole valve is regularly curved and very convex, compared to its size, and the dorsal slope broad.

Interior.—The anterior adductor muscle-scar is pear-shaped, large, shallow and striated from above downwards, placed in the anterior part of the umbonal hollow remote from the margin. The posterior scar has not yet been observed. Details of the hinge and pallial line not known. The cast shows deep ridges and sulci on the internal surface of the valve.

Exterior.—The shell is ornamented with a few, fifteen to twenty, broad concentric sulci, which are close in front, and all spring from the anterior part of the hinge-line; they expand as they cross the shell, becoming closer as they approach the posterior part of the hinge-line in which they terminate. These sulci are separated by blunt, imbricating, broad ridges, which become irregular in size and position towards the lower margin, and are very close and small in front. When the test is preserved, the whole of the grooves and ridges are covered by fine concentric lines of growth, one or more of which, here and there, on the sloping lower part of the ridges, are much accentuated. Shell thin.

Dimensions.—Fig. 21, Pl. XXXVI.

Antero-posteriorly	35 mm.
Dorso-ventrally	25 mm.
Elevation of valve	16 mm.

Localities.—England: the Limestone of Thorpe Cloud, Derbyshire. Ireland: the Carboniferous Limestone of St. Dooghlas, co. Dublin, Kildare, and Millicent, Clane, co. Cork.

Observations.—This species was described and figured by M'Coy in 1844, but subsequently was confounded with another from Lowick (1885), which he erroneously described under the same name. De Koninck drew attention to this fact, and I am in accord with his remarks on the subject, which are as follows: "M. F. M'Coy paraît avoir confonder cette espèce, qu'il a décrite et figurée en 1844, avec une autre qu'il a désignée sous le même nom en 1855. Il est vrai que cette dernière s'en rapproche par sa forme et la largeur de ses plis concentriques, mais ceux-ci sont moins nombreux, quoique la taille de la coquille soit à peu près la même; elle diffère en outre par sa forme générale, qui est beaucoup plus rectangulaire, et par la situation plus antérieure de ses crochets." This shell I now describe as *E. MacCoyii*, and it may at once be recognised from *E. scalaris* by its more rectangular form, the anterior position of the umbones, the absence of obliquity, the smaller number of ridges, and the deep quadrate anterior end.

E. scalaris has externally somewhat the shape of *Cardiomorpha*, but the

anterior muscle-scar is not in the position which obtains in that genus, though the umbones are markedly prosogyrous. It is noteworthy that at least one species of *Cardiomorpha, C. corrugata,* M'Coy, has well-marked, broad, concentric grooves and ridges (Pl. XXIII, figs. 5—7). M'Coy's type specimen is preserved in the Griffith Collection of the Museum of Science and Art, Dublin, and I reproduce it, Pl. XXXVI, fig. 20, by the kindness of the director, Dr. Scharff. It is a medium-sized specimen, and was obtained from Millicent, Clane, co. Cork. M'Coy describes it as being "transversely ovate, short, and very gibbose, anterior end obtusely pointed;" and it is difficult to understand why later on he referred a shell to this species which he described as "oblong, short, very tumid, anterior end very small, compressed, rotundato-quadrate." The two descriptions of *E. scalaris* by M'Coy are so totally different, that there can be no doubt that he had a totally different shell under observation when writing his later work. The type of his second shell, in the collection of the Woodwardian Museum, Cambridge, was obtained from Lowick. The same collection contains several other specimens from the Carboniferous Limestone of Settle, which are certainly different from the Irish shell.

EDMONDIA MACCOYII, sp. nov. Plate XXXVI, figs. 23—30.

EDMONDIA SCALARIS, *M'Coy*, 1855. Brit. Pal. Foss., p. 502, pl. 3 H, fig. 6.
— — (pars), *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 284.

Specific Characters.—Shell transversely subquadrate, very inequilateral, gibbose. The anterior end is very short, rapidly compressed, and relatively deep from above downwards. The anterior border, commencing above, makes blunted right angle with the hinge-line, and descends downwards in an almost straight line, becoming very bluntly curved below, where it passes into the inferior border, which is itself but very feebly curved. The posterior border is truncate, almost straight, joining the lower border with an obtuse curve, and forming a right angle with the hinge-line above. The hinge-line is almost straight, produced posteriorly, as long as any antero-posterior diameter of the shell. The umbones are comparatively large, tumid, incurved, and twisted forwards, contiguous, only slightly elevated above the hinge-line, and situated in the anterior quarter of the shell. The valves are regularly convex, but rapidly compressed above a line passing from the umbo to the postero-inferior angle. There is no lunule or escutcheon. The greatest convexity of the valve is at the junction of the upper and middle thirds of the shell, a little in front of the middle of the valve.

Interior.—The anterior adductor muscle-scar is placed in the anterior part of the umbonal hollow, and is shallow but large and striated. The posterior scar

appears to be obsolete. The hinge-plate consists of a thickened ridge leaving a groove in casts. Pallial line entire. The internal surface of the shell is deeply marked with concentric grooves and ridges corresponding to those on the surface.

Exterior.—The surface is ornamented with regular, broad, angular ridges, twelve to fifteen in number, separated by concentric grooves which enlarge rapidly as they pass across the shell, and become broader as they approach the lower margin, the ridges and grooves being themselves covered with fine concentric lines of growth, which are variable as to size and distance apart. Shell very thin.

Dimensions.—Pl. XXXVI, fig. 24, measures—

Antero-posteriorly	32 mm.
Dorso-ventrally	25 mm.
Elevation of valve	10 mm.

Localities.—England: the Carboniferous Limestone of Settle, Yorkshire; Thorpe Cloud, Castleton and Park Hill, Derbyshire; Narrowdale, Staffordshire; The Coomb and Lowick, Northumberland; the Cayton Gill beds near Harrogate in the Millstone-grit series. Scotland: the Lower Limestone of Auchenskeith and Dockra. Ireland: Carnteel, Tyrone.

Observations.—This species was described as *E. scalaris* by M'Coy in his second great work (*op. supra cit.*), but it differs markedly from the original type, as pointed out by De Koninck. The question of the affinities and differences of the two species has been discussed under my observations on *E. scalaris*, and need not be repeated here.

De Koninck has described a shell, under the name *E. scalariformis*, somewhat the shape of *E. MacCoyii*, but it is rather more transverse. It is quite possible that the two forms may be nothing more than varieties of the same species, but at present I have not access to enough material to venture on any definite statement with regard to them. I may say that the only difference between the shells is that of relative measurements, De Koninck's *E. scalariformis* having its antero-posterior diameter 40 mm. and dorso-ventral 26 mm.; in *E. MacCoyii* the diameters are as 32 : 25.

There appears to have been a great amount of variation in the size, number, and proximity of the concentric ribs. M'Coy's type shows only about ten, while fig. 28, Pl. XXXVI, a specimen from Settle, shows about thirty; but examples with much fewer ribs occur in the same locality.

In shape *E. MacCoyii* resembles *E. rudis* very closely, and the more regularly marked examples of the latter species would appear to pass into the more closely ribbed forms of the former. The extremes are, however, so distinct that I have not hesitated to retain both species.

EDMONDIA ACCIPIENS, *Sowerby*, sp., 1850. Plate XXXVII, figs. 8—16.

NUCULA ACCIPIENS, *J. de C. Sowerby*, 1840. Geol. Coalbrookdale exp., pl. xxxix, fig. 4.
UNIO UREI, *J. de C. Sowerby*, 1840. Ibid., pl. xxxix, figs. 6, 6 *a*.
— PARALLELUS, *J. de C. Sowerby*, 1840. Ibid., pl. xxxix, fig. 8.
NUCULA ACCIPIENS, *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 93.
UNIO UREI, *Morris*, 1843. Ibid., p. 105.
— PARALLELUS, *Morris*, 1843. Ibid., p. 105.
NUCULA ACCIPIENS, *Brown*, 1849. Illus. Foss. Conch., p. 187.
UNIO UREI, *Brown*, 1849. Ibid., p. 180, pl. lxxxviii, figs. 9, 10.
— PARALLELUS, *Brown*, 1849. Ibid., p. 180, pl. lxxxviii, fig. 26.
NUCULA ? ACCIPIENS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 216.
UNIO ? UREI, *Morris*, 1854. Ibid., p. 230.
— ? PARALLELUS, *Morris*, 1854. Ibid., p. 230.
CTENODONTA ACCIPIENS, *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 303.
NUCULA ACCIPIENS, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 287.
UNIO UREI, *Etheridge*, 1888. Ibid., p. 291.
— PARALLELUS, *Etheridge*, 1888. Ibid., p. 291.
SANGUINOLITES GRANULATUS, *Etheridge*, 1890. Trans. N. Staff. Min. and Mech. Engineers, vol. x, p. 127, pl. i, fig. 12.

Specific Characters.—Shell transversely rhomboid-oval, moderately convex, very inequilateral, closed all round. The anterior end is very short, gibbose, and moderately deep from above downwards, its border regularly rounded. The inferior border is long and almost straight for the greater part of its extent, but posteriorly is curved upwards to pass into the posterior border without any angulation. The posterior border is bluntly but regularly rounded, passing with a regular curvature into the hinge-line. The superior border is long, straight, parallel with the ventral border, curved at either extremity, and somewhat shorter than the greatest antero-posterior diameter of the valve. The umbones are gibbose, raised, incurved and twisted forwards, contiguous, and placed close to the anterior extremity of the valve. The hinge-line is erect. Lunule and escutcheon absent. The valves are gibbose in front, and gradually compressed in the posterior half. There is no indication of any oblique line or fold in uncrushed specimens, but there is a slight constriction about the centre of the valve, which becomes broader and shallower as it approaches the margin.

Interior unknown.

Exterior.—The surface is ornamented with concentric sulci and rugæ, which have a direction parallel to the contour of the valve. The rugæ are more regular and better marked in the umbonal region; lower down they often subdivide as they cross the valve, and become split up into bundles of fine striæ of growth, the

sulci becoming also less well marked. In the better preserved specimens granular markings are seen over the valves, especially on the posterior slope.

Dimensions.—Fig. 10, Pl. XXXVII, from the Pennystone Ironstone, Coalbrookdale, in my Collection, measures—

Antero-posteriorly	74 mm.
Dorso-ventrally	34 mm.
From side to side	25 mm.

Localities.—England: the Pennystone Ironstone, Coalbrookdale. A band containing a marine fauna.

Observations.—This shell was described by J. de C. Sowerby, in an appendix to Prestwich's 'Geology of Coalbrookdale,' under three specific names; the very young shell being described as *Nucula accipiens*, while the well-sulcated full-grown shell was erroneously referred to the *Unio* figured by Ure ('History of Rutherglen,' p. 311, pl. xvi, fig. 4) as *Unio Urei*, and a variety with the concentric rugæ more split up into lines and striæ was named *Unio parallelus*. The *Unio* of Ure is *Carbonicola aquilina*, and is perfectly distinct from the species under discussion; moreover it has never yet been found in association with marine fossils. This specific name cannot be retained, and the term *accipiens* is adopted as it is the prior one on the page of description.

Professor Amalizky placed the name *Unio Urei* as a possible synonym of his *Naiadites Verneuili*, a genus of fresh-water edentulous shells allied to *Carbonicola*, but not belonging to *Naiadites*, Dawson.[1] This was of course due to a mistake arising from the comparison of figures, and partly due to the very meagre description of *Unio Urei* originally given.

There appear to be two well-marked forms of this shell, one of which, like the type of *Unio Urei*, has well-marked sulcations, and rugæ only becoming linear near the lower border; the other like the type of *Unio parallelus*, where the rugæ and sulci are somewhat obscure, and they tend to split up even in the upper part of the shell: but in shape and size the two forms are identical, and all gradations of external ornament exist between the extremes. I have, therefore, decided to unite the two species. In the original figures the posterior ends of both forms are incomplete. The postero-superior angle of the type of *Unio Urei* has gone, and a great deal of the posterior end of the type of *U. parallelus* is absent. An examination of the curvature of the lines of growth will demonstrate at once that the posterior end in both forms is rounded, but this is rarely seen owing to the incomplete preservation of the shell above and behind. Fig. 15, Pl. XXXVII, however, shows the real shape of the contour of the posterior end. The valves are often crushed, and this often gives rise to a false appearance of an oblique ridge,—in fact, it is very rare to find a perfect specimen.

[1] 'Quart. Journ. Geol. Soc.,' vol. l, p. 439.

Sowerby described *Unio Urei* as having its "posterior extremity rather pointed," but this was not correct, for he did not recognise that he was describing a specimen with an incomplete posterior end; similarly he does not seem to have recognised that his type of *U. parallelus* was a fragment only, for the measurements given are those of the broken shell.

Mr. Etheridge described a shell (*op. supra cit.*) in the cabinet of Mr. J. Ward, of Longton, as *Sanguinolites granulosus*, which was stated to have come from the North Staffordshire Coal-field at Adderley Green, horizon uncertain. This shell is identical with the specimens from Coalbrookdale, which also possess the minute tubercles thought to be characteristic of his new specimen by Mr. Etheridge. In this character *E. accipiens* agrees with *E. Lyellii* and *E. sulcata*. I am very doubtful whether the shell in question was really obtained from North Staffordshire. Mr. Ward himself is very doubtful where he obtained the specimen, and I have had several talks with him on the subject, and judging from the matrix and condition of his specimen I am of opinion that it originally came from Coalbrookdale, from which place he has a fine series of shells. Mr. Ward has been such an accurate and careful collector that I feel sure that the find of a marine shell in the Coal measures of Adderley Green would never have given rise to an uncertainty of the horizon in his mind. In this specimen the ridge described by Mr. Etheridge is due to crushing. I re-figure the specimen by the kind permission of Mr. J. Ward, fig. 9, Pl. XXXVII.

Edmondia accipiens more closely resembles *E. sulcata* than any other species of the genus, but is distinguished by the following characters:—The umbones are more anterior and the shell more inequilateral; the sulcations and rugæ are not so well marked, and tend to split up into lines and plicæ of growth. The valves are more transverse. There is also a somewhat close resemblance to *Allorisma sulcata*, but the presence of escutcheon, lunule, and sinuate pallial sinus in the latter at once seems to separate the two species.

Sub-genus Scaldia, *de Ryckholt*, 1852.

Scaldia, *de Ryckholt*, 1852. Mélanges paléontol., 1e partie, pl. x, figs. 24–26; 2e partie, p. 67.
— *S. P. Woodward*, 1851–6. Manual of Mollusca, p. 498.
— *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 311.
— *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. xi, p. 54.
— *Fischer*, 1887. Manuel de Conchyliologie, p. 1100.

Generic Characters.—Shell subcircular or oval, equivalve, slightly inequilateral, moderately gibbose. Umbones subcentral, small. No lunule or escutcheon. Ligament external, small, contained in a very narrow groove just above the edge of the hinge.

Interior.—Adductor muscle-scars shallow, more or less rounded. Pallial sinus entire. Hinge-line simple, erect, with a single tooth in each valve under the umbo. Formula: $\frac{\text{R. } 0, 1}{\text{L. } 1, 0}$. There is a thickened, depressed, vertical plate, much hollowed internally, the free edge of which extends outwards into the cavity of the umbo.

Externally the surface is almost smooth, or ornamented by numerous fine concentric lines.

Observations.—This genus was established by de Ryckholt (*op. supra cit.*), and the type was *Scaldia Kickxiana;* but de Koninck considers this species to belong to *Edmondia*, but retains the genus for the six other species originally referred to it by de Ryckholt. In the original description the genus is said to have a sinuated pallial sinus, but de Koninck has shown that this was an error. I am not strongly convinced of the value of this genus, which differs from *Edmondia* in its more orbicular shape, and in the possession of a cardinal tooth in each valve; but, as I have said (*ante*, p. 290), I have seen specimens of *Edmondia Kickxiana* which occasionally show a rudimentary cardinal tooth. De Koninck, however, will not allow that this is the case, for he says, speaking of the type of Ryckholt's *S. Kickxiana*, "Il a considéré comme dent un faible renflement de la lame cardinale, comme le prouve l'exemplaire même dont il s'est servi pour décrire et figurer l'espèce." De Ryckholt's figure shows the muscle-scars and sinuated pallial line very prettily, but no indications of these characters are shown in the type.

I have retained the term *Scaldia* as a sub-genus of *Edmondia*, following Woodward, and regard the hinge and suborbicular shape as important characters for the separation of the two genera.

De Koninck has described ten species as belonging to the genus, retaining six species figured and described by de Ryckholt, but I think it probable that many of them represent only different stages of growth of a species.

I have not found any species of *Scaldia* in the rich fossiliferous localities of the Mountain Limestone of England, but the genus occurs in the Carboniferous Limestone series of Scotland, and is represented by one species which I refer to, *S. fragilis*, de Koninck. In Ireland one species, *S. Benedeniana*, is represented by one specimen in the Museum of the Geological Survey of Ireland from the Limestone of Tuogh, co. Limerick, and two specimens from Kildare in the Museum of the Geological Survey at Jermyn Street, London. Unfortunately, in none of the specimens from these localities is the hinge to be seen.

I figure, for purposes of comparison, a specimen of *Scaldia Lambotteana*, from the Tournay beds, Pl. XXXVII, fig. 4. This specimen (a left valve) shows the hinge-line with the characteristic single cardinal tooth. As in the more ovate species of *Edmondia*, this species resembles that genus in possessing a shelly process of the hinge-plate which projects into the umbonal cavity. There is probably a very close relationship between *Paracyclas*, Hall, 1843, and *Scaldia*, de Ryckholt, 1852. Hall states in his diagnosis, "Structure of hinge not fully observed; ligament supported on each side by a narrow plate, and leaving in the cast two diverging grooves directed forward from the beak." The Devonian shells referred to *Paracyclas* are flatter and more generally compressed, and much more nearly shaped like *Lucina* than the Carboniferous shells referred to *Scaldia*. In the absence, however, of sufficient evidence of the exact structure of the hinge of *Paracyclas*, it is impossible to say at present that the two genera are synonymous.

SCALDIA FRAGILIS, *de Koninck*, 1885. Plate XXXVII, figs. 5—7.

SCALDIA FRAGILIS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. de Belgique, tom. xi, p. 58, pl. xiv, figs. 36—38.

Specific Characters.—Shell of less than medium size, subcircular, strongly gibbose, slightly inequilateral. The anterior end is deep in the dorso-ventral direction, regularly convex, and its border almost semicircularly curved. The inferior border is convexly curved, and the posterior truncate, forming with the inferior margin a bluntly rounded angle. The hinge-line is curved, and makes a more or less obsolete obtuse angle behind with the posterior border. The umbones are small, triangular, and acutely pointed, incurved, subcentral, and somewhat raised above the rest of the shell. The valves are strongly and regularly convex, especially above. Passing obliquely downwards and backwards

from the umbo to the postero-inferior angle is an obscure ridge, above which the shell is compressed and slightly expanded.

Interior.—Not exposed.

Exterior.—The surface is almost smooth, but the microscope shows very fine, close, and regular concentric lines, more pronounced on the dorsal slope. Shell thin.

Dimensions.—Fig. 7, Pl. XXXVII, measures—

Antero-posteriorly	29 mm.
Dorso-ventrally	23 mm.
Elevation of valve	8 mm.

Localities.—Scotland: the Upper Limestone series of Kirktonholm, East Kilbride, in the Cement stone.

Observations.—De Koninck founded the species *S. fragilis* on a single somewhat imperfect valve from the Calcschist of Tournay, and his description is therefore necessarily meagre. The specimens which I have referred to this species are from the cabinet of Mr. J. Neilson, and seem to agree perfectly with de Koninck's figures. One example, Pl. XXXVII, fig. 7, is fairly perfect; and another, Pl. XXXVII, fig. 6, has the greater part of both valves preserved. I have not been able to see any details of the hinge or the interior in the specimens from East Kilbride, the locality where Mr. Neilson obtained his specimens, but Mr. Smith of Kilwinning has a fragment of a valve from Glencart, Dalry, which shows the characteristic single hinge-tooth of Scaldia; but there is not enough left of the shell to speak accurately about its specific affinities, and the surface markings are too pronounced to refer it to the species under discussion.

Scaldia fragilis is distinguished from other species of the genus by the presence of the slight oblique ridge separating the dorsal slope from the rest of the valve.

SCALDIA BENEDENIANA, *de Ryckholt*, 1852. Plate XXXVII, figs. 1—3.

