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Wheelton Hind

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A MONOGRAPH

OF THE

BRITISH CARBONIFEROUS LAMELLIBRANCHIATA.

BY

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Exterior.—The surface is ornamented with numerous concentric, rounded, low ridges and grooves, not always equidistant.

Dimensions.—Pl. VI, fig. 16, from Castleton, measures—

Antero-posteriorly	25 mm.
Dorso-ventrally	30 mm.
From side to side	12 mm.

Locality.—The Carboniferous Limestone of Castleton, Derbyshire.

Observations.—De Koninck states that *P. obliqua* occurs very rarely in the Carboniferous Limestone of Visé. It is not at all a common shell at Castleton, which is the only locality at which I have yet obtained the species, but several specimens have been found here. The shell is much more gibbose and narrower from side to side than *P. Becheri*, and the concentric ridges are much closer and narrower. The umbones do not seem to have been contiguous, one of the specimens showing a small area; but no details of the nature of the hinge-plate have been observed.

Family LIMIDÆ.

Genus LIMATULINA, *de Koninck*, 1886.

LIMATULINA, pars, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 243.

Generic Characters.—Shell small, very inequivalve, generally obliquely swollen, triangularly ovate. The left valve gibbose, its umbo overlapping the right valve, which is flat. Ears depressed, the posterior not being well defined. The anterior ear in the right valve deeply slit for the byssus. The hinge-line straight, and the hinge-plate consisting of a single transverse groove. Exterior surface ornamented by radiating striæ and ribs, which are generally close and numerous, and often rugose.

Observations.—This genus was established by de Koninck for a series of inequivalve, *Pecten*-like shells in which the left valve is much larger than the right valve, and the left umbo arches over and overlaps the small, almost obsolete umbo of the right valve. De Koninck described six species, but I do not think *L. selecta* can belong to this genus. M'Coy's *Lima alternata* should certainly, I think, be placed in the genus, while shells with well-defined posterior ears should be excluded.

The genus *Limatulina* is closely related to *Eumicrotis*, but the latter has a smooth shell; though the inequality of the valves and the different characters of the umbones are very similar to the condition in each genus.

LIMATULINA SCOTICA, sp. nov. Plate IX, figs. 1—5.

Specific Characters.—Shell small, quadrately suborbicular, very inequivalve, subauriculate. The right valve only slightly convex, the left triangularly gibbose and compressed at the antero- and postero-superior angles. The anterior and inferior margins rounded, the posterior concavo-convex from above downwards. The hinge-line straight, of medium length, forming well-marked angles at each extremity with the anterior and posterior borders. The umbones almost central, that of the right valve small, not elevated, and inconspicuous, the left raised above the hinge-line, gibbose and incurved. The anterior superior angle marked off in the right valve, but a deep triangular slit reaching almost up to the umbo, for the passage of the byssus, but marked off in the left valve by a more or less well-defined groove. The posterior superior angle of both valves compressed and subauriculate.

Interior.—Below the umbo, in the left valve is a transverse groove which received the cartilage; that in the right valve is not so deep.

Exterior.—The surface is ornamented with many simple fine radiating ribs and sulci, whose regularity is at times interfered with by obscure lines of growth, which are most marked towards the posterior superior angle.

Dimensions.—Pl. IX, fig. 2, from Muirfoot Burn, New Cumnock, measures

Antero-posteriorly	21 mm.
Dorso-ventrally	20 mm.
From side to side	9 mm.

Locality.—Upper Limestone series, Muirfoot Burn, New Cumnock, Ayrshire.

Observations.—I have collected specimens of this species with Mr. J. Smith at Muirfoot Burn, New Cumnock, where it is accompanied by *Lingula mytiloides*, *Nucula gibbosa*, *Nuculana lævistriata*, *N. attenuata*, and *Cardiomorpha limosa*. None of the specimens are quite perfect, but I have fortunately been able to obtain for study and illustration bivalved examples, which show the characteristic features of the genus. In these specimens the left valve very frequently has both ears missing, and this imperfection gives quite a false idea of the antero-posterior diameter of the valve at the hinge-line. The left umbo is very large, and quite overlaps the diminutive one of the right valve. The hinge-line is elongate and hollow, apparently not striated, and receives a cartilage which united the valves.

Singly, the valves might be mistaken for those small species of Aviculopecten with fine radiating striæ.

LIMATULINA ALTERNATA, *M'Coy*, sp., 1844. Plate XIX, figs. 7—10, 12.

LIMA ALTERNATA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 87, pl. xv, fig. 4.
— PRISCA, *M'Coy*, 1844. Ibid., p. 88, pl. xviii, fig. 6.

Specific Characters.—Shell small, narrow, produced downwards, very gibbose, right valve less so than the left, slightly oblique. The anterior border long, gently convex, the lower margin more round, and the posterior elongate and almost straight. The hinge-line short and straight. The umbones small, pointed, central, that of the left valve overlapping the right valve. Ears not defined. The anterior ear of the left valve rolled, the posterior gently and gradually compressed. An elongate area along the hinge-line.

Interior.—Unknown.

Exterior.—The surface is ornamented with numerous fine, somewhat sinuous, fibrillose, radiating ribs, often alternately large and small. The ribs are often moniliform, being broken up below into rows of irregularly sized tubercles. Both valves have a similar ornament. Concentric lines and rugæ of growth, irregular in strength, cross the ribs at various intervals.

Dimensions.—Pl. XIX, fig. 8, a specimen from Narrowdale, measures

Antero-posteriorly	29 mm.
Dorso-ventrally	24 mm.

Localities.—England: the Carboniferous Limestone of Hill Bolton, Yorkshire; Narrowdale, Staffordshire; Park Hill, Derbyshire; Poolvash, Isle of Man. Ireland: Blackrock and Little Island, and Streamhill, co. Cork; Ardagh, co. Meath.

Observations.—I have examined the types of M'Coy's species *Lima alternata* and *L. prisca*, and have come to the conclusion that the latter is only the young and therefore less expanded form of the former. Whether or no the valve shows alternating ribs, depends entirely on age. I have been fortunate enough to obtain specimens of both valves, and the right is certainly flatter than the left valve. *L. alternata* is easily distinguished from all other species of the genus by its peculiar and highly ornamental markings. The shell seems to have been very thin in full-grown examples, as it is often found expanded and buckled.

Streblopteria ellipsoidea and *Limatulina linguata*, de Koninck, have an appearance and contour very similar to M'Coy's shell.

LIMATULINA DESQUAMATA, *M'Coy*, sp., 1844. Plate XIX, figs. 11, 20—23.

PTERINEA DESQUAMATA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 82, pl. xiii, fig. 2.
PECTEN CONOIDEUS, *M'Coy*, 1844. Ibid., p. 91, pl. xvii, fig. 2.

Specific Characters.—Shell small, equivalve, gibbose, and triangularly ovate, its antero-posterior diameter much less than the dorso-ventral diameter. The anterior and posterior margins oblique and almost straight, the inferior margin rounded. The hinge-line straight, of moderate length. The umbones pointed, narrow, incurved and raised, gibbose, almost central. The anterior ears depressed, well defined, and triangular, the margin falcate; the posterior ear flattened and depressed, of moderate size, the margin falcate.