SCALDIA BENEDENIANA, *de Ryckholt*, 1853. Mélanges paléontol., pt. 2, p. 71, pl. xiv, figs. 30, 31.
CARDIOMORPHA SECTOR, *de Ryckholt*, 1853. Ibid., p. 97, pl. xiii, fig. 9.
SCALDIA BENEDIANA, *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 313.
— — *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. xi, p. 55, pl. xiv, figs. 18—20, 44.

Specific Characters.—Shell below medium size, suborbicular, very slightly oblique, gibbose, somewhat inequilateral. The border is regularly rounded, and passes in a continuous curve from the antero-superior border to the hinge-line just posterior to the umbones. The hinge-line is regularly arched. The umbones are tumid, incurved, and twisted forwards, contiguous and raised above the

hinge-line, and placed somewhat in front of the middle line of the valve. The shell is regularly gibbose, without compression or oblique ridge, nor is the dorsal slope marked off from the rest of the valve. Escutcheon and lunule absent.

Interior.—The anterior adductor muscle-scar is pear-shaped, and situated in the umbonal hollow remote from the margin, bounded behind by a broad shallow ridge. The posterior adductor scar is shallow, and placed in the hollow of the dorsal slope remote from the margin. Pallial line simple. Hinge not exposed in British examples, but it is known in Belgian specimens to be normal. The cavity of the valve is marked by obscure concentric grooves, especially near the lower margin.

Exterior.—The surface of the valve is ornamented by well-marked concentric ridges and lines of growth, with here and there deeper broad concentric grooves in which the striæ of growth are still marked.

Dimensions.—Fig. 1, Pl. XXXVII, in the Museum of the Geological Survey, Jermyn Street, measures—

Antero-posteriorly . . .	21 mm.
Dorso-ventrally . . .	19·5 mm.
From side to side . . .	13 mm.

Localities.—Ireland: the Carboniferous Limestone of Kildare and Tuogh, co. Limerick.

Observations.—This species was described and figured by de Ryckholt as one of six species belonging to his new genus *Scaldia*. De Koninck has retained five of these; but some of them, if not all, are probably slight varieties of the same shell. Added to these should be some of the species described by de Ryckholt under the genus *Cardiomorpha*,—*C. Lacordaireana*, *C. solida*, *C. sector*, and *C. orbitosa*.

It is to be noted that all the species of *Scaldia* described by de Ryckholt were obtained from the beds of Tournay, while eight of the ten species retained by de Koninck are from the same locality.

In the well-preserved condition this species is easily distinguished by the well-marked concentric grooves and ridges of its surface, and its suborbicular contour. The surface of *S. fragilis*, on the contrary, is much more nearly smooth, and it has a somewhat hollowed dorsal slope, and is less oblique.

Although this species is found in at least two localities in Ireland, I am unable to identify any of the shells figured by M'Coy as belonging to this genus. At present I have not met with the species in the Carboniferous Limestone of England.

Family CYPRINIDÆ.

Genus MYTILOMORPHA, gen. nov.

CYPRICARDIA, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209.
CYPRICARDITES, *Conrad*, 1841. Ann. Rep. Geol. Surv. N.Y., p. 53.
CYPRICARDIA (pars), *de Koninck*, 1842. Desc. des Anim. Foss., p. 94.
— *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 85.
— *Murchison, de Verneuil, and de Keyserling*, 1845. Geol. Russie d'Europe, p. 304.
GONIOPHORA, *Phillips*, 1848. Mem. Geol. Surv. Gt. Brit., vol. ii, p. 264.
CYPRICARDIA, *d'Orbigny*, 1849. Prodrome de Paléontol., p. 130.
— *Brown*, 1849. Illust. Foss. Conch., p. 198.
— *Eichwald*, 1853–61. Lethæa Rossica, pt. 1, p. 1014.
TRAPEZIUM (pars), *de Ryckholt*, 1853. Mélanges paléont., pt. 2me, p. 130.
SOLENOPSIS (pars), *de Ryckholt*, 1853. Ibid.
CYPRICARDIA (pars), *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 198.
GONIOPHORA (pars), *Eichwald*, 1860. Lethæa Rossica, p. 1014.
CYPRICARDIA, *Armstrong*, 1864–5. Trans. Geol. Soc. Glasgow, vol. ii, pt. 1, p. 28.
SANGUINOLITES, *Hall*, 1870. Pal. New York, vol. v, p. 299.
CYPRICARDIA, *Young and Armstrong*, 1871. Trans. Soc. Geol. Glasgow, vol. iii, Supplement, p. 50.
— *Young, Armstrong, and Robertson*, 1876. Cat. Western Scottish Fossils, p. 53.
— *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 305.
EUCHARIS, *Waagen*, 1881. Pal. Indica, ser. xiii, vol. i, pt. 3, p. 189.
GONIOPHORA, *Hall*, 1883. Pal. New York, vol. v, pt. 1, p. xxiii.
SANGUINOLITES (pars), *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. de Belgique, tom. xi, p. 58.
GONIOPHORA, *Hall*, 1885. Nat. Hist. New York Palæontol., vol. v, pt. 1; Lamellibranchiata, pt. 2, p. xxiii.
— *Fischer*, 1887. Manuel de Conchyliologie, p. 1077.
CYPRICARDIA (pars), *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 282.
GONIOPHORA, *Miller*, 1889. N. American Geol. and Palæontol., p. 481.
— *Whidborne*, 1891. Devonian Fauna, vol. ii, pt. 1, p. 16.
— *Neumayr*, 1895. Beit. z. einer Morphol. Einth. d. Bivalven, p. 35.
— *Beushausen*, 1895. Abh. de K. Preuss. Geol. Landesanstalt, neue F., Heft 17, p. 196.
CARDIOMORPHA (pars), *Beushausen*, 1895. Abh. k. Preuss. Geol. Landesanstalt, neue Folge, Heft 17, p. 283.

Generic Characters.—Shell equivalve, very inequilateral, more or less triangularly rhomboidal, with a very sharp elevated ridge passing backwards and downwards from the umbo to the postero-inferior angle. The umbones are small and acute, keeled. Lunule small, escutcheon well marked and elongate.

Interior.—The adductor muscle-scars are well marked and deep. Hinge: the

left valve has a strong fold or tooth in front, which is received into a corresponding cavity in the right valve. Pallial line entire, remote from the margin.

Exterior.—The surface is ornamented with close, fine, concentric lines of growth, often subimbricate.

Observations.—The name *Goniophora* was proposed by Phillips (*op. supra cit.*) for the *Cypricardia cymbæformis* of Murchison ('Sil. Syst.,' pl. iii, fig. 10 *a*), but no definition of the genus was given. Hall was the first to give a regular description of the genus, which he adopted for a number of shells occurring in the Devonian series of the State of New York. It appears that the term *Goniophorus* was invented by Agassiz for a genus of Crinoids, and it must therefore be regarded as preoccupied and inadmissible for a genus of shells. None of the synonyms of the genus can be retained, as they all were founded on shells possessing characters distinct from the genus under discussion, and it is therefore necessary to erect a new genus. The term *Mytilomorpha* seems to me to be a suitable one, more especially as I think there is strong evidence that this genus is descended from a mytiliform ancestor. Hall's description of the hinge of *Goniophora* is as follows: "Hinge furnished with a strong oblique fold or tooth in the left valve, situated just beneath the beak, and a corresponding depression in the right valve. No lateral teeth have been observed." These characters obtain in the Carboniferous species. There is certainly no lateral tooth, and I have seen traces of the anterior teeth, but unfortunately I have no specimen sufficiently perfect to figure which shows them.

Whidborne, Neumayer, S. A. Miller, and Beushausen all adopt the genus *Goniophora* for Devonian shells, and the latter gives a lengthy description of the genus, following Hall in his account of the hinge. Whidborne describes his shell as possessing "one if not two small oblique teeth on each valve below the umbo, and perhaps a long transverse lateral tooth behind." M'Coy states ('Brit. Pal. Foss.,' p. 275) that the shell on which Phillips founded the genus does possess a "moderately slender lateral tooth," but referred the shell to *Orthonotus*, Conrad. There can be no doubt as to the intimate external resemblance of the Carboniferous shells which I have placed under the genus *Goniophora*, to those described by the above authors from the Devonian beds of Germany and North America. Neither can there be any doubt as to the advisability of removing these species from the genus *Cypricardia* on account of the structural differences in the hinge, and, moreover, according to Fischer ('Manuel de Conchyliologie,' p. 1072), *Cypricardia*, Lamarck, 1819, was forestalled by *Libitina*, Schumacher, 1817. Neumayer, however, erected a new family, *Goniophorinæ*. It would seem that some of the species included under *Mecynodon*, Keferst, have some external resemblance to *Mytilomorpha*. Some species are, however, entirely without the typical carination. Frech ('Zeit. deutsch. Geol. Ges.,' Bd. xli, p. 127) thinks some

species of this genus are related to *Myophoria*. Kayser ('Jahresbuch Preuss. Geol. Landes,' 1844) thought that there was more similarity between *Mecynodon* and *Mytilomorpha*, but with this Frech evidently does not agree. Beushausen (*op. supra cit.*) retains both *Goniophora* and *Mecynodon*, and he gives such fine figures of the hinge-plate of the latter genus as make it at once plain that the two genera have little or nothing in common. The shape and external marking of the valves in *Mytilomorpha*, and the possession of traces of a byssal sinus, seem to point conclusively to a descent from a mytiliform ancestor; but at the same time the position of the adductor muscle-scars, the large lunule and escutcheon, and the structure of the hinge and absence of an internal ligament, show that the shell cannot be retained in any genus of the family *Mytilidæ*. I have not been able to satisfy myself that a byssus was actually present, the inferior margin of the valves of *Mytilomorpha* containing no byssal notch. The genus is, on the other hand, closely related to *Cypricardella* and *Sanguinolites*, in the latter of which *M. rhombea* has been placed by de Koninck. I think, however, that, seeing how in Devonian times many allied forms were in existence, it is better to separate the strongly keeled mytiloid group from *Sanguinolites*, as other authors have done. *Cypricardella* has such a characteristic hinge and concentric markings on the surface that there can be no doubt of the propriety of distinguishing these two genera. *Sanguinolites* may be distinguished from *Mytilomorpha* by its more transverse, less oblique, less strongly carinate form, with the surface of the valves more ornate, generally furnished with lamellæ or concentric sulcations and ridges, having a rolled hinge-plate, and one or more radiating folds on the dorsal slope.

Although much more numerous a species in Devonian times, I only refer two species of Carboniferous Lamellibranchs to *Mytilomorpha*, one of which is new. The typical Carboniferous form is that described by Phillips as *Cypricardia rhombea*.

De Ryckholt referred the same species to *Solenopsis*.

It seems probable, from the description, that the shell described by Waagen (*op. supra cit.*) as *Eucharis grandæva*, from the Salt Range of India, should rather be referred to *Mytilomorpha*. I am at a loss to conceive why he should have thought that there existed grounds for referring this shell to any genus of the *Myidæ*. His description is an excellent one, and perfectly characteristic of the genus *Mytilomorpha*.

MYTILOMORPHA RHOMBEA, *Phillips*, sp., 1836. Plate XXXVIII, figs. 6—11.

CYPRICARDIA RHOMBEA, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209, pl. v, fig. 10.
— GLABRATA, *Phillips*, 1836. Ibid., p. 209, pl. v, fig. 25.

CYPRICARDIA BIPARTITA, *de Koninck*, 1842. Desc. anim. foss. de Belg., p. 94, pl. i, figs. 15 *a—c*.
— RHOMBEA, *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 86.
— GLABRATA, *Morris*, 1843. Ibid., p. 85.
— RHOMBEA, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 61.
— — *de Verneuil*, 1845. Geol. Russia in Europe, &c., vol. ii, p. 304, pl. xix, fig. 15.
— — *Bronn*, 1848. Nomenclat. Palæontol., p. 386.
— GLABRATA, *Bronn*, 1848. Ibid., p. 386.
— RHOMBEA, *Brown*, 1849. Atlas Foss. Conch., pl. lxxxi, fig. 3.
— GLABRATA, *Brown*, 1849. Ibid., pl. lxxxi, fig. 10.
— RHOMBEA, *d'Orbigny*, 1850. Prodrome de paléontol., p. 130.
SOLENOPSIS SCAPHA, *de Ryckholt*, 1853. Mélanges paléontol., p. 61, pl. xiv, figs. 5, 6.
CYPRICARDIA RHOMBEA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 198.
— GLABRATA, *Morris*, 1854. Ibid., p. 198.
Non — RHOMBEA, *Eichwald*, 1860. Lethæa Rossica, vol. i, p. 1014.
— — — *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 51.
— — GLABRATA, *Young and Armstrong*, 1871. Ibid., p. 50.
— — RHOMBEA, *Young, Armstrong, and Robertson*, 1876. Cat. West Scotl. Foss., p. 53.
— — GLABRATA, *Young, Armstrong, and Robertson*, 1876. Ibid., p. 53.
— RHOMBEA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 305.
— GLABRATA, *Bigsby*, 1878. Ibid., p. 305.
SANGUINOLITES RHOMBEUS, *de Koninck*, 1885. Ann. Mus. d'Hist. Nat. de Belgique, tom. xi, p. 68, pl. xv, fig. 28.
— BIPARTITUS, *de Koninck*, 1885. Ibid., p. 69, pl. xv, fig. 27.
— CUNEATUS, *de Koninck*, 1885. Ibid., p. 71, pl. xvi, figs. 14, 15.
— SCAPHA, *de Koninck*, 1885. Ibid., p. 70, pl. xv, fig. 38.
CYPRICARDIA RHOMBEA, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 282.
— GLABRATA, *Etheridge*, 1888. Ibid., p. 282.

Specific Characters.—Shell above medium size, very inequilateral, transversely and somewhat irregularly trapezoidal, narrowed anteriorly, expanded posteriorly, strongly carinate. The anterior end is very small and narrow, projecting forwards much below the level of the rest of the valve, its border an irregular ellipse passing into the long and straight ventral margin, which forms the longest diameter of the shell, and meets the posterior margin at a rounded right angle. The posterior border is truncate from above downwards, and is almost vertical, very slightly curved, meeting the hinge-line at a rounded angle, almost a right angle. The hinge-line is arched in front but produced, straight and elevated behind. The umbones are comparatively small, angular, incurved and directed forwards, so that they appear produced over the small and low anterior part, but do not form the most anterior part of the valve. Passing obliquely downwards

and backwards from the umbo to the postero-inferior angle is a strong well-marked angular ridge, which divides the shell into two almost equal triangular portions, which are inclined to each other at an obtuse angle. The inferior and lower is compressed and hollowed from before backwards just in front of the ridge, but becomes convex in the anterior part of the valve. The upper and posterior triangle is gently convex, and forms the dorsal slope, but becomes compressed and expanded towards the posterior border. Lunule well developed. Escutcheon large and broad.

Interior.—The anterior adductor muscle-scar is large, deep, and rough, and occupies almost the whole of the cavity of the anterior portion of the shell, and is surrounded behind by a broad ridge of moderate dimensions. The posterior adductor scar is large, smooth, deep posteriorly, and placed immediately below the superior border some distance from the posterior end. The anterior part of the hinge has not been exposed, but posteriorly there is evidence of a simple edentulous, rolled, hinge edge. The pallial line is well marked, entire, and remote from the margin.

Exterior.—The surface is covered with fine, almost obsolete, close, concentric lines and striæ of growth, which in the front part of the valve become near the lower edge collected into bundles separated by deeper grooves. Towards the posterior edge the lines of growth are stronger, and may become almost imbricate. Shell thin.

Dimensions.—The type specimen of Phillips's *Cypricardia rhombea*, Pl. XXXVIII, fig. 8, measures—

Antero-posteriorly	30 mm.
Dorso-ventrally	·18 mm.
Greatest lateral gibbosity of single valve . .	7 mm.

A very large specimen from the Isle of Man, in the collection of Mr. Law, Pl. XXXVIII, fig. 11, measures—

Antero-posteriorly	·90 mm.
Dorso-ventrally	·38 mm.
Laterally	14 mm.

Localities.—England: the Carboniferous Limestone of Hill Bolton and Settle, and the Bolland District of Yorkshire; Wetton, North Staffordshire; Thorpe Cloud, Dovedale, and Castleton, Derbyshire; the Upper Shelly Limestone of Poolvash, Isle of Man. Ireland: the Carboniferous Limestone of Ballycahane, co. Limerick.

Observations.—Under the names *Cypricardia rhombea* and *C. glabrata*, Phillips described two shells from the Carboniferous Limestone of Bolland, of which the type of the former only is still preserved. This is in the Gilbertson Collection of the Museum of Natural History, South Kensington, and I am kindly permitted

by the authorities to refigure it, Pl. XXXVIII, fig. 8. I have, however, a strong suspicion that the two shells really belong to one species, and that *C. glabrata* was only the young state of *Mytilomorpha rhombea*. I have therefore considered it as a synonym, but it would be impossible to retain the species in the absence of the type and any definite description; for, meagre as were the descriptions generally given by Phillips, he described his *C. rhombea* as "rhomboidal valves diagonally carinated," and *C. glabrata* "ovato-rhomboidal valves diagonally tumid."

In company with Morris, de Verneuil, Etheridge, and others, I regard the *C. bipartita* of de Koninck (*op. supra cit.*) as a synonym of Phillips's shell, although in his later work de Koninck protests against such a view, and says, p. 69, "le *S. rhombeus* est relativement plus large, surtout vers son extrémité postérieure, que le *S. bipartitus;* parce que le carène diagonale de celui-ci est beaucoup plus arquée, et que son bord antérieur est formé d'une courbe d'un rayon beaucoup plus court." He gives the following comparative dimensions :—*S. rhombeus*, l. 30 mm., h. 15 mm., ép. 12 mm.; *S. bipartitus*, l. 25 mm., h. 12 mm., ép. 14 mm. I do not believe that any useful purpose can be served by the erection of species on small differences in comparative measurements, and I would remark that in Belgium both species occur at the same horizon, Étage III, Viséan. Judging from the drawing alone there would be some doubt whether de Verneuil's shell is identical with Phillips's, but that author expresses himself in the text as thoroughly convinced upon this point.

I have placed *Solenopsis scapha* of de Ryckholt as a possible synonym. This species occurred in the beds at Visé, and the species was adopted by de Koninck, who figures a very young specimen.

I am also disposed to regard de Koninck's *Sanguinolites cuneatus* as synonymous with *M. rhombea.*

I am of opinion that an error has been made in referring shells, from various localities in the Carboniferous series of the west of Scotland, to the species by Messrs. Young and Armstrong. I have as yet seen nothing like the shell from these localities, but in Scotch cabinets I find that the name *Cypricardia rhombea*, Phillips, is applied to those shells which I describe, p. 356, as *Cypricardella rectangularis.*

The full-grown example, fig. 11, Pl. XXXVIII, from the cabinet of Mr. R. Law of Hipperholm, Yorkshire, far exceeds in size any other specimens with which I am acquainted, and serves to emphasise the essential differences between this species and *M. angulata.* This specimen is a cast of the interior, only incomplete at the postero-superior angle. The details of the anterior part of the hinge are still unknown, and only enough of the posterior hinge-line is left to show a rolled edge and the absence of a lateral tooth. There is no evidence that

this or any other species of the genus possessed a byssus, but the marked sulcation anterior to the ridge very closely resembles the byssal sulcus in shells possessing that organ, but it is probably an ancestral relic pointing to descent from some byssiferous ancestor.

MYTILOMORPHA ANGULATA, sp. nov. Pl. XXXVIII, figs. 12—18.

Specific Characters.—Shell large, triangularly cuneate, much swollen, markedly angulate and carinate, very inequilateral and oblique. The anterior end is very short and narrowed from above downwards, much compressed, its border rounded and small in extent. The inferior border is produced, sinuous, directed downwards and backwards, and becomes convex posteriorly. The posterior border is truncated obliquely from above downwards and backwards, nearly straight for the upper two-thirds, but below it is gradually rounded forwards to meet the inferior border at a well-marked angle, slightly larger than a right angle. The hinge-line is arched and depressed in front, but posterior to the umbones is straight and produced. The umbones are small, pointed, contiguous, twisted forwards and downwards, and reach almost as far as the anterior edge of the shell, above which they are raised. The lunule is deep and excavated, and the escutcheon is long and wide, bounded externally by a marked elongate angular fold. Passing backwards and downwards from the umbo to the posterior inferior angle is a very high acute ridge, which is gently sinuous and often everted in a downward direction, and divides the valves into two unequal parts—an anterior and lower, which is elongate and narrowed; an upper and posterior, which is shorter and broader. These portions are placed at an angle of about 45° to each other. To attain this position the lower portion becomes twisted on itself, the extreme anterior end being flat and vertical. The lower portion of the valve is compressed and hollowed so as to be slightly concave on section, the lower part of the valve being bent rapidly inwards to meet its fellow; the upper portion, forming the dorsal slope, is regularly but slightly convex.

Interior.—The anterior adductor muscle-scar is large, deep, and triangular, placed within the small anterior end, the greater part of which it occupies. The scar is bounded behind and below by a ridge of shelly material. The posterior adductor scar is large, rounded, rough, placed well within the margin of the shell, and some distance below the hinge-line in the hollow of the posterior slope. The pallial line is entire and remote from the margin.

The hinge has not been clearly seen.

The interior of the shell is smooth, the anterior portion showing behind the

ridge bounding the muscle-scar an oblique hollow, behind which is an oblique depression.

Exterior.—The shell is covered with concentric lines of growth, which become very much accentuated as they approach the oblique ridge; on the posterior slope they become flattened and markedly imbricate. The shell is of moderate thickness.

Dimensions.—Fig. 12, Pl. XXXVIII, in my own collection from the upper bed of Thorpe Cloud, measures—

Antero-posteriorly	73 mm.
Dorso-ventrally	45 mm.
Elevation of valve	15 mm.

Locality.—England: the Carboniferous Limestone of Thorpe Cloud, Derbyshire.

Observations.—*Mytilomorpha angulata* attains to a fairly large size, but it is much less transverse and more nearly quadrate than *M. rhombea;* moreover in the latter the segment of the valve in front and below the oblique keel is almost equal to the upper and posterior segment, but with regard to *M. angulata* the latter is much larger than the former, and in addition the oblique ridge is also much more acute, and the anterior end is much smaller in every way.

This species has a considerable superficial resemblance to a mytiloid shell, especially to *Myalina Flemingi*, but the internal characters and the hinge-line show that it has no real affinity to this genus. I cannot find any Belgian specimens of this species, nor at present have I obtained it from any other locality than that of Thorpe Cloud at the entrance to Dovedale. Here it is not at all uncommon, but perfect examples are rare, and I have not yet seen a specimen possessing both valves *in situ*. Casts of the hinge are not common, but show a simple linear hinge edge posteriorly, and in front a thickened hinge-plate with indications of teeth.

Family CRASSITELLIDÆ.

Genus CYPRICARDELLA, *Hall*, 1858.

VENUS, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209.
MICRODON, *Conrad*, 1842. Journ. Acad. Nat. Sci. Phil., vol. viii, p. 247.
CYPRICARDIA, *de Koninck*, 1843. Desc. Anim. Foss., p. 97.
ASTARTE (pars), *de Koninck*, 1843. Ibid., p. 80.
VENUS, *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 104.
— *Brown*, 1849. Illust. Foss. Conch., p. 205.
CYPRICARDIA (pars), *d'Orbigny*, 1851. Prodrome de Paléontol., p. 130.
MEGALODON (pars), *d'Orbigny*, 1851. Ibid., p. 130.

ASTARTE, *de Ryckholt*, 1853. Mélanges paléontol., 2me partie, p. 111.
VENUS (?), *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 231.
CYPRICARDELLA, *Hall*, 1856. Trans. Albany Inst., vol. iv, p. 17.
ASTARTELLA, *Hall*, 1858. Geol. Rep. Iowa, p. 715.
CYPRICARDIA, *Armstrong*, 1864–5. Trans. Geol. Soc. Glasgow, vol. ii, pt. 1, p. 28.
— *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 50.
— *Young, Armstrong, and Robertson*, 1876. Cat. West Scottish Foss., p. 53.
EODON, *Hall*, 1877. Am. Pal. Foss., 1st edit., p. 244.
CYPRICARDIA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 305.
CYPRICARDELLA, *Bigsby*, 1878. Ibid., p. 304.
ASTARTELLA, *Bigsby*, 1878. Ibid., p. 298.
MICRODONELLA, *Œhlert*, 1881.
CYPRICARDELLA, *Whitfield*, 1882. Bull. Am. Mus. Nat. Hist., vol. i, No. 3, p. 63.
— *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belge, tom. xi, p. 91.
? EDMONDIA (pars), *de Koninck*, 1885. Ibid., p. 43.
MICRODON (CYPRICARDELLA), *Hall*, 1885. Nat. Hist. N. York Palæontol., vol. v, pt. 1, Lamell., ii, p. xxv.
CYPRICARDELLA, *Fischer*, 1887. Man. de Conchyliologie, p. 1020.
SANGUINOLITES (pars), *de Koninck*, 1888. Ibid., p. 64.
CYPRICARDIA, *Etheridge*, 1888. Brit. Foss., pt. Palæozoic, p. 282.
— *Miller*, 1889. N. Amer. Geol. and Pal., p. 474.
CYPRICARDELLA, *Beushausen*, 1889. Jahrbuch d. Königl. Geol. Landesanstalt, S. 226.
— *Œhlert*, 1889. Unterdevon. Zeitschrift a. Deutsch. Geol. Ges., Bd. xli, p. 213.
ASTARTELLA, *Miller*, 1889. N. Amer. Geol. and Pal., p. 463.
— *Keyes*, 1894. Missouri Geol. Surv., vol. v, p. 125.
— *Goodchild*, 1894. Proc. Roy. Phys. Soc. Edin., vol. xii, p. 356.
CYPRICARDELLA, *Beushausen*, 1895. Abl. Königl. Preuss. Geol. Landesanstalt, Heft 17, p. 134.

Generic Characters.—Shell ovate, subquadrate, compressed, with a truncated posterior end and oblique ridge. Lunule and escutcheon large, the outer edge of the latter strongly everted. Shell ornamented with concentric ridges or striæ of growth.

Interior.—Hinge with one or two cardinal teeth in each valve, and a long lamellar anterior and posterior lateral teeth. Pallial line entire, internal surface of lower margin often crenulated, shell moderately thick.

Observations.—The genus *Cypricardella* was founded in 1856 by Hall for shells which have been shown to be identical with *Microdon* of Conrad. The latter name, however, had been used by Agassiz for a genus of fishes, and, as de Koninck points out, by Meigen for a genus of Diptera in 1803, and consequently

has to be discarded. Whitfield and de Koninck have both adopted *Cypricardella*, the latter referring fifteen species to it from the Carboniferous beds of Belgium, four of them being doubtfully placed in this genus.

In the second volume of the ' Lamellibranchiata of New York ' (*op. supra cit.*) Hall acknowledges the identity of *Microdon* and *Cypricardella*. I am of opinion that Hall's genus *Astartella* is probably identical with *Cypricardella*. The species on which this genus was founded, *A. vera*, possesses all the characters which I regard as diagnostic of *Cypricardella*. The date of the description of *Astartella* is 1858, the same year as that of *Cypricardella*, but I am unable to ascertain which of the two was actually published first.

It is to be noted that the existence of a posterior lateral tooth was not recognised in either of Hall's genera, but the hinge of *Cypricardella* is described as follows :—" Hinge characterised by a triangular tooth in each valve, that of the left valve short and situated beneath the beak, with a more elongate pit or groove behind it for the reception of the tooth of the right valve. The right valve has also a triangular pit beneath the beak for the reception of the short tooth in the left valve, and a long triangular fold behind, which is sometimes double. No lateral teeth have been observed, unless the long oblique fold of the right valve be regarded as a lateral tooth." It is just such a character as this that I have described as a lateral tooth, and if the sides of a tooth socket be at all pronounced they immediately become cardinal teeth ; hence I consider that this description of the hinge is practically identical with that which obtains in the Carboniferous shells which I refer to *Cypricardella*. De Koninck says that the right valve has two teeth separated by a socket for the single tooth of the left valve, and the cardinal border possesses a long straight groove in both valves destined to receive a ligament which is partly external and partly internal. With the fact that a groove is present I am in agreement, but I do not consider that this groove was for the ligament, as the edges of the valves are in contact at the bottom of the escutcheon, and it is difficult to see how a ligament in such a case could be partly external and partly internal.

Astartella is stated to have two teeth in each valve, the anterior tooth of the right valve being large and strong, and having a longitudinal pit in the summit ; but I am only able to find figures of the hinge in the work (*op. supra cit.*) with the original description.

The shells now referred to *Cypricardella* have been generally classed with *Cypricardia* by British palæontologists, but the characters of the hinge at once separate them from this genus ; but I think that Hall's genus may be placed in the family *Crassitellidæ* rather than in the family *Astartidæ*, to which Fischer and Beushausen have referred it, though it really possesses characters intermediate between the two genera.

Cypricardella is very closely related to *Mytilomorpha* and *Sanguinolites*. The former genus is, however, distinguished by its strong keel dividing the shell into two flattened triangular portions, the absence of well-marked posterior lateral teeth, and the relatively small development of the lunule and escutcheon, the almost obsolete anterior end, the pointed, almost terminal, and angularly compressed umbones, and the absence of regular concentric grooves and ridges externally. The genus *Sanguinolites* is even more closely related to *Cypricardella*, but is more transverse, has a stronger diagonal fold or ridge, and a rolled edge to the hinge-plate posteriorly and an entirely different hinge. The escutcheon is without an everted edge, and the concentric ridges and markings fail on the dorsal slope, which is hollowed and often traversed by one or more diagonal lines, and the periostracum is tuberculated.

Edmondia filigrana, de Koninck, if correctly drawn, is shown to possess a lunule and escutcheon, and therefore cannot be correctly referred to that genus, which possesses neither of those characters. It is of course possible that the artist has committed the error, but if lunule and escutcheon are present the shell would have far greater affinities with *Cypricardella* than with *Edmondia*.

CYPRICARDELLA PARALLELA, *Phillips*, sp. Plate XXXIX, figs. 1—7.

VENUS PARALLELA, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209, pl. v, fig. 8.
CYPRICARDIA PARALLELA, *de Koninck*, 1843. Desc. Anim. Foss., p. 97, pl. iii, fig. 15.
VENUS PARALLELA, *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 104.
— — *Brown*, 1849. Illust. Foss. Conch., p. 205, pl. lxxxiii, figs. 3, 4.
CYPRICARDIA PARALLELA, *d'Orbigny*, 1851. Prodrome de paléontol., p. 130.
ASTARTE PARALLELA, *de Ryckholt*, 1853. Mélanges paléontol., partie ii, p. 119.
— DECURTATA, *de Ryckholt*, 1853. Ibid., p. 113, pl. xv, figs. 5, 6.
? — STENOSOMA, *de Ryckholt*, 1853. Ibid., p. 118, pl. xv, figs. 9, 10.
VENUS? PARALLELA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 231.
ASTARTE PARALLELA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 299.
CYPRICARDIA PARALLELA, *Bigsby*, 1878. Ibid., p. 305.
ASTARTE STENOSOMA, *Bigsby*, 1878. Ibid., p. 301.
CYPRICARDELLA PARALLELA, *de Koninck*, 1885. Ann. Mus. d'Hist. Nat. Belge, tom. xi, p. 96, pl. xiii, figs. 50, 51.
— DECURTATA, *de Koninck*, 1885. Ibid., p. 94, pl. xxi, figs. 35, 36.
? — STENOSOMA, *de Koninck*, 1885. Ibid., p. 95, pl. xxi, figs. 24—27.
CYPRICARDIA PARALLELA, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 282.
? VENUS PARALLELA, *Goodchild*, 1894. Proc. Roy. Phys. Soc. Edinburgh, vol. xii, p. 356.

Specific Characters.—Shell below medium size, subrhomboidal, slightly gibbose, inequilateral. The anterior end is short, moderately deep, excavated above by a

deep lunule, compressed, with a regularly rounded border. The inferior margin is regularly and gently convex. The posterior margin is subtruncate, slightly convex, the postero-inferior angle regularly rounded, the postero-superior a well-marked slightly obtuse angle. The hinge-line is arched, produced, and depressed posteriorly. The umbones are small, incurved and twisted forwards, pointed, contiguous, slightly raised above the hinge-line, and placed at the junction of the anterior and middle thirds of the valve. Passing obliquely downwards and backwards from the umbo to the postero-inferior angle is an obscure ridge which separates the compressed and flattened dorsal slope from the rest of the valve, which is regularly but gently curved, the greatest convexity of the valves being subumbonal. A strong ridge passes backwards from the umbo to the postero-superior angle, separating the escutcheon from the dorsal slope. The escutcheon is large and elongate, and trench-like.

Interior.—No details of the interior have been observed.

Exterior.—The surface is ornamented with regular, close, concentric, fine ridges and sulci, which are continued over the dorsal slope, and terminate in the hinge-line. Shell comparatively thick.

Dimensions.—Fig. 3, Pl. XXXIX, from South-west Yorkshire, measures—

Antero-posteriorly	17 mm.
Dorso-ventrally	14 mm.
From side to side	9 mm.

Localities.—The Carboniferous Limestone of Hill Stebden, Yorkshire, and Pilsbury, Derbyshire.

Observations.—Type specimen of Phillips's *Venus parallela* is preserved in the Gilbertson Collection of the Natural History Museum, South Kensington, and I am permitted to refigure it by the kind permission of Dr. Henry Woodward, fig. 1, Pl. XXXIX. It is a much smaller specimen than some of those I figure, but is fairly perfect. De Koninck somewhat doubtfully referred a specimen from the Limestone of Visé to this species (*op. supra cit.*); and de Ryckholt also adopted it, but undoubtedly described as new, shells of this same species which varied slightly in shape from his conception of the type. De Koninck in his later work adopted several of de Ryckholt's species, but I consider that these are founded on insufficient evidence, the minor differences of size and strength of the external ornament not being of specific value.

C. concentrica approaches nearer to *C. parallela* than any other species of the genus, but the hinge-line is much straighter and more produced posteriorly, and much less compressed, the concentric ridges are much fewer, larger, and further apart, and the shells less convex.

Phillips gives the locality for his shell as Bolland. I have not yet been able to obtain any of his species in that district, though the majority of those

referred to Bolland are to be obtained in the Craven district. A series of five well-preserved but small specimens of this species are in the Museum of the Geological Survey, Jermyn Street, and Mr. E. J. Garwood has collected several examples from the so-called knoll reefs between Cracoe and Burnsall in Craven. Mr. Goodchild refers a number of specimens, in the Armstrong Collection of the Edinburgh Museum of Science and Art, and in the collection of the Geological Survey, to the *Venus parallela* of Phillips, and states that in his opinion this species should be referred to *Cypricardella* of Hall. I expect that he has mistaken *C. crebricostata* of Armstrong and some of the other species of the genus which occur in Scotland for Phillips's shell. He evidently is in error in supposing that the *Cypricardia rhombea* of authors has any relationship to *C. parallela*, for it belongs to a totally different genus, and I have not met with any specimens of that shell from the Carboniferous beds of Scotland. Fig. 6, Pl. XXXIX, is a curious variety, differing much in contour from the type of the species. As it is the only specimen of its kind, I hesitate to erect a new species for it, and for the present suggest that it may be a mere sport.

CYPRICARDELLA CONCENTRICA, sp. nov. Pl. XXXIX, figs. 8—11.

? VENUS ELLIPTICA, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, 1871, vol. iii, Supplement, p. 54.

? — — *Young, Armstrong, and Robertson*, 1876. Cat. West. Scot. Foss., p. 55.

Specific Characters.—Shell small, subcircularly quadrate, very moderately gibbose, slightly inequilateral, very obscurely carinate. The anterior end comprises the anterior third of the valve, and is compressed and narrowed; its border rounded, forming with the inferior border as far as the postero-inferior angle a single almost semicircular curve. The posterior margin is almost straight and obliquely truncate from above downwards and forwards, forming a well-marked almost right angle with the hinge-line, and being bluntly rounded below into the inferior border. The hinge-line is arched, straight, depressed, and often bent downwards on itself posteriorly. The umbones are small, pointed, incurved, contiguous, tumid, slightly raised and placed in front of the middle line. The lunule is narrow, steep, and elongate, the escutcheon broad, deep, and long, marked off from the dorsal slope by an erect, narrow, slightly curved, angular ridge, often bent on itself. Passing downwards and obliquely backwards from the umbones to the postero-inferior angle is an obscurely angular ridge, which separates the compressed and hollowed dorsal slope from the rest of the valve, which is regularly but very gently convex.

Interior.—The anterior adductor muscle-scar is small, round, and marginal. The posterior, very small, is placed immediately below the hinge-line, remote from the posterior end. The pallial line is entire. The hinge consists of a single cardinal tooth with a cavity on each side of it, and an elongate posterior lateral lamellar tooth in the right valve. In the left are two cardinal teeth, separated by a deep triangular cavity and an elongate posterior lateral tooth. Formula $\frac{\text{R. } 0,010,1}{\text{L. } 0,101,1}$. The interior of the valve is smooth.

Exterior.—The surface is ornamented with regular, concentric, raised angular ridges, separated by grooves which are finely striated concentrically; these ridges all terminate at the oblique ridge, only an occasional one being carried across the dorsal slope, which is smooth or very finely striate. Shell moderately thick for its size.

Dimensions.—Fig. 8, Pl. XXXIX, a specimen in the cabinet of Mr. J. Neilson, measures—

Antero-posteriorly	17 mm.
Dorso-ventrally	14 mm.
From side to side	8 mm.

Localities.—Scotland: the Upper Limestone series of Linn Spout, Dalry, and Gare; the Lower Limestone series of Law, near Dalry, and Craigen Glen.

Observations.—I am of opinion that the species just described has been referred to *Venus elliptica* of Phillips by Scotch geologists, but that shell is probably a truncated and incompletely preserved specimen of *Allorisma sulcata.* The majority of specimens which I have examined are small, but Messrs. Neilson and Smith have lent me specimens, Figs. 8 and 10, Pl. XXXIX, which show the shell in its adult state. Mr. Smith, in addition, has examples of the shell showing the hinge, fig. 10 *a*, Pl. XXXIX.

The majority of the species of this genus are not so strongly ribbed concentrically, but one other species, *C. parallela,* which occurs in the Carboniferous Limestone of Hill Stebden, S.W. Yorkshire, possesses this character; here the ribs are much more numerous and closer, and the shell is more gibbose, and has the postero-superior angle much less elevated. The *Astartella vera* of Hall has a very close resemblance indeed to *C. concentrica,* but is more gibbose, transverse, and has a well-marked oblique ridge, and the concentric ridges are more numerous and closer. I have been able to compare the two species directly, as a series of *Astartella vera* were sent to me by the Smithsonian Institution.

CYPRICARDELLA CREBRICOSTATA, *Armstrong*, sp., 1865. Plate XXXIX, figs. 12, 13.

CYPRICARDIA CREBRICOSTATA, *Armstrong*, 1865. Trans. Geol. Soc. Glasgow, vol. ii, pt. 1, p. 28, pl. i, fig. 4.
— — *Young and Armstrong*, 1871. Ibid., vol. iii, Supplement, p. 50.
— — *Young, Armstrong, and Robertson*, 1876. Cat. Western Scottish Fossils, p. 53.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 203.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 282.

Specific Characters.—Shell transversely subquadrate, tumid, anterior and posterior ends both narrowed in the dorso-ventral direction, inequilateral. The anterior end is short, the antero-superior angle a well-marked right angle, from which the margin descends, becoming rounded below, and passes with a rapid curve into the inferior border. The upper part of the anterior end is much encroached upon by a large depressed lunule. The inferior border is almost straight, rounded at either extremity. The posterior margin is bluntly truncate and almost straight, somewhat narrowed in adult specimens by the depression of the posterior part of the hinge-line. The hinge-line is arched, depressed and extended posteriorly, and may be emarginate, thus causing the postero-superior angle to vary in degree. The postero-inferior angle is a right angle. The umbones are comparatively large, tumid, elongate, twisted inwards, pointed, contiguous, very little raised, and placed in the anterior third of the valve. Passing obliquely downwards and backwards from the umbo to the postero-inferior angle is a bluntly rounded ridge, which separates the compressed and hollowed dorsal slope from the rest of the valve. The upper margin of the shell is formed behind by a raised angular everted ridge, which passes backwards and is somewhat depressed, and which separates the deep, wide and elongated escutcheon from the dorsal slope. Anterior to the oblique ridge the valve is regularly and convexly curved from above downwards and before backwards, being more convex in the dorso-ventral diameter.

Interior.—Not yet seen.