Interior.—Hinge appears to be without teeth. Adductor muscle-scar normal in position. Surface smooth in the umbonal region, striated below.

Exterior.—The surface of both valves is ornamented with numerous narrow, somewhat irregular sharp radiating ridges, fresh ribs becoming intercalated between the primary ones as they pass from the umbo to the circumference. Some few irregular concentric rugæ of growth. The anterior ears are crossed by numerous fine radiating ribs, the posterior ears by about seven radiating ribs, the lower ones being wider apart than the upper ones.

Dimensions.—Pl. XIX, fig. 23, measures—

Antero-posteriorly	27 mm.
Dorso-ventrally	29 mm.

Localities.—England: the Carboniferous Limestone of Settle and Hill Bolton, Yorkshire; Redesdale Ironstone, Northumberland. Ireland: the Carboniferous Limestone of Little Island, co. Cork; Town plots, Killala, co. Mayo.

Observations.—*L. desquamata* is on the whole a broader and less gibbose shell than *L. alternata*, while its ribs are more regular in their passage across the shell and better defined. The ears are also better defined and depressed, and more regularly ribbed.

This species was referred by M'Coy to *Pterinea* with another shell, which evidently belongs to a different genus and species, *Pterinea intermedia*, because it has a very elongate hinge, with a markedly elongate posterior ear. M'Coy's description of *L. desquamata* is very good, and the peculiar characters of the shell are easily recognised in it. I was unable to find the type specimen in the Griffith Collection at the Royal College of Science, Dublin.

Genus Palæolima, nov.

Limatulina, pars, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 246.

Generic Characters.—Shell below medium size, obliquely ovate, almost equivalve, moderately swollen. Umbones small, pointed, almost central; ears small, depressed, apparently not slit for the byssus. Exterior surface smooth, or with well-marked

radiating ribs and sulci. A deep groove between the umbones in each valve for the cartilage or ligament.

Observations.—This genus has been erected for shells which have somewhat the external form of *Lima*, but evidently differ from this genus in some details. So far as the hinge can be observed there are no hinge-teeth, and a strong ligament, which is external and lodged in a comparatively deep and broad groove, is therefore necessary. Three species are now referred to *Palæolima*.

PALÆOLIMA SIMPLEX, *Phillips*, sp., 1836. *M'Coy, emend.* 1844. Plate XIX, figs. 24—27.

? PECTEN SIMPLEX, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 212, pl. vi, fig. 27.
AVICULA SIMPLEX, *de Koninck* (pars), 1843. Descr. Anim. Foss. Belg., p. 137, pl. iv, fig. 2.
PECTEN SIMPLEX, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 100.
? AVICULOPECTEN DUPLICIRADIATUS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 239, pl. xxxiv, fig. 1.
cf. LIMATULINA RADULA, *de Koninck*, 1885. Ibid., p. 246, pl. xxxvi, fig. 15.

Specific Characters.—Shell small, almost equivalve, oblique, triangularly ovate, gibbose. The anterior border nearly straight, the lower margin curved, the posterior oblique and almost straight. The hinge-line very short, the umbones gibbose, pointed, incurved, slightly raised, and almost central. The ears small and depressed, not well defined, the posterior very small. A few obscure concentric lines of growth.

Interior.—Unknown.

Exterior.—The surface is ornamented with several broad, bifurcating, unequal, radiating ribs, the anterior ribs flattened, the posterior ribs angular. Ears smooth.

Dimensions.—Pl. XIX, fig. 24, a right valve from Poolvash, measures

Antero-posteriorly	20 mm.
Dorso-ventrally	20 mm.

Localities.—England: the Carboniferous Limestone of Settle; above Hardraw Scar Limestone, Millgill Asgrigg, Yorkshire. Isle of Man: Carboniferous Limestone, Poolvash. Scotland: the Carboniferous Limestone series, Teasses, Largo; Burn at Craigdouffie, Kilsyth; Glen Hind og Dalry. Ireland: the Carboniferous Limestone, Little Island, co. Cork.

Observations.—The type of Phillips's *Pecten simplex* has disappeared, and the description and figure are very meagre and poor. M'Coy, however, gave a better description, from which the shell is fairly easily recognised; but he describes the right valve as "nearly flat," a statement I cannot accept, the right being only a little less gibbose than the left valve.

De Koninck figured two shells of very different appearance in his first work, 1843, and subsequently in 1885 re-described his shell under the name *Aviculopecten ? duplicriradiatus*. The writer of the description of this shell states that de Koninck confounded his species with that of Phillips, but that it differs in possessing bifurcating radiating ribs. Now one of the few characters that Phillips's figure does undoubtedly show, is that of having bifurcating radiating ribs. I have, therefore, no hesitation in placing de Koninck's specific name as a synonym of *P. simplex*. I strongly suspect that *Limatulina radula* belongs to the same species.

Phillips says of his species, "Upper valve, fig. 27, much flatter," but the figure shows a comparatively gibbose shell.

PALÆOLIMA LÆVIS, sp. nov. Plate XIX, figs. 13—16.

Specific Characters.—Shell small, slightly inequivalve, gibbose, ovate, oblique, with lower part of the posterior margin produced. The anterior border rounded and short. The posterior margin almost straight and very oblique. Hinge-line straight, of moderate length. Umbones gibbose, pointed, placed almost at the centre of the hinge-line. That of the left valve larger and more elevated than that of the right valve. Ears very marked, narrow, the posterior the longer, while the anterior is deeper.

Interior.—Unknown.

Exterior.—Surface smooth. Ears smooth.

Dimensions.—Pl. XIX, fig. 13, a right valve, measures—

Antero-posteriorly	14 mm.
Dorso-ventrally	13 mm.

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

Observations.—I cannot find any previous description of this little shell. In the cabinet of Mr. J. Wright, of Belfast, there is a tablet of seven specimens which have served for the description of the species. Two of them are right valves and the others left valves. The oblique character of the shell and the overlapping of the left umbo have induced me to place the species in the genus *Palæolima*.

PALÆOLIMA OBLIQUIRADIATA, sp. nov. Plate XIX, figs. 17—19.

Specific Characters.—Shell of moderate size, transversely oblique, oval, obliquely gibbose, inequivalve, very inequilateral. Ears almost obsolete. The anterior border ellipsoidal, the lower margin slightly convex in front, produced downwards and more convex posteriorly. The posterior border almost straight, very oblique

and truncate. Hinge-line straight and short. Umbones small, oblique, pointed, placed about the junction of the anterior and middle thirds of the hinge-line. The anterior ear small and depressed, not very sharply defined from the rest of the valve. The posterior ear much depressed, narrow, and its posterior superior angle greater than a right angle. The valve obliquely swollen and its greatest convexity nearer the posterior than the anterior border. The dorsal slope well marked and broad, forming a broad oblique hollow groove which lies between the ear and an oblique angular ridge, which forms the posterior margin of the valve.

Interior.—Unknown.