Exterior.—The surface is ornamented with very numerous regular distinct rounded ridges, only well seen under the microscope, which are continued across the dorsal slope to the upper margin of the valve. Shell thin.

Dimensions.—Fig. 13, Pl. XXXIX, from shale above the Arden Limestone, in the collection of Mr. J. Smith, measures—

Antero-posteriorly	12 mm.
Dorso-ventrally	10 mm.
From side to side	7 mm.

Localities.—Scotland: the Upper Limestone series of Westerhouse and Gare, in shale above the Arden Limestone, Carluke.

Observations.—This species is one of two very distinct species of the genus *Cypricardella* described by Armstrong (*op. supra cit.*). In the Armstrong Collection of the Edinburgh Museum of Science and Art are four tablets labelled *Cypricardia crebricostata.* Dr. Traquair has kindly compared them for me with specimens of other Scotch species which I forwarded to him, so that there is no doubt of the true characters of Armstrong's species, which can be distinguished from all others of the genus by its shape and markings. The concentric ribs are very regular, closer and finer than obtains in any other species. The shell is comparatively more gibbose than *C. parallela*, and has the posterior end narrowed from above downwards by the descent of the upper border, which is very marked. All the localities where the shell has been yet obtained are on one horizon, which is placed at 300 fathoms below the Ell coal. Armstrong's figures are much enlarged, but are not particularly distinctive of the species.

CYPRICARDELLA SELYSIANA, *de Koninck*, sp., 1843. Plate XXXIX, figs. 27—30.

CYPRICARDIA SELYSIANA, *de Koninck*, 1843. Desc. Anim. Foss., p. 95, pl. vi, fig. 7.
— — *d'Orbigny*, 1850. Prodrome de paléontol., p. 130.
TRAPEZIUM LYELLIANUM, *de Ryckholt*, 1853. Mélanges paléontol., 2me partie, p. 133, pl. xiv, figs. 27, 28.
— PRÆSECTUM, *de Ryckholt*, 1853. Ibid., p. 132, pl. xiv, figs. 15, 16.
CYPRICARDIA RHOMBEA, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glas., vol. iii, Supplement, p. 51.
— — *Armstrong, Young, and Robertson*, 1876. Cat. West. Scotl. Foss., p. 53.
— SELYSIANA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 305.
TRAPEZIUM PRÆSECTUM, *Bigsby*, 1878. Ibid., p. 315.
— LYELLIANUM, *Bigsby*, 1878. Ibid., p. 315.
SANGUINOLITES SELYSIANUS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 64, pl. xv, fig. 36.
— LYELLIANUS, *de Koninck*, 1885. Ibid., p. 64, pl. xv, fig. 39; pl. xvii, figs. 9, 10.
— PRÆSECTUS, *de Koninck*, 1885. Ibid., p. 67, pl. xv, fig. 37.
CYPRICARDIA SELYSIANA, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 282.

Specific Characters.—Shell very inequilateral, subquadrate, oblique, only moderately tumid, carinate. The anterior end is short and narrow in the dorso-ventral diameter, compressed, and its border is gradually rounded, its upper border being much below the level of the umbones. The inferior border is convex

in front, but almost straight for its posterior two thirds. The posterior border is truncated obliquely from above downwards and forwards, and is straight, so that the postero-superior angle projects further backwards than any other part of the shell. The postero-inferior angle is blunt and obtuse, the postero-superior angle almost a right angle, and is well marked. The superior border is much arched in front, and is almost straight posterior to the umbones. The umbones are small, pointed, twisted forwards, contiguous, and are placed very far forwards, being encroached upon in front by a large lunule. Passing obliquely backwards and downwards from the umbo to the postero-inferior angle is a blunt, obtuse, but well-defined ridge separating the shell into two unequal portions: the anterior or larger is very gently convex; the posterior is compressed, expanded and hollowed, forming the dorsal slope. The escutcheon is large, and becomes wider and deeper as it passes backwards.

Interior.—The anterior adductor muscle-scar is small and deep, situated immediately within the anterior superior angle, and separated from the rest of the shell by a ridge, which leaves a groove in casts. The posterior adductor scar is small and shallow, and is placed a little within the margin of the posterior superior angle. Pallial line entire. The hinge of the right valve consists of a thin anterior lamellar tooth, with a hollow groove above it for the corresponding tooth of the opposite valve, a cardinal tooth with a socket in front and behind it, and a long lamellar posterior lateral tooth.

Exterior.—The surface is ornamented with fine concentric lines of growth, and an occasional one so much accentuated that it forms a well-marked sulcus.

Localities.—Scotland: the Upper Limestone series of Gare, Robroyston. The Lower Limestone series of Craigen Glen; Law, Dalry. Roscobie and Daloch Quarry, Fife.

Dimensions.—Fig. 30, Pl. XXXIX, measures—

Antero-posteriorly	13 mm.
Dorso-ventrally	10 mm.
Elevation of valve	2·5 mm.

Observations.—This species was established for a specimen from the Limestone of Visé in 1842 by de Koninck, and re-described in 1885, a single figure only being given. In the meanwhile de Ryckholt (*op. supra cit.*) had described under the genus Trapezium two shells, also from the limestone of Visé, which I have no doubt are synonymous with *C. Selysiana*. De Koninck retained the three species, referring them to the genus *Sanguinolites*, and says in his observations on the latter species it is closer to *S. præsectus* and *S. Lyellianus* than any other, and is distinguished from the former by its rectangular shape, and from the latter by having the umbones placed not so far forward and by the prolongation of its anterior end below them. A large series of examples shows that these characters

are only varietal, or due to small differences of growth only, and indeed de Koninck's descriptions of all these species are practically identical. He has correctly recognised that the *Cypricardia rhombea* of Young and Armstrong is not the *C. rhombea* of Phillips, but referred it to *T. præsectum* of de Ryckholt.

I have been able fortunately to meet with shells showing the hinge and internal characters most perfectly preserved, and therefore have sufficient grounds for placing the species under *Cypricardella* rather than under *Sanguinolites;* but the external form, and above all the peculiar everted margin of the escutcheon, show more affinity to the former than to the latter genus.

CYPRICARDELLA ANNÆ, *de Ryckholt*, sp., 1853. Plate XXXIX, figs. 31—35.

? NUCULA CARINATA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 68, pl. xi, fig. 21.
? TRAPEZIUM ANNÆ, *de Ryckholt*, 1852. Mélanges paléontol., p. 134, pl. xiv, figs. 21, 22.
? LEDA CARINATA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 205.
CTENODONTA CARINATA, *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 303.
SANGUINOLITES ANNÆ, *de Koninck*, 1885. Ann. Mus. d'Hist. Nat. de Belgique, tom. xi, p. 65, pl. xvii, figs. 11, 12.

Specific Characters.—Shell small, oblique, nearly regularly diamond-shaped, inequilateral, strongly carinate. The anterior end is short, narrow, and almost obsolete, its border rounded. The inferior margin is straight, depressed, and comparatively short, meeting the posterior border at a wide obtuse angle. The posterior border is obliquely truncate from above downwards and forwards, almost straight, and about as long as the inferior border. The hinge-line is very long, arched in front, slightly curved, produced, depressed posteriorly, meeting the posterior border at a well-marked acute angle. The umbones are small, obtuse, twisted forwards, not elevated, and placed very far forwards. Passing downwards and obliquely backwards from the umbones to the postero-inferior angle is a well-marked obtuse keel, which divides the valve into two almost equal triangular portions: the lower and anterior is gently swollen; the upper and posterior is compressed and somewhat concave, forming an expanded dorsal slope. Lunule and escutcheon well marked. The latter is wide and deep, its edges angular.

Interior.—The anterior adductor muscle-scar is small, rounded, situated immediately within the antero-superior angle, and is marked off from the rest of the valve below and behind by a well-marked ridge. The posterior muscle-scar is larger, and is placed just within the postero-superior angle. The pallial line is simple. The hinge appears to have a thin elongate posterior lateral tooth, but the anterior part has not yet been isolated.

Exterior.—The surface is ornamented with many regular very fine lines of growth, parallel to the contour of the shell. Shell thin.

Dimensions.—Pl. XXXIX, fig. 35, a specimen from Poolvash, Isle of Man, in the collection of Mr. R. Law, measures—

Antero-posteriorly	16 mm.
Dorso-ventrally	12 mm.
From side to side	8 mm.

Localities.—England: the Carboniferous Limestone of Settle, Yorkshire; in shale above the Underset Limestone, Faraday Gill, West Flank of the Nine Standards, near Kirkby Stephen, and the Shelly Limestone of Poolvash, Isle of Man.

Observations.—This species was described by de Ryckholt under the term *Trapezium annæ*, and was referred to *Sanguinolites* by de Koninck (*op. supra cit.*). It has, however, a far greater affinity to *C. Selysiana*, the hinge of which has been isolated, and on these grounds I have removed it to the genus *Cypricardella*. The shape of the shell is peculiar, being almost a true lozenge. The oblique ridge is more pronounced and more nearly vertical than in *C. Selysiana*, apparently dividing the valve into two equal triangular portions. The postero-superior angle is so much produced backwards beyond the rest of the valve that the posterior margin is obliquely truncate downwards and forwards, and the postero-inferior angle is beneath the umbo.

I am inclined to think that the *Nucula carinata* of M'Coy may have belonged to this species. The type of this shell is still preserved in the Griffith Collection of the Science and Art Museum, Dublin, but it is so imperfect and badly preserved that I am unable to be absolutely certain as to what it really is. I have therefore felt unable to adopt this name, which is prior to that of de Ryckholt.

CYPRICARDELLA RECTANGULARIS, *M'Coy*, sp. Plate XXXIX, figs. 20—26.

? NUCULA RECTANGULARIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 71, pl. xi, fig. 20.

Specific Characters.—Shell very inequilateral, transversely rectangular, compressed, keeled. The anterior end is very short, and narrowed from above downwards, being only about half the height of the other dorso-ventral diameters of the valve. Its border is rounded, the antero-superior and inferior angles being obsolete. The inferior border is nearly straight, almost parallel to the hinge-line. The posterior border is truncate and nearly straight, almost vertical, with well-marked postero-superior and inferior angles. The hinge-line is arched in front, straight, somewhat raised, and produced posteriorly, as long as the

antero-posterior diameter of the valve. The umbones are small, contiguous, and directed forwards, and placed very anteriorly, much elevated above the anterior end, but not raised above the rest of the shell. The lunule is well marked, and the escutcheon elongate and narrow. Passing downwards and backwards obliquely from the umbo to the postero-inferior angle is an obtuse ridge, in front of which the valve is slightly convex, but behind it is rapidly compressed and expanded, forming the dorsal slope.

Interior.—The anterior adductor muscle-scar is small and round, placed immediately within the antero-superior angle. The hinge of the right valve has a single, central, cardinal tooth, with a socket on either side, a long, anterior, lamellar tooth, and a smooth hinge-plate posteriorly bevelled at the expense of its lower edge.

Exterior.—The surface is ornamented with fine, concentric, raised lines of growth.

Dimensions.—Fig. 21, Pl. XXXIX, in the collection of Mr. J. Neilson, from Gallowhill, Strathavon, measures—

Antero-posteriorly	12 mm.
Dorso-ventrally	8 mm.
From side to side	5 mm.

Localities.—England : in a thick bed of calcareous shales, in the Faraday Gill, above the Underset Limestone on the west flank of the Nine Standards, Kirkby Stephen. Scotland : the Upper Limestone series of Orchard, and Williamswood ; the Lower Limestone series of Craigen Glen, Campsie ; Gallowhill, Strathavon.

Observations.—This species, I have every reason to believe, is that described by Young and Armstrong in both their catalogues as *Cypricardia rhombea*, to which, however, it has not the very slightest resemblance. *C. rectangularis* is much less strongly marked with concentric ridges than *C. concentrica*, but is not so smooth as *C. Annæ;* but the latter is at once distinguished by its square shape, *C. rectangularis* always being oblong even in the very young. The stages of growth are very well marked on the valves, and the protoconch has the same shape as the full-grown shell.

Fortunately I have been able to obtain access to a specimen which shows the hinge-plate and part of the interior, fig. 23, Pl. XXXIX. This is in the collection of Mr. J. Smith, of Kilwinning.

Notwithstanding the large size of the escutcheon, no trace of external ligament is visible in the most perfect examples.

Nucula rectangularis, M'Coy, is preserved in the Griffith Collection of the Science and Art Museum, Dublin. It is a very small and poor specimen, but it certainly has many of the characteristics of the better preserved Scotch examples. M'Coy's description is far from accurate, and I cannot think that his observation

that the shell possessed hinge-teeth like *Nucula* can be correct. The shell is so unlike this genus in every important character, and I feel certain that it should be more correctly referred to *Cypricardella*. I have adopted M'Coy's name for the Scotch shells with a certain amount of hesitation, for the poorness of the type and the meagreness of the description make it impossible to be absolutely certain as to its identity.

In England I have only obtained specimens of this species from a bed of shale very high up in the Yoredale series of the Upper Eden Valley (*loc. supra cit.*). This shale has an interesting marine fauna, and is exposed in a little stream marked on the map as the Faraday Gill, which carries off the water from the west flank of the Nine Standards. The position of the shale is probably between the Underset and the Main Limestones, but it may be really higher up in the series. The stratigraphical succession is as follows, but some of the Limestones are evidently repeated by a fault.

Massive grit, forming top of hill.
Shales, much obscured by peat.
Massive grit.
Sandy micaceous shales with fragments of marine shells.
Grit, soft and red, very fossiliferous, containing *Productus semireticulatus, P. cora, Spirifera trigonalis, Sp. lineata, Sp. glabra, Sp. ovalis, Streptorhynchus crenistria, Athyris ambigua, Bellerophon*, sp., *Pleurotomaria*, sp.
Fine sandstones.
Thin sandy shales.
Muddy micaceous shales.
Chert.
Black cherty limestone.
Brown shales.
Sandstone, thick.
Sandy shales.
Sandstone full of plant remains.
Sandstone, massive.
Shales, micaceous.
Limestone, thick white, with encrinites; ? Main Limestone.
Sandstone.
Shales.
Thin coals.
Sandstone.
Sandy shales.
Black earthy shales.
Thin limestone.
Earthy shales.
Limestone.
Sandstone.
Sandy shales.
Black shale with thin sources of sandstone near the base.
Thin coal smut. (Series continued.)
Shales.
Thin coal.
Black shales.
Sandstone.
Limestone, thick, with large corals.
Black and grey shales becoming calcareous, very fossiliferous. With *C. rectangularis*, etc.
Limestone, thick; ? Underset Limestone.
Sandstone.
Shales with stigmaria.
Yellow stigmarian clay.
Thin sandstone.
Shales.
Thin coal.
Sandstone.
Dark shales.
Slack sandstone with plant remains.
Shales.
Limestone (? 3 yards limestone).
Sandstones.
Shales.
Grit.
Shales.
Limestone (5 yards limestone).
Shale.
Grit.
Shales.
Coal.
Underclay.
Grits.
Sandstones and shales.
Limestone (scar or middle limestone).

From the point near the shooting box the section is continued downwards in the stream, of which details have also been given in the 'Memoir of the Geological Survey, Geology of the Country round Mallerstang,' p. 83. Two beds of Limestone are seen in the section, which are identified as the Five Yards and the Middle Limestone, here full of *Productus giganteus*. This would make the Limestone immediately below the fossiliferous shales the Underset, and would fix the horizon of that band; but in a brook on the east side of Swarth Fell a series of fossiliferous shales are above the Main Limestone, and the faunas of the two localities are very nearly identical, though this fact only points to similarity of conditions under which the beds were deposited.

The following fossils occur with *C. rectangularis*:—*Cypricardella Annæ*, *Nuculana attenuata*, *Ctenodonta sinuosa*, *Pecten*, sp., *Murchisonia*, sp., *Discites*, sp., *Productus semireticulatus*, *P. punctatus*, *Spirifera trigonalis*, *Sp. ovalis*, *Athyris ambigua*, *Streptorhynchus crenistria*, *Discina nitida*, stems of encrinites, and *Phillipsia*, sp.

CYPRICARDELLA ACUTICARINATA, *Armstrong*, sp., 1865. Pl. XXXIX, figs. 14—19.

CYPRICARDIA ACUTICARINATA, *Armstrong*, 1865. Trans. Geol. Soc. Glasgow, vol. ii, pt. 1, p. 28, pl. i, figs. 3, 3 *a*.

— — *Young and Armstrong*, 1871. Ibid., vol. iii, Supplement, p. 50.

— — *Armstrong, Young, and Robertson*, 1876. Cat. Western Scottish Fossils, p. 53.

— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 203.

SANGUINOLITES ACUTICARINATA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat., tom. xi, p. 63, pl. xv, figs. 48—50.

CYPRICARDIA ACUTICARINATA, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 282.

Specific Characters.—Shell subtrapezoidal, at times almost quadrate, very inequilateral, strongly carinate. The anterior end is very short and low, and compressed, its border rounded, much encroached upon above by the comparatively large lunule. The inferior border is convexo-concave, and terminates posteriorly at a sharp-pointed projection where it meets the posterior border. The posterior border is truncated, slightly oblique from above downwards or even vertical, concave above; it joins the posterior border with a well-marked angle, which may project slightly backwards.

The superior border is shorter than the antero-posterior diameter of the shell, and appears to be straight for the greater part of its extent, but it is really gently arcuate when examined in the single valve.

The umbones are small, contiguous, pointed, twisted inwards and forwards, and are situated very far forwards. Springing from the posterior edge of the umbo is a very marked, raised, narrow, sharp, erect ridge, which passes obliquely downwards and backwards to the postero-inferior angle, becoming more pronounced as it passes across the shell. This ridge divides the valve into two

portions, of which the anterior is the larger, and this part of the valve is convexly swollen. Posterior to the ridge the valve is so rapidly compressed as to be concave along the dorsal slope. The lunule is large and cordate; the escutcheon large, deep, and elongate, deeper and wider behind than anteriorly.

Interior.—The anterior adductor muscle-scar is small and deep, situated immediately within the anterior superior angle, and separated from the rest of the shell by a ridge. The posterior adductor scar is small and shallow, situated at the posterior superior angle some little distance from the margin. Pallial line entire, very finely marked, and remote from the margin. The hinge consists in the right valve of a single cardinal tooth with a shallow pit on each side, and an elongate groove between two ridges posteriorly to receive the tooth of the opposite valve. The left valve possesses a central pit for the cardinal tooth of the right valve, with a rudimentary tooth on each side, and a single, long, lamellar posterior tooth. Formula $\begin{matrix} \text{R } 0\,;\ 010\,;\ 0 \\ \text{L } 0\,;\ 1.0.1\,;\ 1 \end{matrix}$. The inferior and posterior edges of the valve are finely serrate on the internal aspect, as in Astarte.

Exterior.—The surface is ornamented with very concentric, fine lines of growth, but here and there one of them becomes highly accentuated, especially near the lower border. The umbonal region and the upper part of the valve are almost smooth.

Dimensions.—Fig. 18, Pl. XXXIX, a specimen from Orchard, in the collection of Mr. J. Neilson, measures—

Antero-posteriorly	11 mm.
Dorso-ventrally	7 mm.
From side to side	8 mm.

Localities.—Scotland: the Upper Limestone series of Orchard; Linn Spout, Dalry; Robroyston; Gare and Westerhouse, Carluke; Williamswood, Cathcart; Auchentibber, Kilwinning; Lower Limestone series, Law, Dalry.

Observations.—This species was described as occurring in Scottish Carboniferous beds by Armstrong. It can be distinguished at once from all the smaller species of the genus by the strong, acute, oblique keel, which gives the shell a very characteristic contour when viewed from above. De Koninck has figured this species apparently from the Limestone of Visé, but from his language there appears to have been some doubt as to the locality. He says, "Cette espèce paraît avoir été trouvée dans le Calcaire Carbonifère de Visé."

I have been fortunate enough to isolate the hinge in a left valve in the collection of Mr. J. Smith, of Kilwinning, fig. 15, Pl. XXXIX. The other details have been obtained from mere fragments; in hinge structure and internal anatomy *C. acuticarinata* agrees entirely with those of *C. crebricostata*, of which some fine and perfect valves have been obtained.

PLATE XXVI.

Fig. 1.—*Sedgwickia gigantea.* M'Coy's type specimen preserved in the Griffith Collection of the Museum of Science and Art, Dublin. (Page 278.)

Fig. 2.—*Sedgwickia gigantea.* A full-grown, much crushed specimen. From the *Schizodus pentlandicus* bed, Randerston, Fife. My Collection. (Page 278.)

Fig. 3.—*Sedgwickia gigantea.* A cast of the interior. From Magazine, Midlothian. My Collection. (Page 278.)

Fig. 4.—*Sedgwickia scotica.* A very fine example. From the McDonald Limestone beds of Muirkirk. In the Collection of Mr. Adam Whyte, of Muirkirk. (Page 283.)

Fig. 4 *a.*—*Sedgwickia scotica.* The same specimen viewed from above.

Fig. 5.—*Sedgwickia scotica.* A medium-sized example. From the Lower Limestone series of Bath. In the Collection of Mr. J. Neilson. (Page 283.)

Fig. 6.—*Sedgwickia scotica.* A larger specimen. From the same locality at Muirkirk. My Collection. (Page 283.)

Fig. 7.—*Sedgwickia scotica.* A specimen with the anterior concentric lines of growth very well preserved. From Beith. My Collection. (Page 283.)

Fig. 8.—*Sedgwickia ovata.* A portion of a cast of a right valve, showing the anterior adductor muscle-scar. From the Redesdale Ironstone. My Collection. (Page 281.)

Fig. 9.—*Sedgwickia ovata.* A fairly perfect bivalve example. Same locality. My Collection. (Page 281.)

Fig. 9 *a.*—*Sedgwickia ovata.* The same specimen viewed from above.

Fig. 10.—*Sedgwickia ovata.* A specimen of a testiferous right valve of average size. Same locality. My Collection. (Page 281.)

Fig. 11.—*Sedgwickia ovata.* A specimen from the Scorpion beds of Glencartholne, Eskdale. My Collection. (Page 281.)

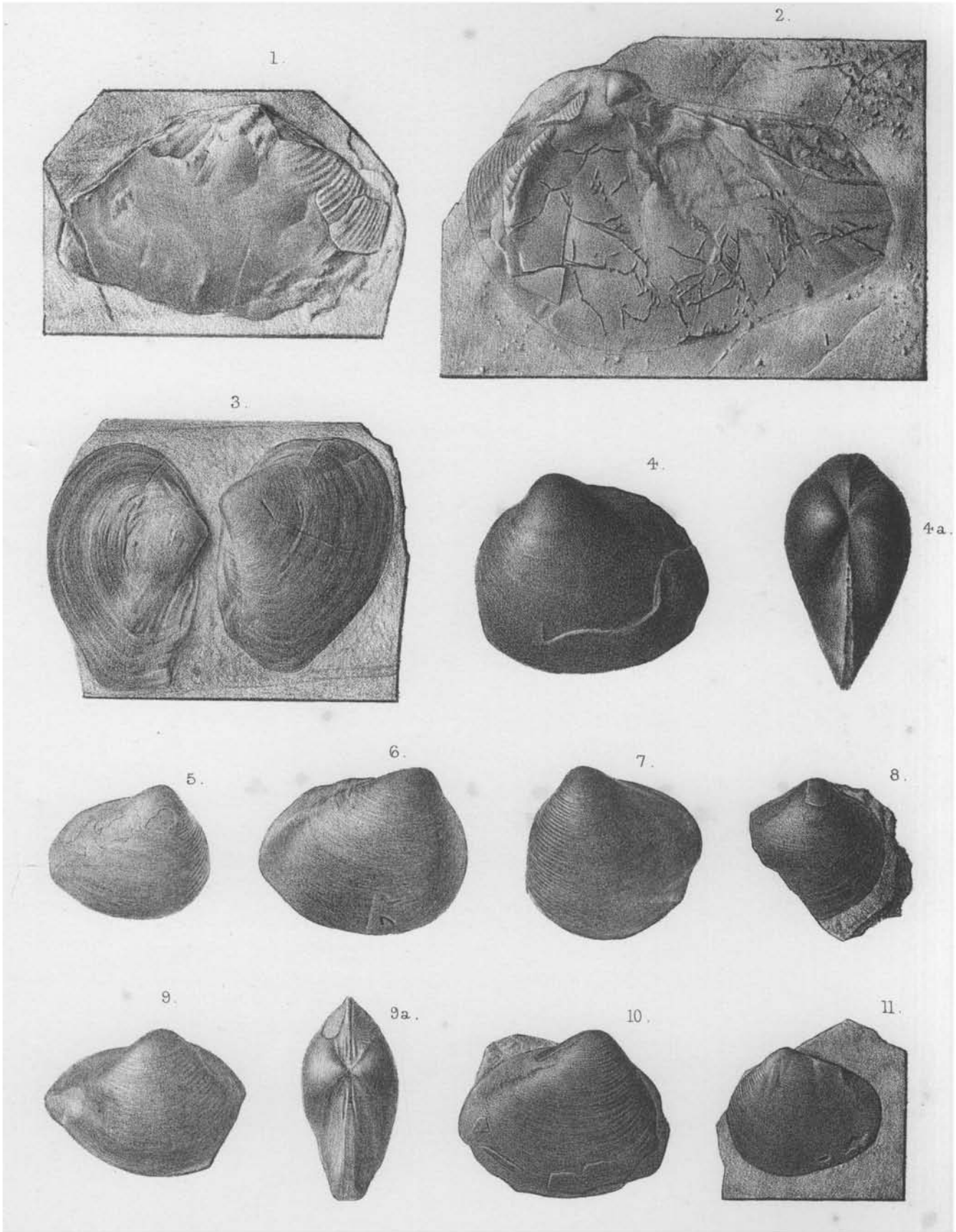

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PLATE XXVII.

Fig. 1.—*Sedgwickia ovata.* A right valve, showing the characteristic markings in front. From the Redesdale Ironstone. My Collection. (Page 281.)

Fig. 1 *a.*—*Sedgwickia ovata.* The same shell, showing the hinge with a small median cardinal tooth.

Fig. 2.—*Sedgwickia ovata.* A left valve with the shell removed posteriorly, showing the posterior adductor muscle-scar and pallial line. Same locality. My Collection. (Page 281.)

Fig. 3.—*Sedgwickia ovata.* A right valve with most of the test preserved. Same locality. My Collection. (Page 281.)

Fig. 4.—*Sedgwickia ovata.* A young specimen of the left valve. Same locality. My Collection. (Page 281.)

Fig. 5.—*Sedgwickia suborbicularis.* A testiferous left valve. From Pot Metal Plantation, Kirkaldy. In the Collection of the Geological Survey of Scotland. (Page 284.)

Fig. 6.—*Sedgwickia suborbicularis.* A full-grown left valve. From Inverteel Quarry, Kirkaldy. Same Collection. (Page 284.)

Fig. 7.—*Sedgwickia suborbicularis.* A young example. From Hope Quarry, Pathhead, Haddingtonshire. Same Collection. (Page 284.)

Fig. 8.—*Sedgwickia suborbicularis.* A testiferous right valve, showing erosion of the umbo. The same locality and Collection as Fig. 6. (Page 284.)

Fig. 9.—*Sedgwickia attenuata.* M'Coy's type. A right valve. Preserved in the Griffith Collection of the Museum of Science and Art, Dublin. (Page 285.)

Fig. 10.—*Sedgwickia gigantea.* The type of M'Coy's *Dolabra securiformis.* A cast of both valves. Same Collection. (Page 278.)

Fig. 11.—*Sedgwickia attenuata.* The cast of a right valve. From Calcareous-grit, Pulse Hill, near Marsden. My Collection. (Page 285.)

Fig. 12.—*Sedgwickia attenuata.* The cast of both valves. Same locality. My Collection. (Page 285.)

Figs. 13, 14. *Sedgwickia attenuata.* Casts. Same locality. My Collection. (Page 285.)

Fig. 15.—*Edmondia rudis.* A perfectly preserved cast of the interior. From the Carboniferous Limestone of Castleton, Derbyshire. In the Collection of Mr. J. Barnes, F.G.S. (Page 302.)

Fig. 15 *a.*—*Edmondia rudis.* The same specimen viewed from above, showing the grooves of the lamellæ attached to the hinge-plate.

Fig. 16.—*Edmondia unioniformis.* From the Carboniferous Limestone of Tournay, Belgium, showing the edentulous hinge, 16 *a*, and at 16 *b* the hinge viewed from below. (Page 291.)

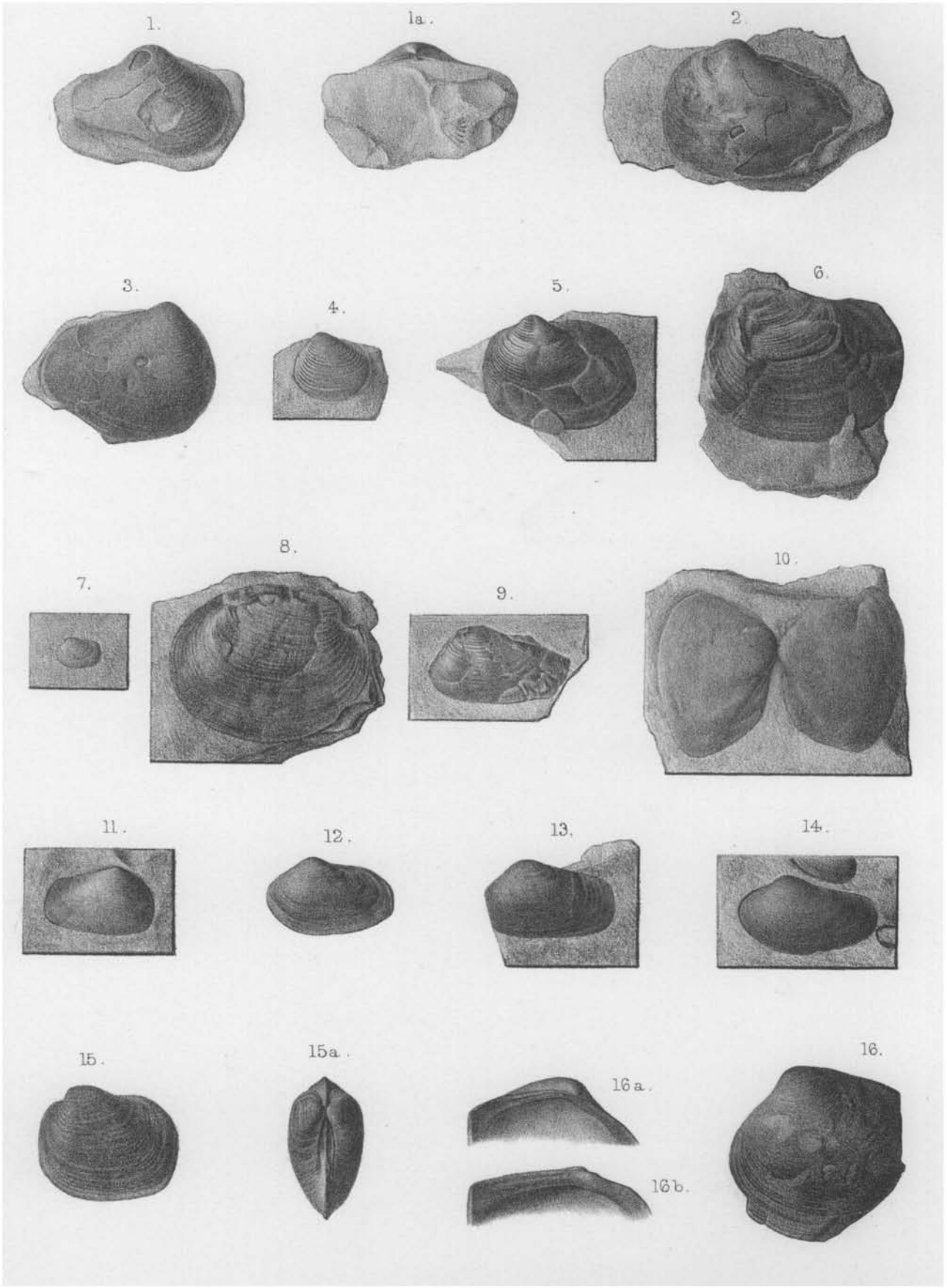

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PLATE XXVIII.

Fig. 1.—*Edmondia unioniformis.* The type of Phillips's *Isocardon unioniformis.* Preserved in the Gilbertson Collection of the Natural History Museum, South Kensington. (Page 291.)

Fig. 1 *a.*—*Edmondia unioniformis.* The same specimen viewed from above.

Fig. 2.—*Edmondia unioniformis.* A perfectly-preserved specimen (a cast). From Tomdeeby, Limerick. In the Collection of the Geological Survey of Ireland. (Page 291.)

Fig. 2 *a.*—The same specimen viewed from above.

Fig. 3.—*Edmondia unioniformis.* A left testiferous valve. From the Redesdale Ironstone, Bellingham. My Collection. (Page 291.)

Fig. 4.—*Edmondia unioniformis.* A right testiferous valve. From the Carboniferous Limestone of Castleton, Derbyshire. My Collection. (Page 291.)

Fig. 5.—*Edmondia unioniformis.* The cast of both valves. Same locality. My Collection. (Page 291.)

Fig. 5 *a.*—*Edmondia unioniformis.* The same specimen, viewed from the front, showing the absence of the lunule.

Fig. 6.—*Edmondia unioniformis.* A beautiful example of the left valve. From the Limestone of Rockfort Lodge, Bandoran. In the Collection of the Geological Survey of Ireland. (Page 291.)

Fig. 7.—*Edmondia unioniformis.* A testiferous left valve. From Castleton, Derbyshire. My Collection. (Page 291.)

Figs. 8, 9.—*Edmondia rudis.* Two very well-preserved specimens (casts) of the interior. From the Lower Limestone shales of Beith. In the Collection of Mr. J. Neilson. (Page 302.)

Fig. 10.—*Edmondia rudis.* A specimen from the same locality, viewed from above, showing the grooves for the lamellar process of the hinge-plate. My Collection. (Page 302.)

Fig. 11.—*Edmondia rudis.* The cast of the interior of a medium-sized example. Same locality. My Collection. (Page 302.)

Figs. 12—14.—*Edmondia rudis.* Three examples, dwarfed in size. From the Pennystone Ironstone Coal-measures, Coalbrookdale. My Collection. (Page 302.)

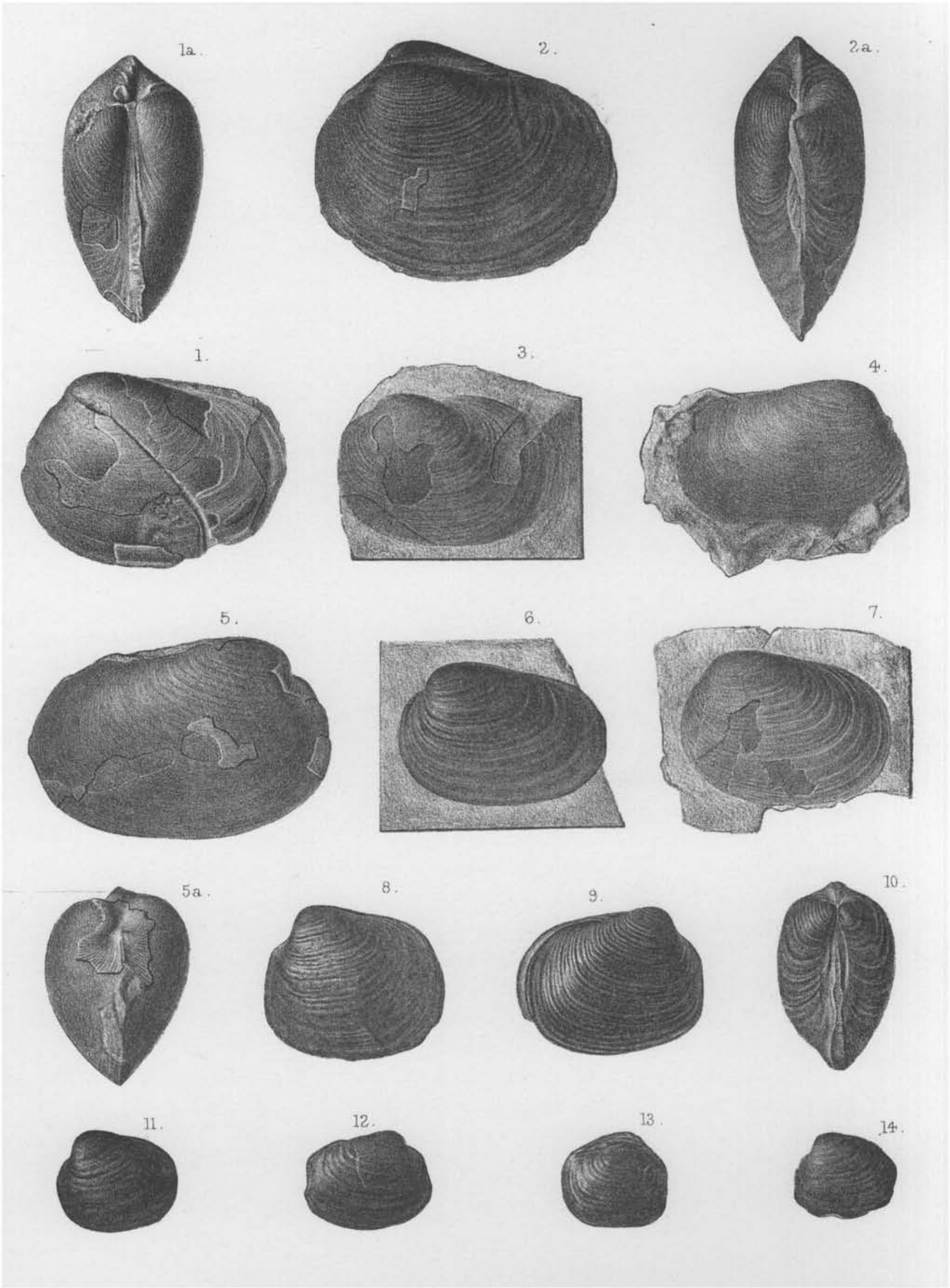

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PLATE XXIX.

Fig. 1.—*Edmondia oblonga.* A left valve. From the Carboniferous Limestone of Lowick. In the Woodwardian Museum, Cambridge. (Page 298.)

Fig. 2.—*Edmondia oblonga.* The cast of a perfect specimen, showing the adductor muscle-scars and pallial line. Same locality and Collection. (Page 298.)

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Fig. 5.—*Edmondia oblonga.* The type of Portlock's *Sanguinolaria oblonga.* From co. Tyrone. Preserved in the Museum of the Geological Survey, Jermyn Street. (Page 298.)

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Fig. 8.—*Edmondia primæva.* A large left valve. Same locality. My Collection. (Page 306.)