Exterior.—The surface is ornamented with numerous broad, flat, radiating ribs, some of which bifurcate as they pass across the shell. The ribs are broader, and the grooves that separate them less deep, in the anterior part of the valve. The ribs are crossed by concentric rugæ and lines of growth. The ears are without radiating ridges and have only lines of growth.

Dimensions.—Pl. XIX, fig. 17, a left valve from Settle, measures—

Antero-posteriorly	46 mm.
Dorso-ventrally	24 mm.
Gibbosity of valve	7·5 mm.

Localities.—The Carboniferous Limestone of Settle, Yorkshire, and Park Hill, Derbyshire.

Observations.—This species differs from *P. simplex* in its great obliquity, and possesses more numerous and flatter ribs than that species. A series of three specimens from Settle, one of which (Pl. XIX, fig. 18) is bivalved, are in the Woodwardian Museum, Cambridge, and I have three specimens in my cabinet from Park Hill, Derbyshire. Unfortunately the hinge-line is not quite perfect in any of them, and the anterior ear is not well exposed. The peculiar characters of the species are so well marked that it is not likely to be confounded with any other. The radiating ribs are not well marked in young examples or in the umbonal region of the full-grown specimens.

Family PECTINIDÆ.

The Pectiniform shells of the Carboniferous period have been referred to various genera by different authors. Phillips described his specimens as *Avicula* and *Pecten*. Portlock used the term *Pecten*, but referred one fine example to *Orthis*. M'Coy subdivided his species among the genera *Pecten*, *Avicula*, *Lima*, *Malleus*, *Meleagrina*, *Pterinea*, and *Monotis*; but later on he proposed the new genus *Aviculopecten*, to which he referred the majority of Carboniferous Pectiniform shells. The type of this new genus was *A. planoradiatus*, which subsequently

proved to be the left valve of a species previously described by M'Coy as *Pecten tabulatus*. He also defined the genus *Streblopteria*, the type of which is *S. lævigata*, and he retained *Pecten* and *Amusium*. De Koninck in 1885 referred the Pectiniform shells from the Carboniferous Limestone of Belgium to *Rutotia*, *Streblopteria*, *Aviculopecten*, *Limatulina*, and *Entolium*. Of these it seems that *Rutotia* is a synonym of *Eumicrotis*, Meek, and *Entolium* of *Syncyclonema*, Meek.

Still, however, the shells referred to *Aviculopecten* were evidently diverse in character, and when describing the Lamellibranchs from the Devonian rocks of the State of New York, Hall found it necessary to subdivide them, retaining *Aviculopecten* for shells of the type of *A. planoradiatus*, M'Coy, with large well-formed ears, but separating under the name of *Pterinopecten* shells with an anterior ear only and a very long hinge-line, *Lyriopecten* for shells with a shorter hinge-line and a small anterior ear, and *Crenipecten* for shells with a crenulated hinge-plate. This was a good advance, and two at least of these new genera are represented in Carboniferous times.

Even thus *Aviculopecten* seems to me to include heterogeneous groups, and at least the smooth shells described by Phillips as *Pecten ellipticus* and *P. anisotus*, with very small posterior ears, should be removed. De Koninck placed the latter group with *Streblopteria*, but this genus has no posterior ear, hence I propose to refer smooth, ovate, *Pecten*-like shells, with a smooth, grooved hinge-line, well-marked anterior ear, but short and small posterior ear, often showing flat colour-bands, to *Pseudamusium*, H. and A. Adams, as restricted by Verrill. I have also found that shells possessing characters of *Amusium* occur in Carboniferous times, and hence refer certain species to this genus.

I have also obtained from Carboniferous rocks a series of Pectiniform shells, which I cannot refer to any described genus. One has the valves smooth and very oblique, a very short hinge-line, the posterior part of the valves excavated, and the right valve the more gibbose. For this I propose the name *Obliquipecten*. Specimens occur at Settle, Castleton, and Narrowdale.

The following genera of Pectiniform shells are retained in the family Pectinidæ on account of the well-marked anterior ear in the right valve of each of them :— *Aviculopecten*, M'Coy ; *Crenipecten*, Hall ; *Pterinopecten*, Hall ; *Obliquipecten*, Hind ; *Pseudamusium*, H. and A. Adams; *Streblopteria*, M'Coy; *Eumicrotis*, Meek ; *Amusium*, Klein ; and *Syncyclonema*, Meek.

Palæolima and *Limatulina* are placed in the family Limidæ, though I am not sure that the former is not nearer to *Spondylus* than to *Lima*. As to species, those of Sowerby are all retained, namely, *Aviculopecten plicatus*, *Pterinopecten papyraceus*, and *P. granosus*. Fleming is responsible for *A. dissimilis*. Fourteen of the species described by Phillips are retained ; one only, *P. arenosus*, the type of which has been lost, is regarded as the young form of *A. dissimilis*, Fleming. I

consider J. de Carle Sowerby's species *A. gentilis* to be good, but have doubts as to the value of *P. scalaris* of this author.

M'Coy described as new seventy-five species of Pectiniform shells in his earlier work, and sixteen of these were founded on right valves. Many of his specific names are synonyms, representing opposite valves or different stages of growth of the same shell. Several of the types are too poor to recognise their true affinity, and several others had been previously described by other writers, while two species, *Avicula pulchella* and *Pecten flabellulum*, do not belong to the family. Of these two shells the first is a fragment of *Pteronites persulcatus*, and the second, I think, the interior of *Athyris planosulcata*. I am able to retain only about twenty species.

In his second work, M'Coy described three other species, *Aviculopecten docens*, *A. planoradiatus*, and *A. Ruthveni*. The first is Portlock's *Pecten semicostatus*. The second species, founded on a left valve, had been previously described by M'Coy as *P. tabulatus;* and the last species, retained for the present, seems to me to be probably a damaged and full-grown specimen of *A. interstitialis*, Phillips. De Koninck described three species of *Pecten* and twelve species under the genus *Avicula* in his early work, 1842; but in 1885 he described eleven species of *Rutotia*, sixteen species of *Streblopteria*, forty-six species of *Aviculopecten*, five species of *Entolium*, and six species of *Limatulina*, a very large number of which I regard as synonyms, either representing different stages of growth or simple variations, not of specific value.

The study of the family of *Pectens*, as represented in Carboniferous beds, has been very troublesome owing to the poor material and the difficulty of obtaining specimens well enough preserved to study the important details. The surface-ornament of shells belonging to different genera is often so similar that, unless the hinge-line, and especially the ears, are present, a correct determination of the affinities of the shell is almost impossible. In addition, the hinge-plate is rarely if ever exposed even in the larger specimens. The poor and imperfect condition of many of the types has also caused a difficulty; and to this and the non-recognition of opposite valves of the same shell is due the inordinately large number of supposed species described.

Genus EUMICROTIS, *Meek*, 1864.

EUMICROTIS, *Meek*, 1864. Amer. Journ. Sci., 2nd ser., vol. xxxvii, p. 218.
— *Meek and Hayden*, 1865. Pal. Upper Missouri, p. 53 (Smithsonian Contrib. Knowl., vol. xiv, No. 5).
RUTOTIA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 196.