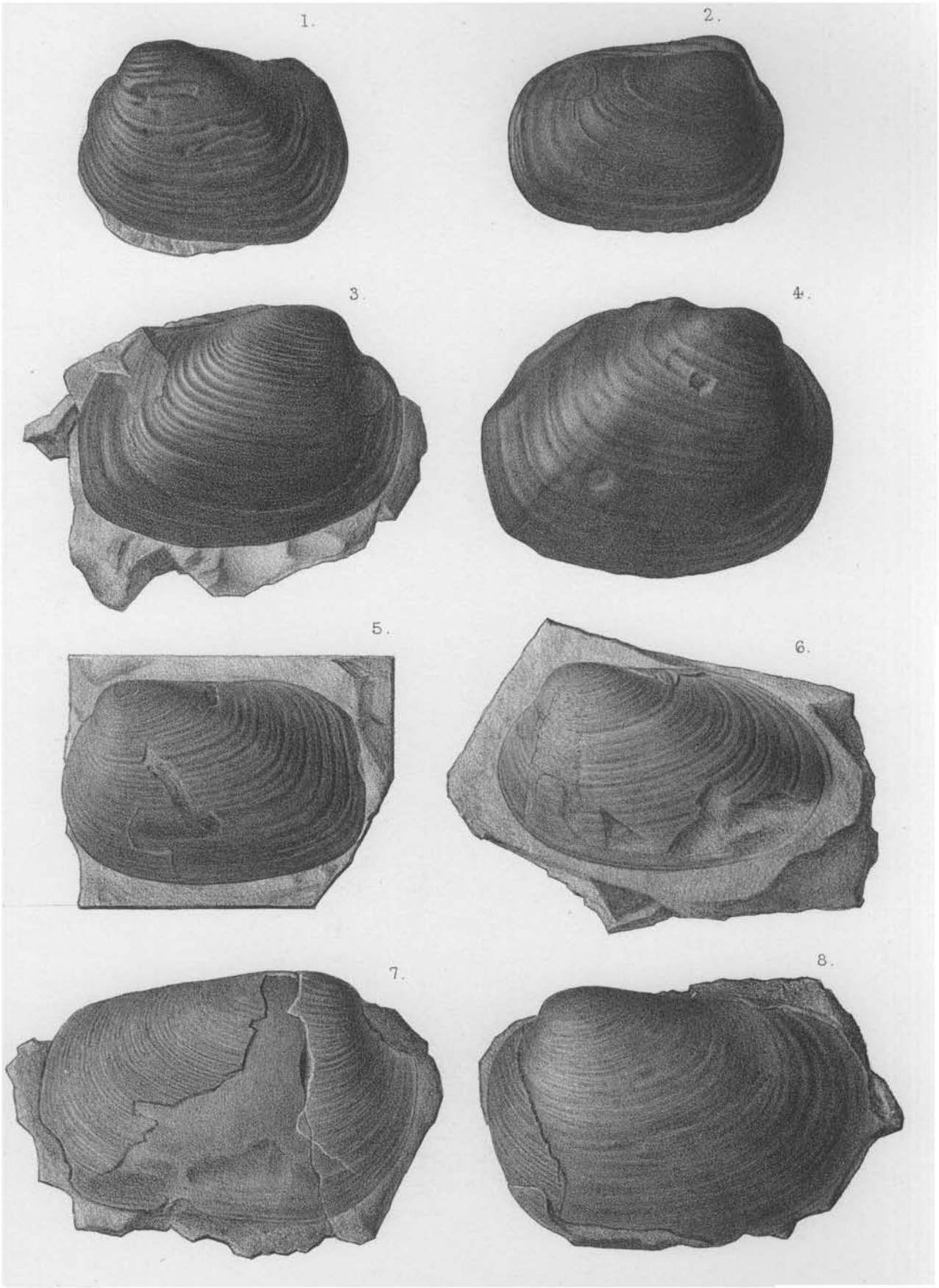

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PLATE XXX.

Fig. 1.—*Edmondia primæva.* A fine example of the right valve. From Doohybeg, co. Limerick. In the Collection of the Geological Survey of Dublin. (Page 306.)

Fig. 2.—*Edmondia primæva.* The type of M'Coy's *Lutraria prisca.* Preserved in the Griffith Collection of the Museum of Science and Art, Dublin. (Page 306.)

Fig. 3.—*Edmondia primæva.* A large specimen (fragment), viewed from above, showing the umbo and dorsal edge of the valve. From Doohybeg, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 306.)

Fig. 4.—*Edmondia gigantea.* A fine specimen. From Little Island, co. Cork. In the Collection of Mr. J. Wright, of Belfast. (Page 308.)

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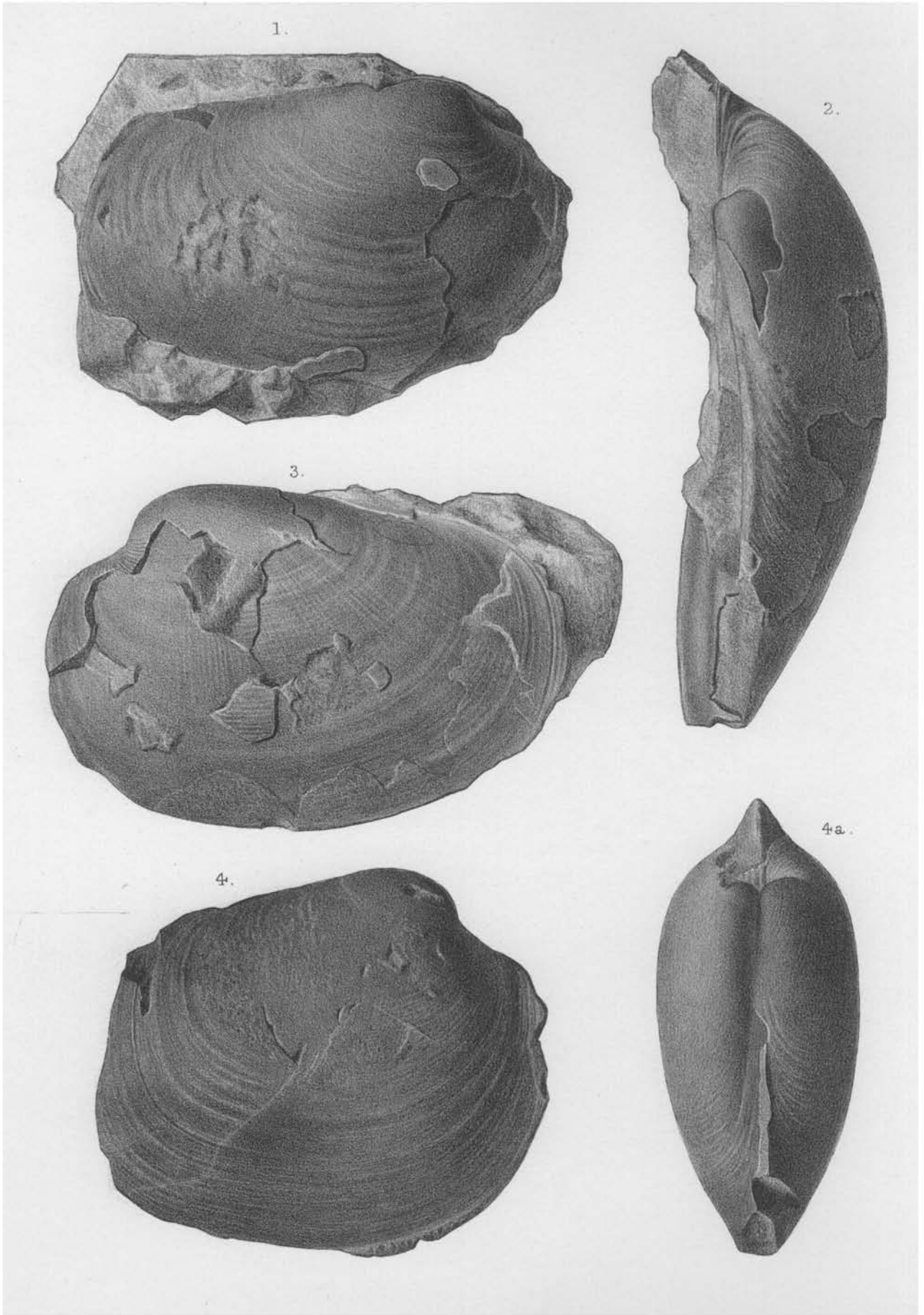

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PLATE XXXI.

Fig. 1.—*Edmondia Lyellii.* A bivalve specimen, from Beith, showing the anterior adductor muscle-scar. In the Collection of Mr. R. Craig, of Beith. (Page 300.)

Fig. 1 *a*.—*Edmondia Lyellii.* A portion of the shell of the same specimen, magnified to show the punctate markings on the surface.

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Fig. 2 *a*.—*Edmondia Lyellii.* The same specimen viewed from in front.

Fig. 3.—*Edmondia Lyellii.* A cast of the left valve, showing both adductor muscle-scars and the pallial line. From Beith. In the Collection of Mr. J. Young, LL.D. (Page 300.)

Figs. 3 *a*, *b*.—*Edmondia Lyellii.* Two views, to show the groove for the lamellar process of the hinge-plate.

Fig. 4.—*Edmondia Lyellii.* A perfect specimen of the right valve. From Beith. In the Collection of the Geological Society of Glasgow. (Page 300.)

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Fig. 5.—*Edmondia Lyellii.* A very fine example of both valves from Craighall, Fife. In the Museum of Science and Art, Edinburgh. (Page 300.)

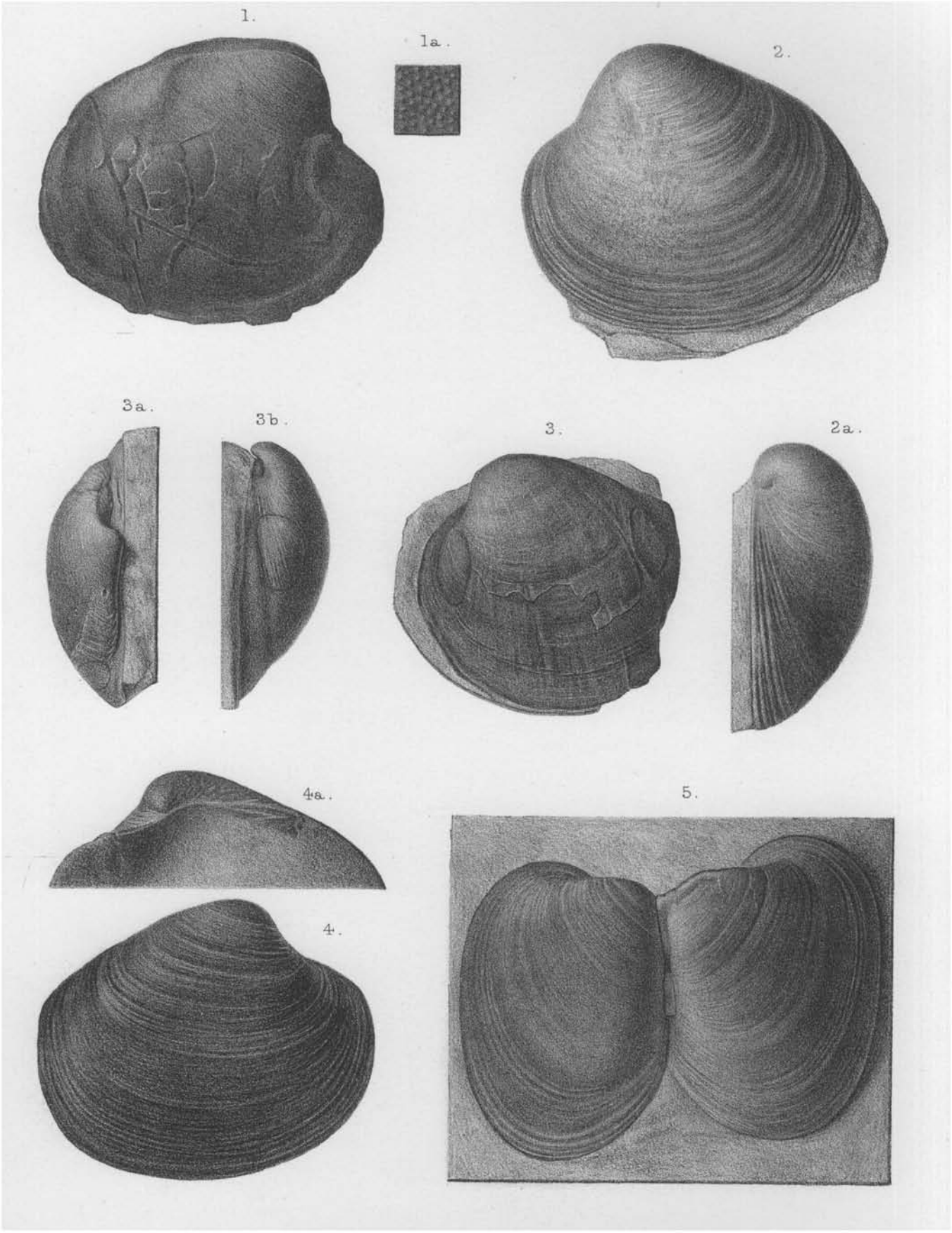

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PLATE XXXII.

Fig. 1.—*Edmondia rudis.* A medium-sized left valve. From the upper beds of the Carboniferous Limestone of Castleton, Derbyshire. My Collection. (Page 302.)

Fig. 2.—*Edmondia unioniformis.* A left valve, with more strongly-marked ridges of growth than usual. Same locality. My Collection. (Page 291.)

Fig. 3.—*Edmondia rudis.* The cast of a left valve. From the Shelly Limestone of Poolvash, Isle of Man. My Collection. (Page 302.)

Fig. 4.—*Edmondia rudis.* The cast of a right valve, of deeper dimensions than is usually found. From the upper beds of the Carboniferous Limestone of Castleton, Derbyshire. My Collection. (Page 302.)

Fig. 5.—*Edmondia rudis.* A less rugose form, incomplete at the posterior part of the hinge-line. Same locality. My Collection. (Page 302.)

Fig. 6.—*Edmondia rudis.* A large example, with more regular markings, having the contour of *Corbula ? senilis* of Phillips. Same locality. My Collection. (Page 302.)

Fig. 7.—*Edmondia Goldfussi.*—A left valve, chiefly a cast of the interior. From the upper beds of the Carboniferous Limestone, Thorpe Cloud, Derbyshire. My Collection. (Page 309.)

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Figs. 9, 10.—*Edmondia Goldfussi.* A left and right valve respectively, with portions of the test preserved. Same locality. My Collection. (Page 309.)

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Fig. 13.—*Edmondia transversa.* The left valve of a bivalve example. From the Lower Limestone series of Auchenskeith, Ayrshire. My Collection. (Page 317.)

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Fig. 16.—*Edmondia transversa.* An almost perfect cast, showing (16 *a*) the grooves for the lamellar processes of the hinge-plate. Same locality as Fig. 14. My Collection. (Page 317.)

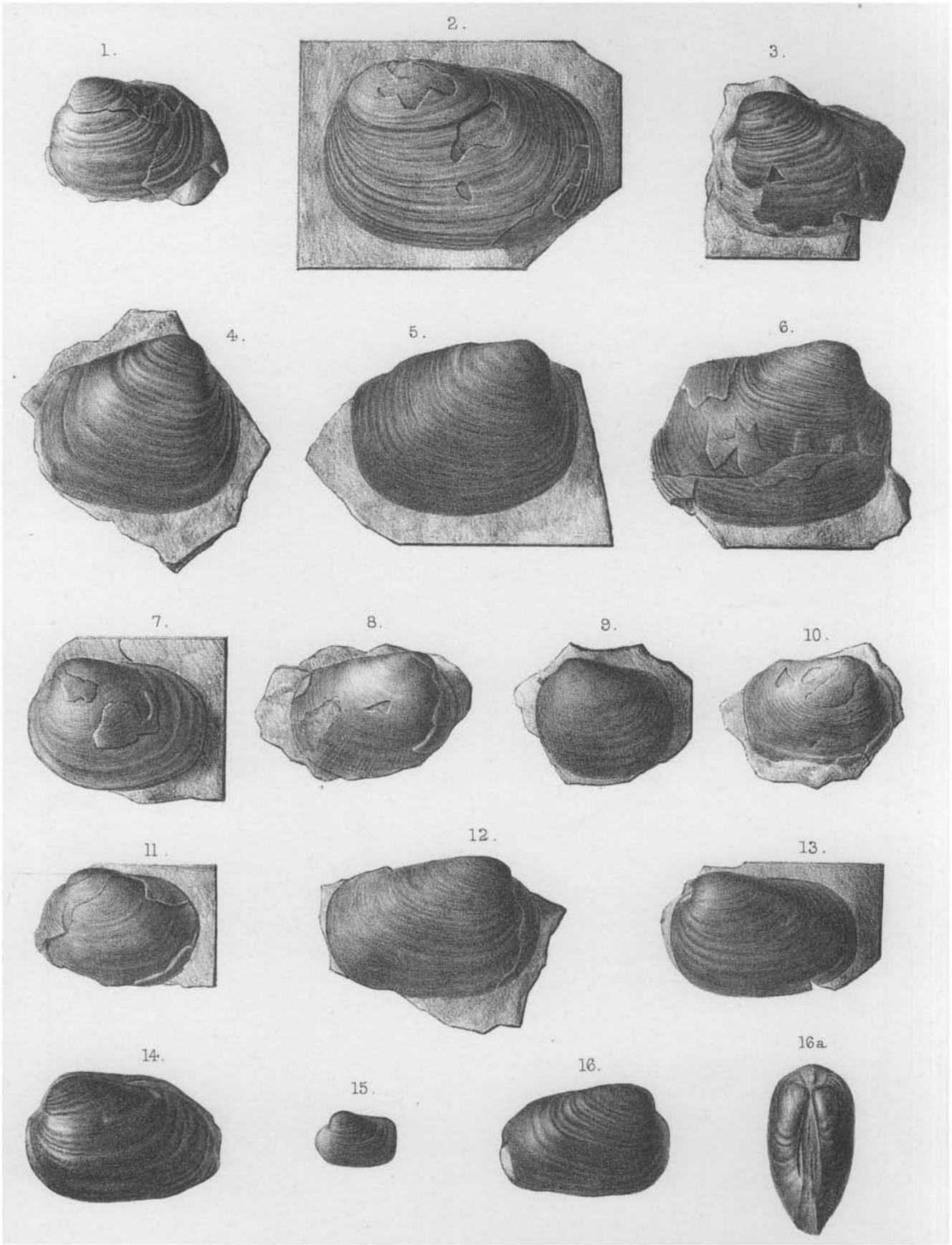

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PLATE XXXIII.

Fig. 1.—*Edmondia Lowickensis.* A perfect specimen. From the Index Limestone series of Thornliebank, Scotland. In the Collection of Mr. J. Neilson. (Page 296.)

Fig. 1 *a.*—The same specimen viewed from above.

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Fig. 5.—*Edmondia compressa.* The anterior half of a left valve. From the upper beds of the Carboniferous Limestone, Thorpe Cloud, Derbyshire. My Collection. (Page 304.)

Fig. 6.—*Edmondia compressa.* A left valve. From the upper beds of the Carboniferous Limestone, Castleton, Derbyshire. My Collection. (Page 304.)

Fig. 7.—*Edmondia compressa.* The type specimen figured by M'Coy. Preserved in the Griffith Collection of the Museum of Science and Art, Dublin. (Page 304.)

Figs. 8, 9.—*Edmondia compressa.* Two examples of medium size. From the same locality as Fig. 6. My Collection. (Page 304.)

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Fig. 12 *a.*—*Edmondia Josepha.* The same specimen viewed from above.

Fig. 13.—*Edmondia Josepha.* A cast. From a marine band in the Calciferous Sandstone series of Fife. My Collection. (Page 294.)

Fig. 14.—*Edmondia Josepha.* The cast of a young example. From Beith. My Collection. (Page 294.)

Fig. 15.—*Edmondia sulcata.* A small example. A cast from the Limestone at Lowick, Northumberland. In the Woodwardian Museum, Cambridge. (Page 318.)

Fig. 16.—*Edmondia expansa.* A very fine example. From the Carboniferous Limestone of Halkyn Mountain, North Wales. In the Collection of the Grosvenor Museum, Chester. (Page 322.)

Fig. 16 *a.*—*Edmondia expansa.* The same specimen viewed from above.

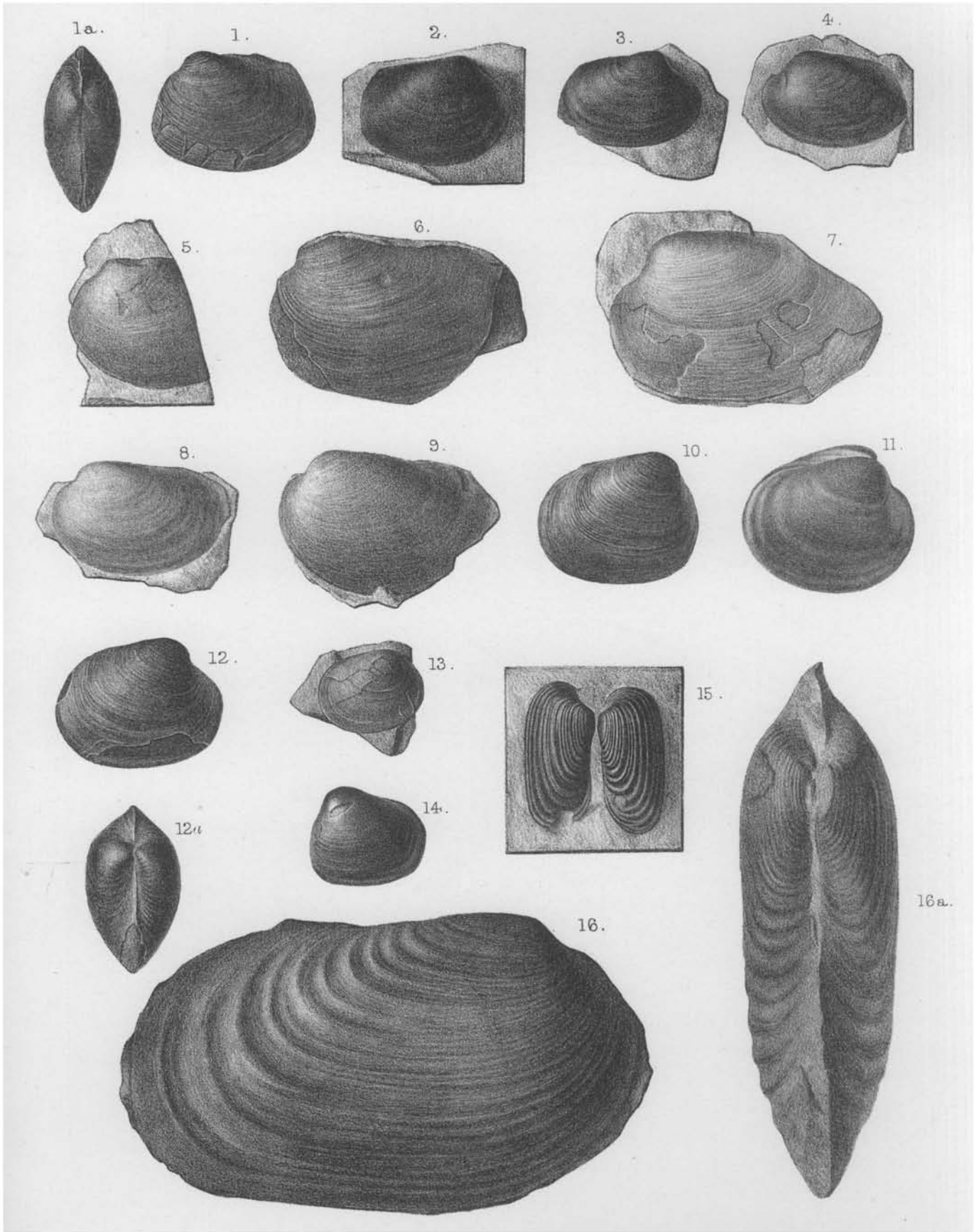

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PLATE XXXIV.

Fig. 1.—*Edmondia expansa.* The cast of a medium-sized shell. From one of the Limestones near Richmond, Yorkshire. In the Collection of the York Museum. (Page 322.)

Fig. 2.—*Edmondia expansa.* The right valve of a full-grown shell. From Wensleydale. In the same Collection. (Page 322.)

Fig. 3.—*Edmondia sulcata.* Probably the type of Phillips's *Sanguinolaria? sulcata.* Same locality and Collection. (Page 318.)

Fig. 4.—*Edmondia expansa.* The cast of a small example from the Main Limestone, West Witton, Yorkshire. My Collection. (Page 322.)

Fig. 5.—*Edmondia sulcata.* A fine example from the Carboniferous Limestone of Kildare. In the Collection of the Woodwardian Museum, Cambridge. (Page 318.)

Fig. 6.—*Edmondia sulcata.* A very fine cast, showing the hollow for the lamellar process of the hinge. From the Beith Limestone series. My Collection. (Page 318.)

Fig. 6 *a.*—*Edmondia sulcata.* The same specimen viewed from above.

Fig. 7.—*Edmondia expansa.* A left testiferous valve. From the Carboniferous beds of North Yorkshire. In the Collection of Mr. J. Wright of Belfast. (Page 322.)

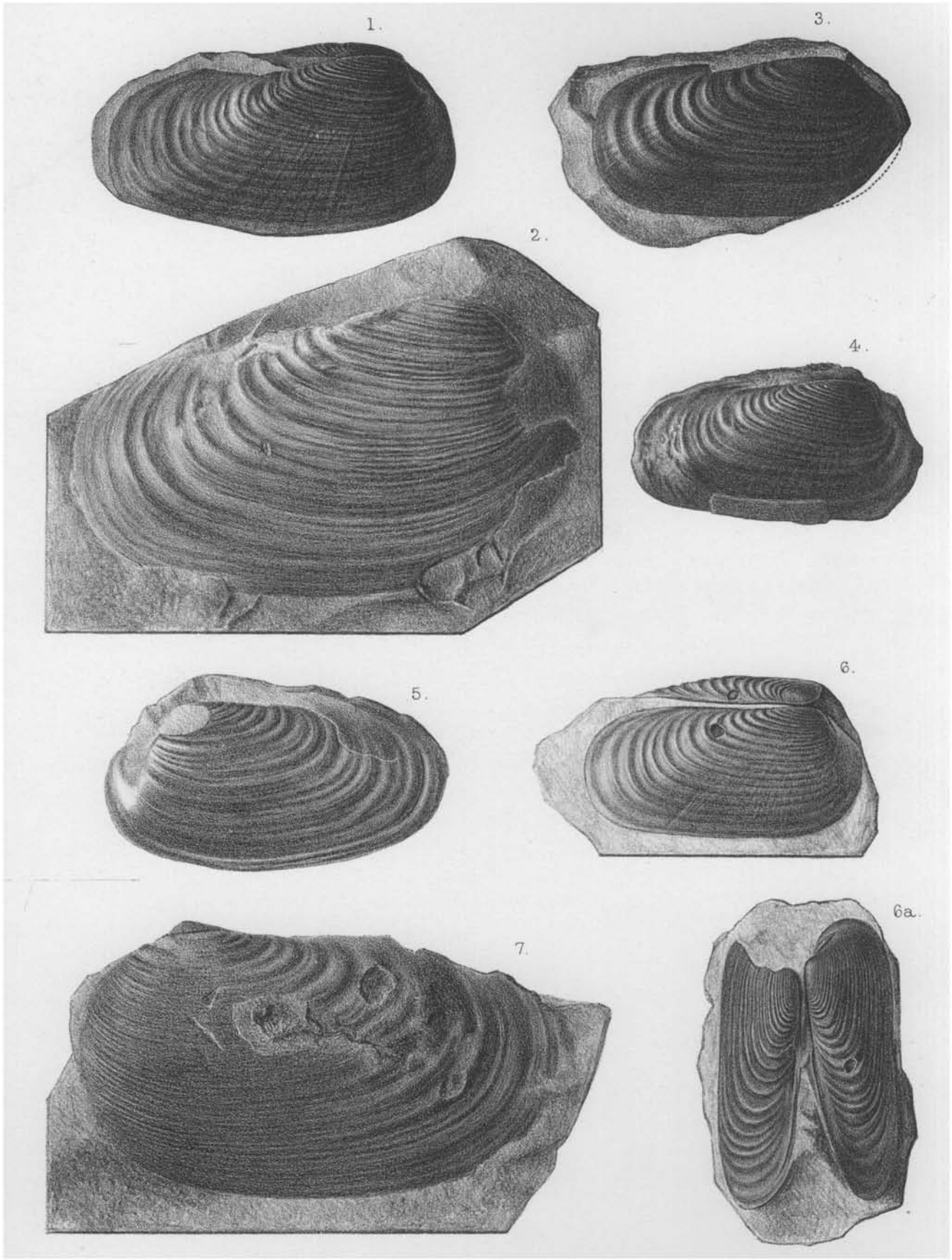

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PLATE XXXV.

Fig. 1.—*Edmondia arcuata.* From the horizon of the Hurlet Limestone, St. Monans, Fife. (Page 310.)

Fig. 2.—*Edmondia arcuata.* The left valve of a cast, showing the anterior adductor muscle-scar. From the Redesdale Ironstone beds. My Collection. (Page 310.)

Figs. 3, 4.—*Edmondia arcuata.* The right valves of casts. From the same locality. My Collection. (Page 310.)

Fig. 5.—*Edmondia sulcata.* A specimen from the Limestone of North Wales, showing (*a*) the lamellar plate of the hinge of the left valve. In the Collection of Mr. G. H. Morton. (Page 318.)

Fig. 6.—*Edmondia arcuata.* A testiferous example. From the Redesdale Ironstone series. My Collection. (Page 310.)

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Fig. 7 *a.*—*Edmondia arcuata.* The same specimen viewed from above, showing the grooves from the lamellar process of the hinge, and the lanceolate depressions caused by the thickening within the umbo.

Fig. 8.—*Edmondia arcuata.* A small example from the same series. My Collection. (Page 310.)

Fig. 9.—*Edmondia arcuata.* A less transverse variety. Same locality. My Collection. (Page 310.)

Fig. 10.—*Edmondia arcuata.* A testiferous example of the right valve. Same locality and Collection. (Page 310.)

Fig. 11.—*Edmondia sulcata.* A specimen with the tuberculated periostracum preserved. From Hind Og Glen, Dalry. My Collection. (Page 318.)

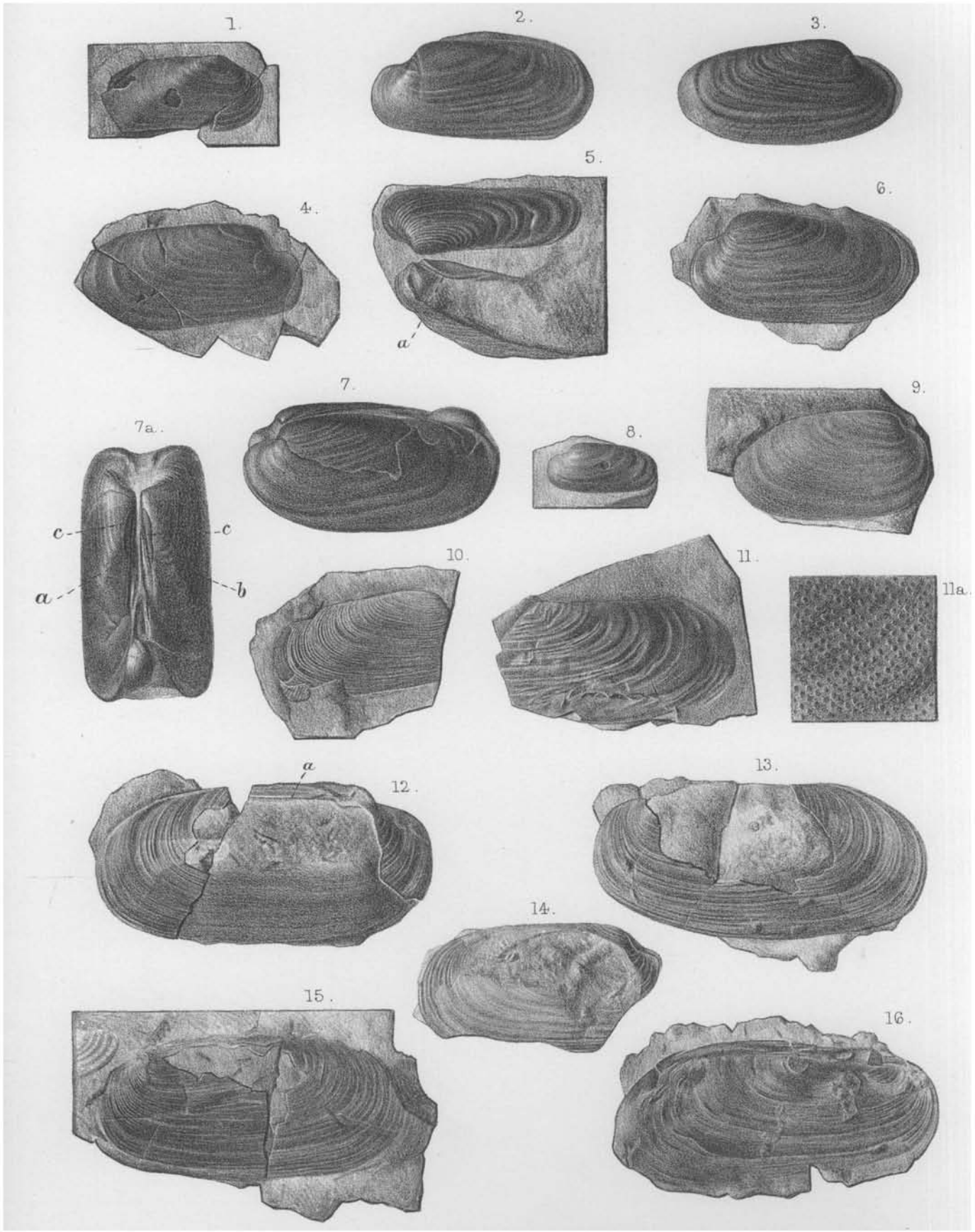
Fig. 11 *a.*—*Edmondia sulcata.* A portion of the above shell magnified.

Fig. 12.—*Edmondia Pentonensis.* A full-grown right valve, showing (*a*) the internal lamellar plate of the hinge. From shale between the Limestones at Penton Linns, Roxburgh. My Collection. (Page 313.)

Fig. 13.—*Edmondia Pentonensis.* A left valve. Same locality and Collection. (Page 313.)

Fig. 14.—*Edmondia Pentonensis.* A right valve. From the Redesdale Ironstone beds. My Collection. (Page 313.)

Figs. 15, 16.—*Edmondia Pentonensis.* Two valves from Penton Linns. My Collection. (Page 313.)


1.
2.
3.
4.
5.
a
6.
7.
7a.
8.
9.
c
c
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b
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11.
11a.
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13.
14.
15.
16.

PLATE XXXVI.

Fig. 1.—*Edmondia laminata.* A left valve. From the Carboniferous Limestone of Thorpe, Grassington. In the Collection of the Geological Survey, Jermyn Street. (Page 324.)

Fig. 2.—*Edmondia laminata.* A left valve. From the Carboniferous Limestone of Thorpe Cloud, Derbyshire. My Collection. (Page 324.)

Fig. 3.—*Edmondia laminata.* A medium-sized right valve. From the Carboniferous Limestone of Settle. In the Collection of the Woodwardian Museum, Cambridge. (Page 324.)

Figs. 4—7.—*Edmondia laminata.* A series to show different stages of growth. From the Carboniferous Limestone of Thorpe Cloud. My Collection. (Page 324.)

Fig. 8.—*Edmondia MacCoyii.* A very young shell. Same locality and Collection. (Page 328.)

Fig. 9.—*Edmondia scalaris.* A very young example. From the Carboniferous Limestone of Thorpe Cloud. My Collection. (Page 327)

Fig. 10.—*Edmondia laminata.* A specimen showing a much smoother surface, the strong ridges and sulcations becoming much less marked. (Page 324.)

Fig. 11.—*Edmondia laminata.* The type specimen of Phillips's *Lucina laminata.* Preserved in the Gilbertson Collection of the Natural History Museum, South Kensington. (Page 324.)

Fig. 12.—*Edmondia laminata.* The type specimen of M'Coy's *Astarte quadrata.* Preserved in the Griffith Collection of the Museum of Science and Art, Dublin. (Page 324.)

Fig. 13.—*Edmondia laminata*, var. *sublævis.* A left valve. From the Carboniferous Limestone of Thorpe, near Grassington. In the Collection of the Geological Survey, Jermyn Street. (Page 327.)

Figs. 14—16.—*Edmondia laminata*, var. *sublævis.* Valves showing different degrees of variation in the concentric ridges. From the Carboniferous Limestone of Thorpe Cloud. My Collection. (Page 327.)

Fig. 17.—*Edmondia laminata*, var. *sublævis.* A cast of the interior. Same locality and Collection. (Page 327.)

Fig. 18.—*Edmondia laminata*, var. *sublævis.* From the Carboniferous Limestone of Castleton, Derbyshire. My Collection. (Page 327.)

Fig. 19.—*Edmondia scalaris.* A right valve. From the Carboniferous Limestone of Kildare. In the Collection of the Geological Survey, Jermyn Street. (Page 327.)

Fig. 20.—*Edmondia scalaris.* The type specimen figured by M'Coy. In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 327.)

Fig. 21.—*Edmondia scalaris.* A full-grown left valve. From the Carboniferous Ironstone of St. Dooghlas, co. Dublin. My Collection. (Page 327.)

Fig. 22.—*Edmondia scalaris.* A bivalve example. From the south of Ireland. In the Collection of Mr. J. Neilson, of Glasgow. (Page 327.)

Fig. 23.—*Edmondia MacCoyii.* A testiferous example. From the Carboniferous Limestone of Park Hill, Derbyshire. In the Collection of the Geological Survey, Jermyn Street. (Page 329.)

Fig. 24.—*Edmondia MacCoyii.* A cast of the interior. Same locality and Collection. (Page 329.)

Fig. 25.—*Edmondia MacCoyii.* A young example. From the Carboniferous Limestone of Settle. My Collection. (Page 329.)

Figs. 26, 28, 30.—*Edmondia MacCoyii.* A series of specimens showing variation in the number and distance of the concentric ridges. From Settle. In the Currow Collection of the Woodwardian Museum, Cambridge. (Page 329.)

Fig. 27.—*Edmondia MacCoyii.* A small testiferous example. From the Carboniferous Limestone of Castleton. My Collection. (Page 329.)

Fig. 29.—*Edmondia MacCoyii.*—A specimen of the left valve. Same locality and Collection. (Page 329.)

Fig. 31.—*Edmondia laminata.*—A giant specimen. From the Carboniferous Limestone of Park Hill, Derbyshire. In the Collection of the Geological Survey. (Page 324.)

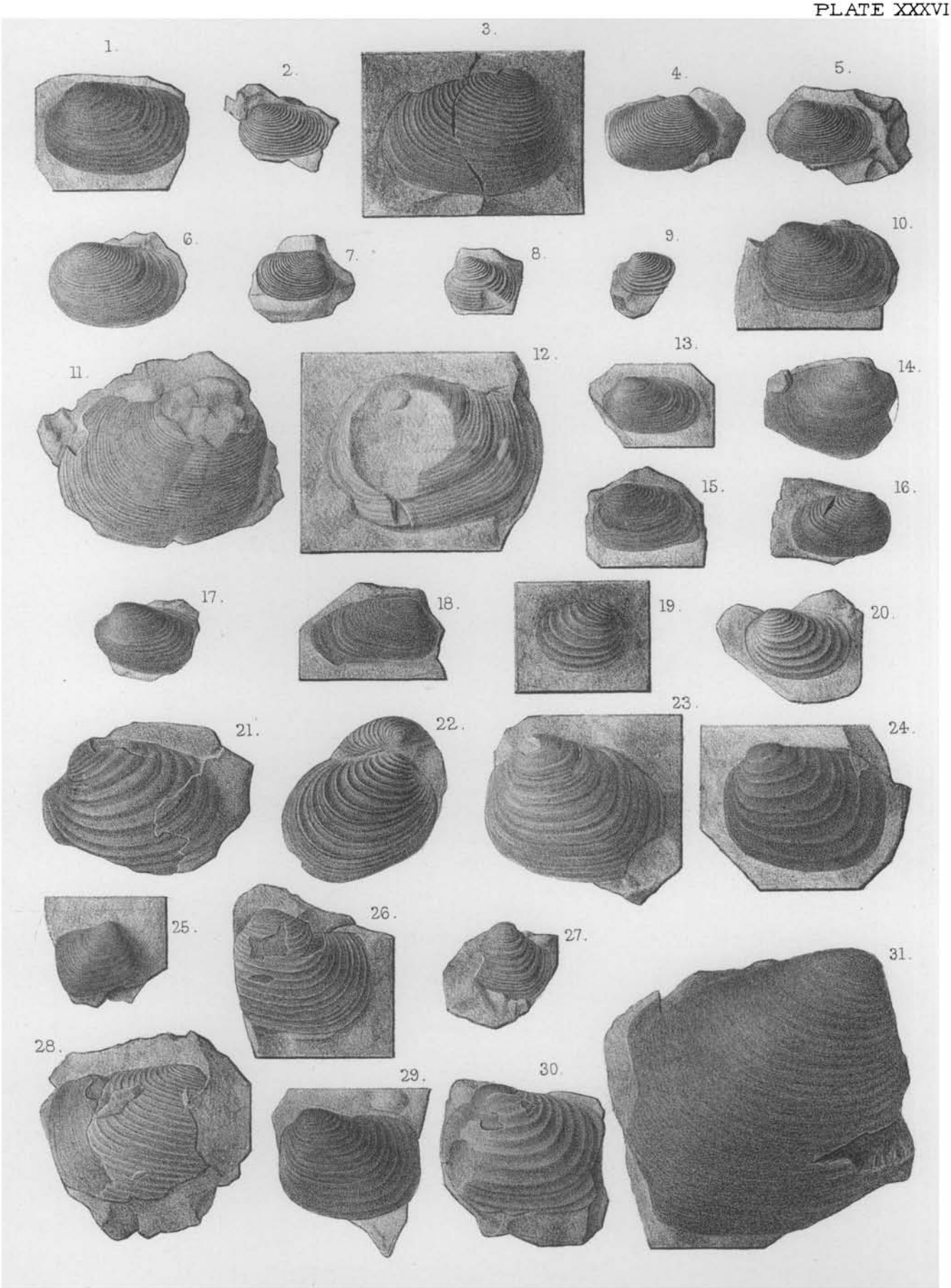

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PLATE XXXVII.