Generic Characters.—Shell suborbicular, slightly oblique, the left valve moderately tumid, without ears. The right valve flattened, with a small anterior ear.

The anterior border somewhat convex, the lower much so, but the posterior nearly straight. The hinge-line straight, much shorter than the antero-posterior diameter. The umbo of the right valve small and scarcely projecting above the hinge-line; that of the left much larger, elevated, gibbose, and incurved. Right valve deeply indented by the byssal notch, which forms a triangular pit, and separates a small ear from the rest of the valve. In the left valve, the notch is indicated by a more or less marked depression.

Interior.—Meek states that the adductor scar is large and subcentral, while the impressions of retractor muscles are several, small, and placed near the beaks, and the hinge is edentulous.

Exterior.—The surface is adorned with concentric lines of growth, and in some species with radiating more or less scaly ribs, the more distinct on the left valve.

Observations.—The genus *Eumicrotis* was defined by Meek to include shells from the Permian and Upper Carboniferous of North America. He considered that *Monotis speluncaria*, Schlotheim, sp., and King, from the Permian of England, also belonged to his new genus, and that it had been wrongly referred to *Monotis*, Bronn. This species, however, has a peculiar posterior lobe separated from the rest of the valve by an oblique sinus; the left umbo is arched to a greater extent, and the hinge-line is not so pronounced as in *Eumicrotis*. The type is *Eumicrotis Hawni*.

Meek and Hayden say that "the shells embraced in this genus are apparently most nearly allied to *Aucella* of Keyserling." De Koninck established the genus *Rutotia* to receive shells from the Carboniferous Limestone which were smooth, inequivalve, orbicular or oval, with the left valve more convex and higher than the right; but he did not realise that the genus *Eumicrotis*, Meek, had been founded for similar shells, and therefore had the right of priority. De Koninck described eleven species, some of which represent different stages of growth of a single species. His figures of *E. hemisphæricus*, Phill., sp., are not good, and do not show the characters of the anterior and posterior superior angles.

The most common species is *E. hemisphæricus*, Phillips, sp., and it shows the peculiar generic characters described by Meek and Hayden. There can be no doubt of the propriety of separating *P. hemisphæricus* from *Pecten*, and on account of the inequality of the valves it could not be placed in *Posidonomya*. The shell has certainly no connection with *Aviculopecten*. Unfortunately the hinge characters have not yet been observed, but it would appear that there is in the right valve an internal ridge (leaving a groove in casts), which passes from the front of the umbo to the anterior border, forming a curve with the concavity upwards; while in the left valve is a deep narrow hollow externally between the umbonal margin and the rudimentary anterior ear (Pl. VII, fig. 5). Unfortunately this portion of the valve is not complete in the only bivalved example I have yet obtained.

EUMICROTIS HEMISPHÆRICUS, *Phillips*, sp., 1836. Plate VII, figs. 1—6.

PECTEN HEMISPHÆRICUS, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 212, pl. vi, fig. 16.
POSIDONOMYA HEMISPHÆRICA, *de Koninck*, 1843. Descr. Anim. Foss. Belg., p. 142, pl. i, fig. 16.
AVICULA HEMISPHÆRICA, *Brown*, 1849. Illust. Foss. Conch., p. 160, pl. lxv, fig. 5.
AVICULOPECTEN HEMISPHÆRICUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 164.
RUTOTIA HEMISPHÆRICA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 197, pl. xxxix, figs. 6, 7.
Cf. STREBLOPTERIA PRÆLINEATA, *de Koninck*, 1885. Ibid., p. 204, pl. xxxii, fig. 4.

Specific Characters.—Shell of medium size, suborbicular, a little inequilateral, very inequivalve, the right valve only slightly convex, the left gibbose. The anterior inferior margin convex, the posterior almost straight and nearly vertical. The hinge-line straight, the smallest, antero-posterior diameter of the valve, making well-marked right angles with the anterior and posterior margins. The umbones subcentral, that of the right valve being small and not elevated, the left being gibbose, elevated, and arched over that of the right valve. No posterior ears, but the valves compressed at the antero- and postero-superior angles, especially the latter, which is the larger and more pronounced. The right valve deeply marked by a triangular pit, which runs up almost to the umbo, for the byssus, and marks off a small ear from the rest of the valve; left not cut, but showing a more or less well-marked depression forming a swollen lobe in the position of the anterior ear. Both valves more convex in the anterior than in the posterior portion.

Interior.—Details not observed.

Exterior.—The surface is marked with very fine microscopic lines of growth, sometimes squamous, best seen in the upper part of the valve, but to the naked eye it is almost smooth.

Dimensions.—Pl. VII, fig. 1, a bivalved example from Hill Bolton, measures—

Antero-posteriorly	37 mm.
Dorso-ventrally	42 mm.
From side to side	18 mm.

Localities.—England: the upper beds of the Carboniferous Limestone of Castleton, Derbyshire; Settle, Hill Bolton, Yorkshire; Narrowdale, Staffordshire; and Poolvash, Isle of Man. Ireland: the Carboniferous Limestone of Little Island, co. Cork; Clogherbrian, co. Kerry.

Observations.—The type of Phillips's *Pecten hemisphæricus* is fortunately preserved in the Gilbertson Collection at the Natural History Museum, South

Kensington, and a new drawing of it is given in the accompanying Pl. VII, fig. 2. Phillips says that "it may possibly be *Avicula*," but de Koninck was the first observer who recognised the distinctive characters of the shell and separated it under his new genus *Rutotia*. Unfortunately, shells belonging to the genus had been recognised and described previously from Permian beds under the name of *Eumicrotis*, and this must therefore have precedence.

The type specimen is a left valve, which shows the ear-like process in front and the absence of any posterior ear. I have fortunately been able to obtain some right valves, which show a fairly well-formed though small anterior ear, separated from the rest of the valve by a deep and broad notch for the byssus. Pl. VII, fig. 1, represents a bivalved example with the right anterior ear wanting, from the Carboniferous Limestone of Hill or El Bolton, Craven district of Yorkshire. Pl. VII, fig. 4, shows the right valve, with the anterior ear well preserved.

E. hemisphæricus is very like the shell I figured as *Posidoniella gibbosa* in Vol. I, Pl. V, figs. 12—14. I should not feel it an easy task to determine the left valves, but fig. 12 shows both valves to have been equally gibbose, and the right valve seems to have had no ear.

EUMICROTIS OVALIS, *de Koninck*, sp., 1885. Plate XI, figs. 8, 9; Plate XVIII, figs. 8, 9.

RUTOTIA OVALIS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 200, pl. xxii, figs. 36, 40.

— ORNITHOCEPHALA, *de Koninck*, 1885. Ibid., p. 200, pl. vii, figs. 29, 30; pl. xxii, figs. 25, 29.

Specific Characters.—Shell below medium size, slightly inequivalve, slightly obliquely ovate, gibbose. Its margins rounded. The hinge-line straight, not extending very far backwards. The umbones comparatively large, gibbose, pointed, incurved, twisted slightly forwards; the left only slightly more gibbose than the right, subcentral, separated by an area. The anterior ear well formed in the right valve and separated by a byssal slit from the rest of the valve, not so well marked in the left valve. The posterior ears obsolete, the posterior superior edge of the valve being small; the angle very obtuse.

Interior.—Unknown.

Exterior.—The surface is smooth, even concentric lines of growth being hardly visible.

Dimensions.—Pl. XVIII, figs. 8 and 9, a bivalved example from Settle, measures—

Antero-posteriorly	24 mm.
Dorso-ventrally	25 mm.
From side to side	14 mm.

Localities.—England: the Carboniferous Limestone of Settle, Yorkshire; Castleton, Derbyshire. Ireland: co. Cork.

Observations.—I can see no sufficient reason for the recognition of the two species, *Rutotia ovalis* and *R. ornithocephala*, de Kon., and therefore have adopted the first of them. *E. ovalis* can be easily recognised by its large, obliquely twisted umbones, and small posterior wing.

Genus STREBLOPTERIA, *M'Coy*, 1851.

STREBLOPTERIA, *M'Coy*, 1851. Ann. Mag. Nat. Hist., ser. 2, vol. vii, p. 170.
— — 1855. Brit. Pal. Foss., p. 482.
— *Meek and Worthen*, 1866. Geol. Surv. Illinois, vol. ii, Palæont., p. 332.
— *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 202.
— *Miller*, 1889. N. Amer. Geol. and Palæontol., p. 514.
— *Tornquist*, 1896. Fossilführ. Untercarbon. Südvogesen, Abh. geol. Specialkarte Elsass-Lothringen, Band v, Heft 5, p. 60.

Generic Characters.—Valves ovate, or rotund, the anterior side extended obliquely forwards. The anterior ears small, well defined, and separated from the valve by a deep slit for the byssus. The posterior wing broad, undefined, nearly rectangular, extending as far as the posterior margin of the shell. Valves gently convex, equivalve (*de Koninck*).

Interior.—With a short narrow tooth diverging slightly from the hinge-line on the posterior side of the umbones. Ligament internal, lodged in a simple narrow facet along the hinge-margin. Adductor muscle-scar large, single, shallow, placed posterior to the middle line and high up in the valve.

Exterior.—Surface smooth or with radiating ridges.

Type species.—*Streblopteria lævigata*, M'Coy.

Observations.—The genus *Streblopteria* was established by M'Coy for *Pecten*-like shells, with a compressed quadrate posterior wing, having a single tooth in the hinge and an obliquely expanded anterior side. To this genus he referred two species alone, namely, *S. lævigata* and *S. pulchella*, the latter only known by a mere fragment, which on examination proves to be the extreme anterior end of *Actinopteria*, probably *A. persulcata*, M'Coy. De Koninck doubted the generic characters of this shell. Meek and Worthen, accepting the genus, propose to extend it to receive shells without the peculiar backward obliquity of the typical species of "*Streblopteria*," but they state that the presence of a cardinal tooth in the smooth shells they propose to include in the genus is not ascertained. They

decide to include in *Streblopteria*, "smooth little Carboniferous and Permian species, which seem to have generally, if not always, a deep sharply-defined byssal sinus in the anterior margin of the right valve."

These authors propose to refer to this genus such forms as *Pecten dissimilis* and *P. consimilis*, M'Coy, and refer an American species, previously described by themselves as *P. tenuilineatus*, to the genus.

I cannot think it wise to extend the genus *Streblopteria* to receive shells with well-marked posterior ears, especially when Meek and Worthen state in their description, "posterior wing broad, undefined, nearly rectangular, extended nearly as far as the posterior margin of the shell," and I cannot admit that their shell belongs to this genus. It is difficult to understand on what grounds they would refer *P. dissimilis*, with its well-marked ears and its strongly ribbed character, to *Streblopteria*. *Pecten consimilis*, M'Coy, a synonym of *Pecten anisotus*, Phillips, has a small, not extended, well-defined posterior ear, and therefore not belonging to this genus, from which it also differs in being ovate and having no expanded anterior margin.

De Koninck accepted M'Coy's genus and described eighteen species, of which I think *S. elongata*, M'Coy, sp., *S. prælineata*, *S. picta*, *S. pullus*, *S. ellipsoidea*, *S. propinqua*, having well-marked posterior ears, do not belong to the genus. I am not prepared, however, to accept all the other species, as I suspect some of them represent different stages of growth of the same shell. I find that the length of the hinge-line and the development of the posterior wing vary greatly with each stage of growth.

Streblopteria seems to form a passage between *Posidoniella* and *Posidonomya* and a more strictly Pectiniform type. The two former genera have no anterior ear, or a very rudimentary anterior ear respectively, but both have a rectangular expanded posterior wing. *Eumicrotis*, too, would seem to come even between *Posidoniella* and *Streblopteria*, because in that genus the right valve has a well-marked anterior ear, separated by a deep and long slit for the byssus from the rest of the valve. There is no evidence that *Posidonomya* was byssiferous, but *Posidoniella* often occurs in numbers attached to fossil vegetable remains.

STREBLOPTERIA LÆVIGATA, M'Coy, 1855. Plate XI, figs. 1—7.

MELEAGRINA LÆVIGATA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 80, pl. xii, fig. 5.

AVICULOPECTEN LÆVIGATUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 165.

STREBLOPTERIA LÆVIGATA, *M'Coy*, 1855. Brit. Pal. Foss., p. 482.

— — *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 203, pl. xxxii, figs. 2, 3; pl. xl, figs. 14, 15.

Specific Characters.—Shell above medium size, obliquely suborbicular, expanded anteriorly, flattened and produced at the posterior superior angle. The left valve convex, the right less so. The margin forming a single varying curve from the anterior ear to the posterior superior angle, but the posterior margin having a less curvature than the right. The hinge-line straight, very short in front and prolonged backwards. The anterior ears small and triangular, compressed and sharply defined, that of the right valve deeply slit for the byssus. No posterior ear, but a rectangular expanded wing-like process. The umbones tumid, pointed and incurved, gibbose, with a more sudden slope in front than behind, subcentral.

Interior.—Unknown.

Exterior.—The surface is smooth, but the microscope shows very fine concentric lines of growth, and the anterior ears have fine concentric, almost obsolete, intricate markings. One specimen shows about 8—10 narrow, widely separated radiating colour-bands.

Dimensions.—Pl. XI, fig. 4, from Lowick, in the Woodwardian Museum, measures—

Antero-posteriorly	97 mm.
Dorso-ventrally	97 mm.

Localities.—England: the Carboniferous Limestone of Lowick and Settle. Ireland: the Carboniferous Limestone of Caherass and Doohylebeg, co. Limerick; Cork, co. Cork; Millicent, co. Kildare; Cloghran, co. Dublin.

Observations.—This species must be regarded as the type of *Streblopteria*, M'Coy, and demonstrates the absence of a posterior ear, so that the genus must be limited to shells with this character.

A very large specimen from Lowick (Pl. XI, fig. 4) is perfect except the anterior ear, but shows very well the character of the posterior superior angle and hinge-line. It is a right valve. The left valve is more gibbose than the right, and its anterior ear comparatively more depressed. The hinge-plate has not been exposed, and I am unable to say anything on this subject. In young examples the valve is comparatively more gibbose and the umbonal gibbosity more oblique.