Fig. 1.—*Scaldia Benedeniana.* A testiferous example from the Carboniferous Limestone of Kildare. In the Collection of the Geological Survey, Jermyn Street. (Page 336.)

Fig. 2.—*Scaldia Benedeniana.* The cast of a left valve. Same locality and Collection. (Page 336.)

Fig. 3.—*Scaldia Benedeniana.* A fully grown right valve. From the Carboniferous Limestone of Tuogh, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 336.)

Fig. 4.—*Scaldia Lambotteana.* From the Carboniferous Limestone of Tournay. To show the hinge-plate and single cardinal tooth in the left valve. My Collection. (Page 335.)

Fig. 5.—*Scaldia fragilis.* A left valve. From the Upper Limestone Series of Kirktonholm, East Kilbride. In the Collection of Mr. J. Neilson. (Page 335.)

Fig. 6.—*Scaldia fragilis.* A pair of testiferous valves. Same locality and Collection. (Page 335.)

Fig. 7.—*Scaldia fragilis.* A right valve. Same locality and Collection. (Page 335.)

Fig. 8.—*Edmondia accipiens.* The type specimen of *Nucula accipiens*, figured by Sowerby in Prestwich's 'Geology of Coalbrookdale.' In the Collection of the Natural History Museum, South Kensington. (Page 331.)

Fig. 9.—*Edmondia accipiens.* The specimen on which Etheridge founded *Sanguinolites granulatus.* Locality doubtful. In the Collection of Mr. J. Ward, F.G.S., of Longton. (Page 331.)

Fig. 10.—*Edmondia accipiens.* A fairly perfect example from the Pennystone Ironstone of Coalbrookdale. My Collection. (Page 331.)

Fig. 11.—*Edmondia accipiens.* A specimen showing an artificial oblique ridge, due to crushing. Posterior end almost perfect. Same locality. My Collection. (Page 331.)

Fig. 12.—*Edmondia accipiens.* A deep variety named *Unio parallelus* by Sowerby. Striæ more numerous and closer. Same locality. My Collection. (Page 331.)

Fig. 13.—*Edmondia accipiens.* A strongly sulcated variety. Same locality and Collection. (Page 331.)

Fig. 14.—*Edmondia accipiens.* The type specimen of Sowerby's *Unio Urei.* From the same locality. In the Collection of the Natural History Museum, South Kensington. (Page 331.)

Fig. 14*a*.—*Edmondia accipiens.* The same specimen viewed from above, showing the slits for the elongated lamellar hinge-processes, and the absence of a lunule and escutcheon. (Page 331.)

Fig. 15.—*Edmondia accipiens.* An uncrushed sulcated specimen, showing the contour of the posterior end. Same locality. My Collection. (Page 331.)

Fig. 16.—*Edmondia accipiens.* A specimen of Sowerby's *Unio parallelus.* Same locality. My Collection. (Page 331.)

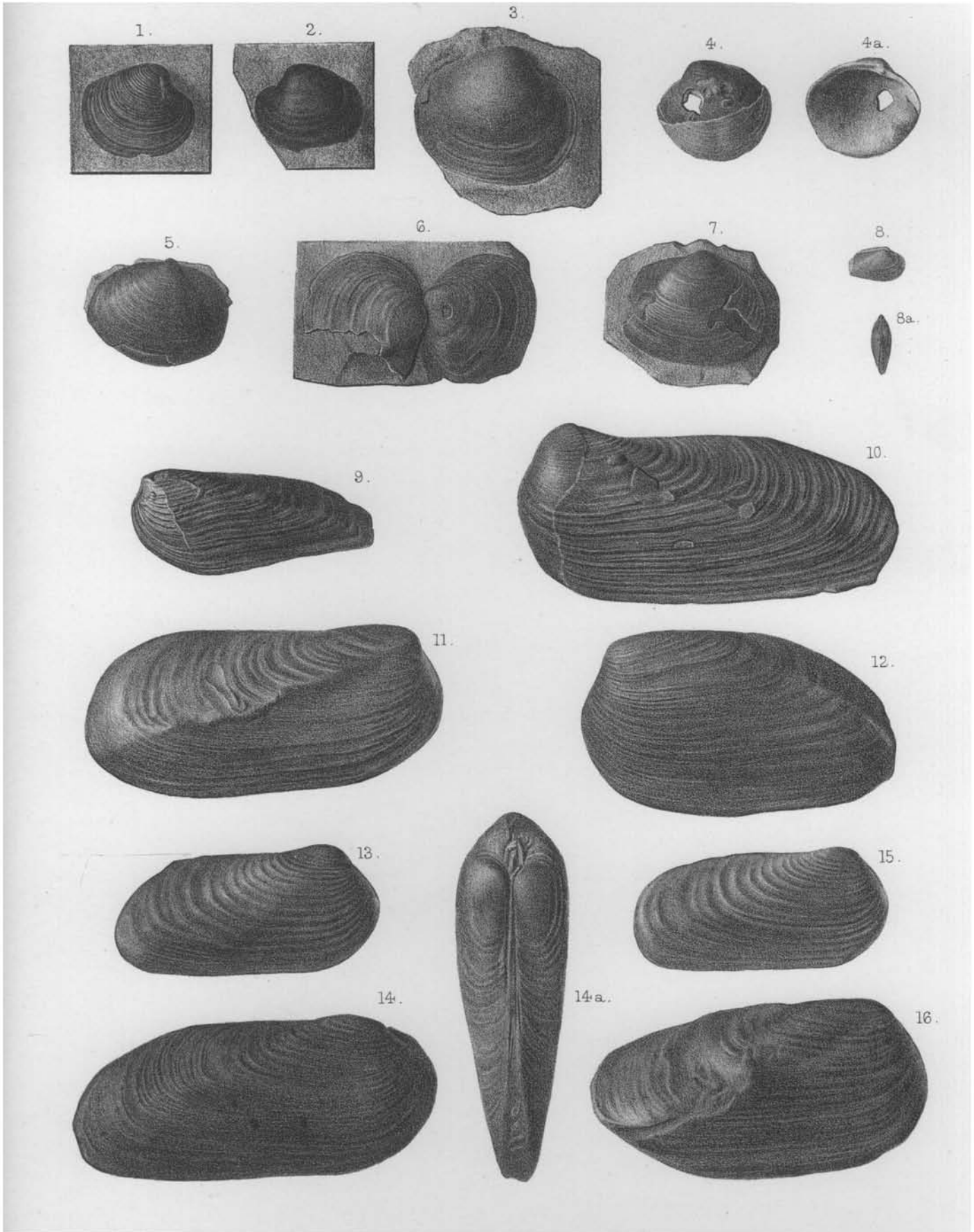

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PLATE XXXVIII.

Fig. 1.—*Edmondia subplicata.* A specimen of a right valve to show contour. The outer coat of the shell has been removed by the waves. From the Calciferous Sandstone series of Randerston, Fife. My Collection. (Page 315.)

Fig. 2.—*Edmondia subplicata.* A right valve showing the hinge. Same locality and Collection. (Page 315.)

Fig. 3.—*Edmondia subplicata.* A testiferous example. Same locality and Collection. (Page 315.)

Fig. 4.—*Edmondia subplicata.* An almost complete right valve. Same locality and Collection. (Page 315.)

Fig. 5.—*Edmondia subplicata.* A left valve, with the outer shell removed. Same locality and Collection. (Page 315.)

Fig. 6.—*Mytilomorpha rhombea.* A left valve, from the Carboniferous Limestone of Wetton, Staffordshire. Purchased by grant from Royal Society to be placed in the Natural History Museum, South Kensington. (Page 340.)

Fig. 7.—*Mytilomorpha rhombea.* A right valve, from the Carboniferous Limestone of Poolvash, Isle of Man. Collected by Mr. Law. (Page 340.)

Fig. 8.—*Mytilomorpha rhombea.* The type specimen of Phillips's *Cypricardia rhombea.* A right valve from the Carboniferous Limestone of Bolland. In the Gilbertson Collection of the Natural History Museum, South Kensington. (Page 340.)

Fig. 9.—*Mytilomorpha rhombea.* A right valve from the Carboniferous Limestone of Poolvash, Isle of Man. My Collection. (Page 340.)

Fig. 10.—*Mytilomorpha rhombea.* The cast of the anterior two-thirds of a left valve. Showing adductor scar and pallial line. Same locality and Collection. (Page 340.)

Fig. 11.—*Mytilomorpha rhombea.* The cast of a very fine example of the left valve. In the Collection of Mr. Law. Same locality. (Page 340.)

Fig. 12.—*Mytilomorpha angulata.* The cast of a full-grown example, showing the posterior adductor muscle-scar and pallial line. From the Carboniferous Limestone of Thorpe Cloud. My Collection. (Page 344.)

Fig. 13.—*Mytilomorpha angulata.* A right valve showing the large escutcheon. Same locality and Collection. (Page 344.)

Fig. 14.—*Mytilomorpha angulata.* A right valve with portion of the test. Same locality and Collection. (Page 344.)

Fig. 15.—*Mytilomorpha angulata.* A right testiferous example, a little incomplete in front. Same locality and Collection. (Page 344.)

Fig. 16.—*Mytilomorpha angulata.* A right valve showing anterior adductor muscle-scar. Same locality and Collection. (Page 344.)

Fig. 17.—*Mytilomorpha angulata.* The cast of the interior of the front part of the right valve, with anterior adductor muscle-scar and pallial line. Same locality and Collection. (Page 344.)

Fig. 18.—*Mytilomorpha angulata.* A right valve. Same locality and Collection. Page 344.)

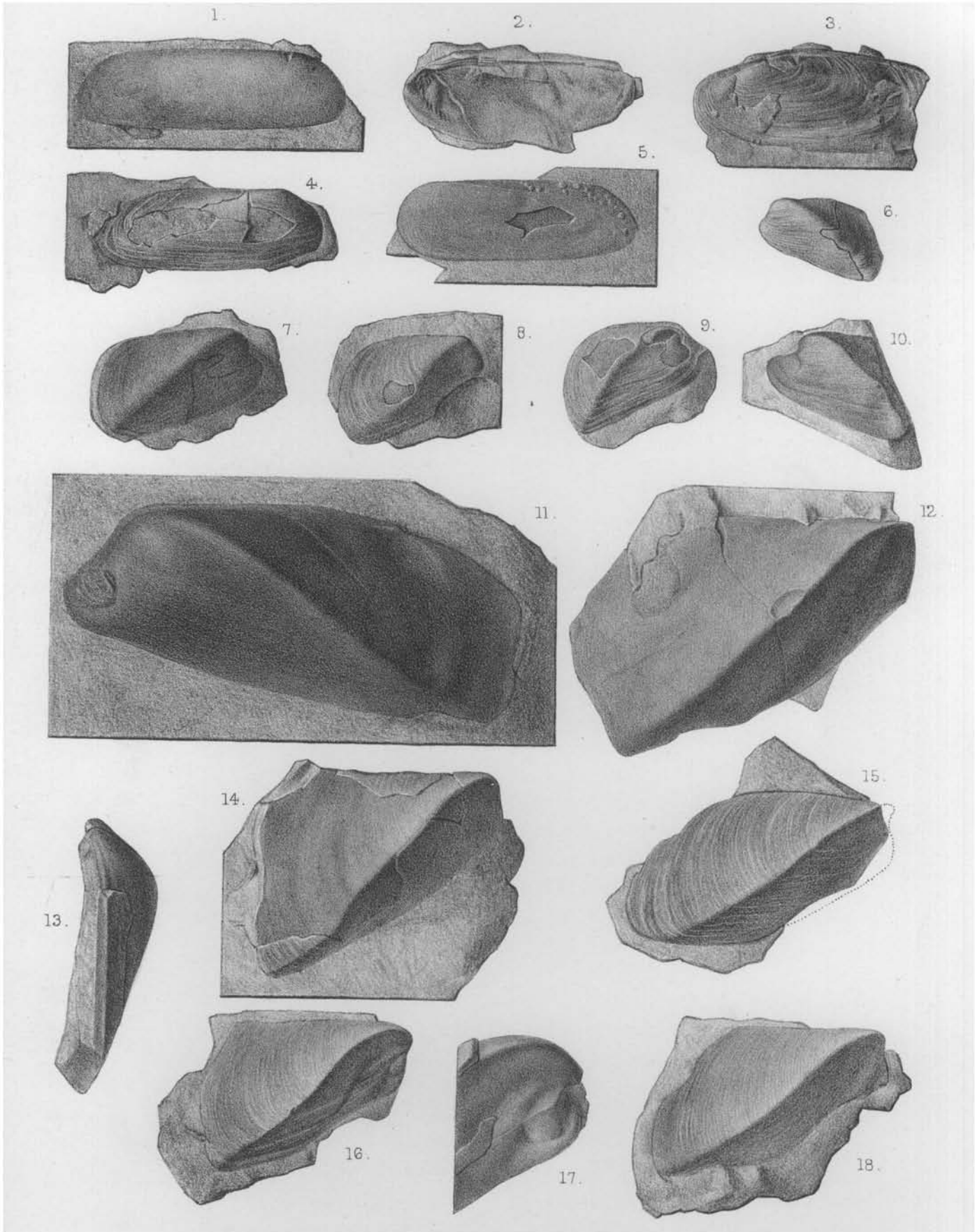

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PLATE XXXIX.

Fig. 1.—*Cypricardella parallela.* The type specimen of Phillips's *Venus parallela* from the Carboniferous Limestone of Bolland. In the Gilbertson Collection, Natural History Museum, South Kensington. (Page 348.)

Fig. 2.—*Cypricardella parallela.* A full-grown example from the Carboniferous Limestone of Hill Stebden, Yorkshire. Collected by Mr. Garwood. (Page 348.)

Fig. 3.—*Cypricardella parallela.* A well-preserved example showing the surface markings more perfectly than Phillips's type. Same locality and collection. (Page 348.)

Fig. 4.—*Cypricardella parallela.* A more rhomboidal form. Same locality and collection. (Page 348.)

Fig. 5.—*Cypricardella parallela.* Same locality and collection. 5 *a.* Showing hinge-line and escutcheon. (Page 348.)

Fig. 6.—*Cypricardella parallela?* A very transverse variety, but with characteristic escutcheon and lunule. Same locality and collection. (Page 348.)

Fig. 7.—*Cypricardella parallela.* A medium-sized specimen from the Carboniferous Limestone of Pilsbury, Derbyshire. 7 *a.* Enlarged view. In the Collection of the Geological Survey, Jermyn Street. (Page 348.)

Fig. 8.—*Cypricardella concentrica.* A fine full-grown shell from the Lower Limestone series of Craigen Glen. In the Collection of Mr. J. Neilson, with a view, Fig. 8 *a*, of the lunule, umbones, and escutcheon. (Page 350.)

Fig. 9.—*Cypricardella concentrica.* A specimen showing the hinge of the left valve, from the Lower Limestone series of Law Dalry. 9 *a.* Enlarged view. In the Collection of Mr. J. Smith. (Page 350.)

Fig. 10.—*Cypricardella concentrica.* A right valve from shale below the Lower Limestones, Beith. In the Collection of Mr. J. Smith. (Page 350.)

Fig. 10 *a.*—*Cypricardella concentrica.* The same specimen, enlarged view, showing the hinge.

Fig. 11.—*Cypricardella concentrica.* A young example. 11 *a.* Enlarged view. From shales below the Linn Spout Limestone, Linn Spout, Dalry. My Collection. (Page 350.)

Fig. 12.—*Cypricardella crebricostata.* A medium-sized example from shale above the Arden Limestone, Carluke. In the Collection of Mr. J. Smith. (Page 352.)

Fig. 13.—*Cypricardella crebricostata.* A full-grown example, showing Fig. 13 *a*, a view of the umbones, lunule, and escutcheon. Same locality and collection. (Page 352.)

Fig. 14.—*Cypricardella acuticarinata.* A left valve from the Upper Limestone series of Orchard. In the Collection of Mr. J. Smith. 14 *a.* Enlarged view. (Page 359.)

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Fig. 17.—*Cypricardella acuticarinata.* Same locality and collection. (Page 359.)

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Fig. 24.—*Cypricardella rectangularis.* A specimen from Orchard. In the Collection of Mr. J. Neilson. 24 *a.* Enlarged view. (Page 356.)

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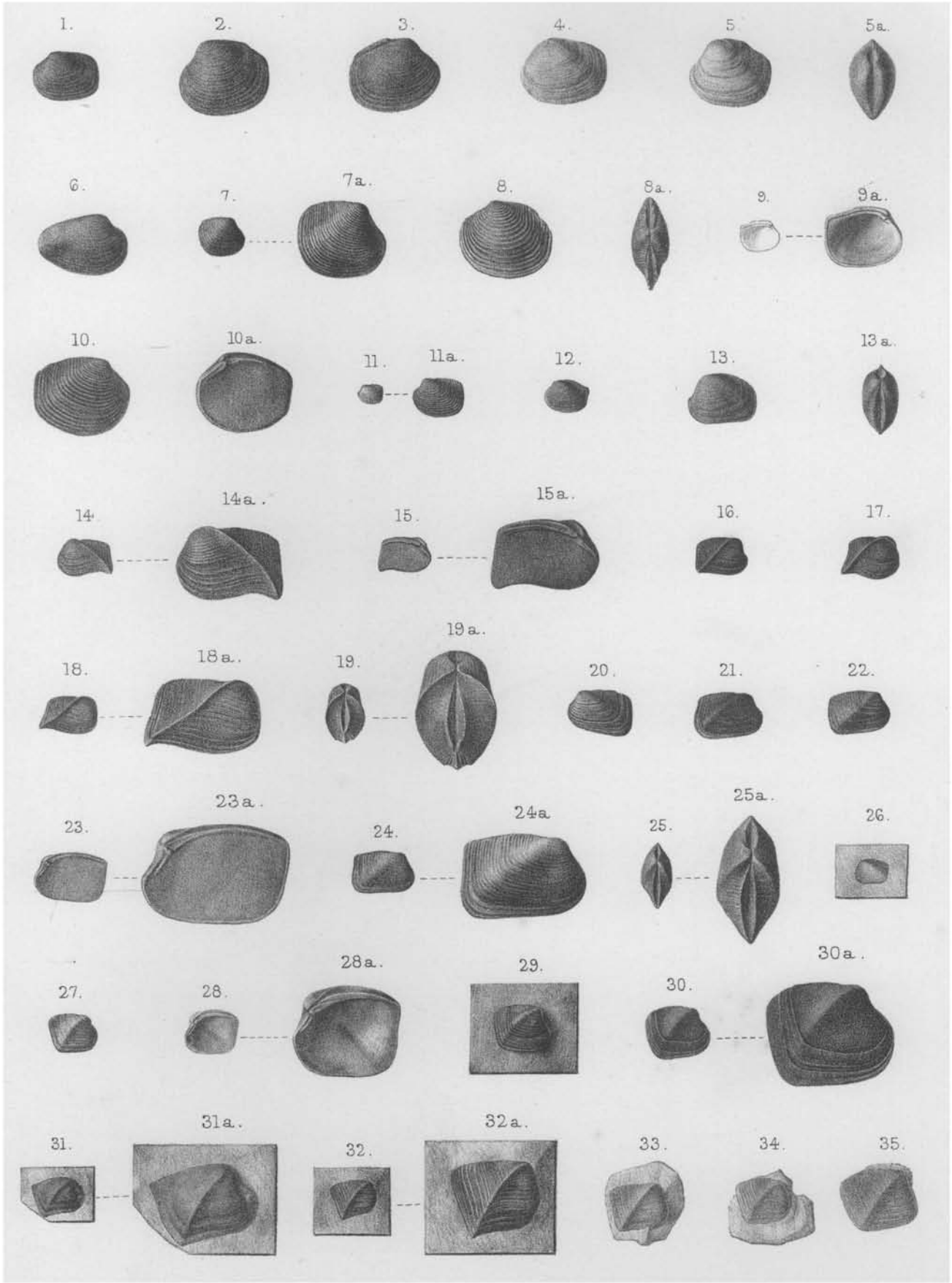
Fig. 35.—*Cypricardella annæ.* A right valve from the Poolvash Limestone, Isle of Man. (Page 355.)



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