Pl. XI, fig. 6, represents a specimen which has the colour-bands preserved. It is from the dark limestone of Cloghran, co. Dublin. The opposing valve of the same specimen (Pl. XI, fig. 5) shows the anterior ear, the shell posterior to the umbo having been broken.

STREBLOPTERIA ORNATA, *R. Etheridge, jun.*, sp., 1873. Plate XI, figs. 10—12.

AVICULOPECTEN ORNATUS, *R. Etheridge, jun.*, 1873. Mem. Geol. Surv. Scotland, Expl. Sheet 23, p. 103.
— — — — Geol. Mag., vol. x, p. 346, pl. xii, fig. 2.

Specific Characters.—Shell of medium size, compressed, subcircularly quadrate, inequilateral. The left valve more convex than the right valve. The anterior and lower margins of the shell regularly rounded, the posterior almost straight and oblique. The hinge-line straight and prolonged backwards, making a well-marked, almost a right angle with the posterior margin. The umbo of the left valve large and swollen, pointed and incurved, overlapping that of the right valve, which is small, flattened, and not raised. The anterior ear small, triangular, and well defined in the right valve; depressed and somewhat rolled in the left valve. No posterior ears, but the posterior superior angle of the valves flattened and expanded in the form of a rectangular wing.

Interior.—Unknown.

Exterior.—The surface is ornamented with close, concentric lines, which are crossed on the anterior side by fine, flexuous, radiating striæ. The posterior wing is almost smooth. The anterior ear of the right valve has a few well-marked radiating ribs.

Dimensions.—Pl. XI, fig. 11, a left valve, measures—

Antero-posteriorly	28 mm.
Dorso-ventrally	28 mm.

Localities.—Scotland: the Lower Limestone series of Kinghorn, Fife; Calderwood Limestone series of Waygateshaw Pit, Carluke; between Avon Paper Mill and Linlithgow Bridge; River Gryfe, near Crosslea Mill, near Houston. Also, according to Etheridge, the Upper Limestone series of several localities and horizons. Ireland: the Carboniferous series of Fair Head, co. Antrim; Rathkeale, co. Limerick.

Observations.—Mr. R. Etheridge, jun., founded this species and figured a right valve (*op. cit.*, 1873). The anterior ear of the type specimen seems to be detached; otherwise the figure of it is a good one.

The absence of a posterior ear removes the species from *Aviculopecten*, with which it has in other respects little or no affinity, and affirms its relationship to *Streblopteria*. I have been able to study the left valve from specimens in the collection of the Geological Survey of Scotland, which have been generously placed at my disposal for the purpose. It is considerably more gibbose than the right

valve. Several specimens of the left valve are crushed and have lost their original shape, and are therefore misleading as to their condition when living.

S. ornata is easily distinguished from *S. hemisphærica* by the presence of flexuous radiating striæ in front, and from *S. lævigata* by its more rounded shape and the concentric linear ornament.

Genus PTERINOPECTEN, *Hall*, 1884.

PTERINOPECTEN, *Hall*, 1884. Pal. N. York, vol. v, pt. i, Lamell., p. xii.

Generic Characters.—Shell Pectiniform, hinge-line long. Posterior ears not well defined, being simple expansions or extensions of the upper lateral margins to the hinge-line. Test ornamented with rays, ears having the same ornament as the rest of the valve, and both valves having an almost identical adornment.

Observations.—There can be no doubt of the propriety of separating shells with a prolonged hinge-line and indefinite posterior ears from *Aviculopecten*, M'Coy; for the type species of this genus is *A. planoradiatus*, which was described with *A. Ruthveni* when the genus *Aviculopecten* was originally diagnosed in the 'Annals and Magazine of Natural History,' 2nd series, vol. vii. Hall recognises *Pterinopecten* in beds of Devonian age in North America, and it seems to have persisted until Middle Coal Measure times in England; but the genus is not rich in species, one single species only being found above the Carboniferous Limestone *massif* and its equivalent, the Yoredale Rocks of Wensleydale and the North.

Zittel has evidently mistaken the type of *Aviculopecten*, for he figures and describes *P. papyraceus* as the type, instead of *A. planoradiatus*, which proves to be the left valve of a shell previously described by M'Coy as *P. tabulatus*.

PTERINOPECTEN PAPYRACEUS, *Sowerby*, sp., 1823. Plate VII, figs. 7—13.

PECTEN PAPYRACEUS, *Sowerby*, 1823. Min. Conch., vol. iv, p. 75, t. 354.
AVICULA PAPYRACEA, *Goldfuss*, 1834–40. Petref. Deutschl., vol. ii, p. 126, t. 116, fig. 5.
PECTEN PAPYRACEUS, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 213.
AVICULA PAPYRACEA, *de Koninck*, 1842–4. Anim. Foss. Terr. Carb. Belg., p. 136, pl. v, fig. 6.
PECTEN SUBPAPYRACEA, *de Verneuil*, 1845. Géol. Russie d'Europe, p. 325, pl. xxi, fig. 3.
AVICULA PAPYRACEA, *Brown*, 1849. Illust. Foss. Conch., p. 159, pl. 61**, fig. 11.

AVICULOPECTEN PAPYRACEUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 165.
— — *M'Coy*, 1855. Brit. Pal. Foss., p. 488.
— — *Salter*, 1864. Mem. Geol. Surv., Country round Oldham, pl. i, fig. 1.
— — *Baily*, 1875. Char. Brit. Foss., pl. xxxix, fig. 1.
— — *Roemer*, 1876. Lethæa Geogn., taf. 44, fig. 1.
— — *R. Etheridge, jun.*, 1876. Geol. Mag., dec. 2, vol. iii, p. 152, pl. vi, fig. 7.
— — — 1877. Ibid., vol. iv, p. 243, pl. xii, figs. 4, 5.
— MOSENSIS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 214, pl. xxxvi, fig. 20.
— PAPYRACEUS, *Wild*, 1892. Trans. Manch. Geol. Soc., vol. xxi, p. 395, pl. iii, fig. 12.

Specific Characters.—Shell semi-oval, inequilateral, slightly oblique towards the posterior side, the left valve very moderately convex, the right valve much less so. The anterior border very slightly convex, the lower strongly curved, the posterior convex below and concave above. The hinge-line straight and long, the longest antero-posterior diameter of the valve. Umbones small, and only slightly tumid, the right less swollen than the left, placed about two-fifths the length of the hinge-line from the anterior end. The anterior ears more definite than the posterior, that of the right valve being the more distinct and separated from the valve by a deep groove, which is represented at the margin by a deep notch for the byssus. The left ear convex, not incised, margin only slightly notched. The posterior ears not marked off from the rest of the valve, and only indicated by the gradual compression of the valve. The postero-superior angle extending slightly beyond the rest of the margin, so that the border of the valve shows a slight concavity just below it.

Interior.—Unknown.

Exterior.—The surface is ornamented with many somewhat irregular, flattened, radiating ribs, secondary ribs often arising between the original ones, which pass without dividing to the border. At times these ribs are decussated by lines of growth, which vary much in degree in individual shells. Ears have a similar ornament to the rest of the valve, but the lines of growth are much more marked in these positions. The number and closeness of the ribs also vary. The ribs are separated by smooth, flattened spaces.

Dimensions.—Pl. VII, fig. 13, a left valve from the Lower Coal Measures of Southowram, measures—

Antero-posteriorly	60 mm.
Dorso-ventrally	53 mm.
Convexity of left valve	5 mm.

Localities.—England: specially characteristic of the series of beds which succeed the *massif* of Carboniferous Limestone, and found at many horizons as high as the Middle Coal Measures. Derbyshire: Pendleside series of Mam Tor, river Noe, near Castleton, and Railway Cutting, Tissington; Coal Measures between top hard coal and deep soft coal, Midland Railway Cutting, $\frac{3}{4}$ mile north of Pilsley Junction. Staffordshire: Pendleside series of river Dane, in Swythamley Hall gardens, Quarry near Mixon Hey, and the Coombes, near Leek; Coal Measures of Cheadle Coalfield (above stinking coal); roof of thin coal about 42 yards above Tilborne Coal; Pottery Coalfield (above 7 ft. Banbury, and at Weston Coyney brick works, and below the Twist Coal). Lancashire: Pendleside series of Pendle Hill, Dinckley Hall, river Hodder; above the Bullion Coal, Sholver, Colne, and universally; 150 yards over Great Mine, Ashton-under-Lyne. Cheshire: Pendleside series, E. of Bosley Minn. Shropshire: Pennystone Ironstone of Coalbrookdale. Yorkshire: Pendleside series of the Vale of Todmorden, Pule Hill, Marsden; Flasby and Burnsall Fells; below the third grits at Eccup, and Wadsworth Moor; Coal Measures of Halifax (roof of the Hard bed), and universally at that horizon. North Wales: Holywell Shales of Flintshire. Isle of Man: *Posidonomya*-beds, Poolvash. Scotland: $2\frac{1}{2}$ feet above the Calderwood Cementstone, Lower Limestone Group, East Kilbride; and ? above the Ell Coal, Wishaw. Ireland: Pendleside series (Upper Limestone Shales) of co. Dublin; Meath; Glenaster, Foynes Island, and Mount David, co. Limerick; Roscliffe, co. Clare; Coal Measures of Firoda Colliery, Kilkenny; Gannister series of Castlecomer.

Observations.—This species is most important, as it is the characteristic Lamellibranch of a special fauna, and therefore of zonal value. Its zone is very thick, measuring some 2000—4000 feet in some areas, but *Pterinopecten papyraceus* appears in the lower beds of this mass of rocks, and recurs at several horizons throughout the series, which extends from the top of the *massif* of Carboniferous Limestone to a layer high up in the Coal Measures. The species has been long known, and it has been fully described by Sowerby, de Koninck, M'Coy, and Etheridge. The slight differences which occur in the descriptions by these authors are doubtless all due to different degrees of preservation in the specimens studied. To this matter Mr. R. Etheridge, jun., has called attention. Very frequently *P. papyraceus* is much compressed, but the true characters of the shell are best observed in specimens preserved in nodules of black limestone. Well-preserved specimens always show a well-marked anterior ear in both valves, but the posterior ear is not marked off from the valve by a groove, and its margin extends slightly beyond the rest of the valve, so that the posterior border is sinuous above.

The marking of the shell is simple; a series of long, radiating, narrow ribs which pass uninterruptedly from the umbo to the border of the valve, is separated by smaller ribs which commence on the body of the valve between any two main

ribs. I have not noticed one rib dividing or coalescing with another. The concentric lines of growth are rarely very distinct, but they are occasionally so well marked as to interrupt the radiating ribs and cause a more or less widely reticulate appearance. I am unable to agree with Mr. R. Etheridge, jun., that the radiating ridges frequently bifurcate. I have never seen such a condition, and think he must have been misled by the intercalated ribs, which on careful examination are found to arise independently in the spaces between the primary ribs. The shell varies considerably as to the number and closeness of the radiating ribs. The ribs are strongest and widest apart on the posterior ears.

A personal examination of the type specimen of *Aviculopecten Mosensis*, de Koninck, leaves no doubt in my mind that the latter name is a synonym of *P. papyraceus*. The matrix of the fossil is a black limestone, and therefore not the Visé Limestone. It belongs to a horizon at Visé above the *massif*, and indicates beds of the Pendleside series.

I also think that the *Avicula Samuelsii* of Brown, described and figured in 'Trans. Manch. Geol. Soc.,' vol. i, 1841, p. 225, pl. vii, fig. 65, is the young of *P. papyraceus*.

PTERINOPECTEN CONCAVUS, *M'Coy*, sp., 1884. Plate IX, figs. 6, 7.

PECTEN CONCAVUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 90, pl. xv, fig. 10.
AVICULOPECTEN CONCAVUS, *M'Coy*, 1854. Brit. Pal. Foss., p. 484, pl. 3 E, fig. 2.

Specific Characters.—Shell of medium size, transversely quadrato-orbicular, only moderately convex. The anterior, inferior, and lower part of the posterior margin convex, the upper part of the posterior border sinuous. The umbones small, pointed, not raised. The hinge-line long and straight. The anterior ears long, large, and well defined, especially in the right valve, the posterior ears not well marked off from the body of the valve, long, their depth indicated by an extension of the posterior border in a falciform manner.

Interior.—Unknown.

Exterior.—The surface is ornamented with numerous close, fine, rounded, radiating ribs, new ones becoming intercalated between them as they pass towards the margin of the valve. The ears are ornamented in the same way as the rest of the valve. The ribs are crossed by concentric lines of growth, which are here and there more or less deeply marked, best seen at the posterior border and posterior ear, where the radiating striæ are interrupted by them.

Dimensions.—Pl. IX, fig. 6, the type of *Aviculopecten concavus*, M'Coy, measures—

Antero-posteriorly	94 mm.
Dorso-ventrally	76 mm.

Localities.—England: the Carboniferous Limestone of Lowick, Northumberland. Ireland: Arenaceous Carboniferous Limestone of Killogunra, Killala.

Observations.—This species has been described on two occasions by M'Coy. The type used for the second description is from Lowick, and is in the collection of the Woodwardian Museum, Cambridge. The specimen is a left valve, re-figured in Pl. IX, fig. 6, and I regard it as much crushed and flattened. In the same collection and from the same locality are two other specimens, one being a right valve (Pl. IX, fig. 7), which is moderately convex, and as this valve is always less gibbose than the left valve in all known species of the genus, it is reasonable to suppose that the apparent flatness of the left valve is merely accidental. M'Coy says that "this large species has the left valve *concave outwardly* in most specimens, . . . in which it differs from all other Palæozoic species. The opposite valve is slightly more convex," etc., etc. The ears have fine radiating ribs, being marked exactly in the same way as the body of the valve.

This shell might be mistaken for *Aviculopecten semicircularis*, M'Coy, sp., if the ears were not exposed; in the latter species the posterior ears have no radiating ribs, are better marked, and are almost smooth and much depressed.

PTERINOPECTEN RADIATUS, *Phillips*, sp., 1836. Plate IX, figs. 12—16.

AVICULA RADIATA, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 211, pl. vi, fig. 8.
— BOSQUETIANA, *de Koninck*, 1851. Descr. Anim. Foss. Terr. Carb. Belg., Suppl., p. 682, pl. lvii, fig. 3.
AVICULOPECTEN BOSQUETIANUS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 215, pl. xxxv, figs. 29, 30.

Specific Characters.—Shell below medium size, almost semicircular, very slightly and transversely oblique, inequilateral, inequivalve, the right valve being almost flat and the left somewhat convex. The anterior and inferior borders convex, the posterior convex below, sinuous above. The hinge-line straight and long. The umbones small, that of the left valve the more convex, pointed, and placed a little posterior to the junction of the anterior and middle thirds of the hinge-line. The anterior ears well defined, that of the left side marked off from the rest of the valve by a sudden more or less deep oblique sulcus, which in some specimens is almost obsolete. The same sulcus more pronounced in the right valve. Posteriorly the ears not marked off in any way from the rest of the valve, but formed by a gradual compression of the valve in this position, and their limit marked at the posterior margin by a projection of the posterior superior angle and the portion of the valve immediately beneath it.

Interior.—Unknown.

Exterior.—The surface is ornamented by simple, distinct ribs of variable

number, which pass from the umbo to the margin, becoming broader as they approach the free edge of the valve, and separated from each other by shallow grooves, in which secondary ribs may arise, these being intercalated between the primary ones. The ribs show small tumefactions at intervals in their course. The ribs are coarser and wider apart towards each extremity. Concentric lines of growth are seen crossing the valves at irregular intervals.

Dimensions.—Pl. IX, fig. 14, measures—

Antero-posteriorly	50 mm.
Dorso-ventrally	40 mm.
Convexity of valve (left) . . .	3·5 mm.

Localities.—England: the Carboniferous Limestone (upper beds) of Settle, Yorkshire; Castleton, Park Hill, and Thorpe Cloud, Derbyshire. Ireland: Carboniferous Limestone of St. Doulagh's, co. Dublin; Little Island, co. Cork; Kildare.

Observations.—The type of Phillips's *Avicula radiata* is a very small shell, and it is not difficult to understand why the species has not been recognised by authors. The type specimen (Pl. IX, fig. 16) is preserved in the Gilbertson Collection, Natural History Museum, South Kensington, and is a very young stage of growth of the left valve. An examination of any of the larger examples and a study of the contour of a young example by comparing the lines of growth, show that Phillips's shell has exactly the same contour as the young stage of de Koninck's *Aviculopecten Bosquetianus*. I am therefore compelled, on the grounds of priority, to retain Phillips's name instead of that given by de Koninck. I have seen specimens of the right valve, which is very flat, but have met with none which were sufficiently well preserved to be figured. This species has been described and figured under the name of *A. Bosquetianus* on two occasions by de Koninck, who obtained his specimens from Visé. Although de Koninck stated that this species occurred in Bolland, it has not been inserted in any British list of fossils from the Carboniferous Limestone so far as I can ascertain. Referring to this species in a foot-note, de Koninck alludes to the essential identity of the shell with the Devonian species referred by Hall to *Pterinopecten*, but he hesitates to accept any subdivision of the genus *Aviculopecten*.

Pterinopecten radiatus resembles *P. papyraceus* more closely than any other shell, but the nodular character of the ribs and the more transverse shape form an important and easily recognised difference between the two species. Pl. IX, fig. 13, represents a peculiar variety of *P. radiatus*, in which the ribs are few and wide apart, due to the fact that only in very few places have intercalating or secondary ribs been formed. Another peculiarity in this specimen is the well-defined anterior ear separated from the body of the valve by a deep groove. It belongs possibly to another species, but I hesitate to describe a new species from a single specimen.

PTERINOPECTEN GRANOSUS, *Sowerby*, sp., 1827. Plate X, figs. 1—3, 6.

PECTEN GRANOSUS, *Sowerby*, 1827. Min. Conch., p. 144, pl. dlxxiv, fig. 2.
? — — *Portlock*, 1843. Rep. Geol. Londonderry, pp. 436, 437.
— — *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 93.
— — *Brown*, 1849. Illust. Foss. Conch., p. 154, pl. lxv, fig. 16.
AVICULOPECTEN GRANOSUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 164.
— — *M'Coy*, 1855. Brit. Pal. Foss., p. 486.
— — *Baily*, 1875. Figs. Char. Brit. Foss., p. 113, pl. xxxix, fig. 2.
Non — — *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 213, pl. xxxvi, figs. 11, 12.
— NODULOSUS, *de Koninck*, 1885. Ibid., p. 211, pl. xxxvii, figs. 6, 12—15.
— BLANDUS, *de Koninck*, 1885. Ibid., p. 216, pl. xxxiii, figs. 25, 26; pl. xxxvi, fig. 29.

Specific Characters.—Shell attaining a fair size, obliquely suborbicular. Antero-posterior and dorso-ventral diameters almost equal. Inequivalve, almost equilateral. The left valve moderately convex, the right nearly flat. The anterior and inferior borders convex, the posterior convex below, sinuous above. The hinge-line straight, equal in length to the greatest transverse diameter of the valve. The umbones placed in front of the centre of the hinge-line, that of the left valve tumid and slightly raised, that of the right valve small and inconspicuous. The anterior ears well marked, triangular, pointed, separated from the valve by a well-defined groove, and projecting beyond the anterior border. The posterior ears not marked off from the valve. The upper border of the posterior ear produced backwards and pointed, its margin falcate.

Interior.—The hinge-plate is elongate, narrow, and transversely striate.

Exterior.—The surface is ornamented with numerous radiating ribs, distinctly tuberculated or moniliform, separated by folds, the surface of which is transversely striate. Secondary ribs arise in the grooves between the main ribs, and in large full-grown examples as many as three fine moniliform ribs are seen between the larger ones. In small shells the ribs are more numerous, finer, and closer together. Concentric lines of growth cross the ribs, some being strongly marked, and always well developed in the position of the posterior ear.

Dimensions.—Pl. X, fig. 2, from the Carboniferous Limestone of Clitheroe, measures—

Antero-posteriorly	65 mm.
Dorso-ventrally	60 mm.
Elevation of left valve	10 mm.

Localities.—England: the Carboniferous Limestone of Clitheroe, Lancashire; Hill Bolton and Settle, Yorkshire; Castleton, Kniveton, and Glutton Dale, Derbyshire; Lowick and Redesdale (Redesdale Ironstone), Northumberland. Scotland: Lower Carboniferous of Eskdale, Dumfriesshire; Pathhead, Haddingtonshire. Ireland: Carboniferous Limestone of Clane, co. Kildare; Woodlands and Malahide, co. Dublin; Clogherbrian, co. Kerry; Banteer, co. Cork.

Observations.—The type specimen is preserved in the Sowerby Collection, Natural History Museum, South Kensington, and it is re-figured in Pl. X, fig. 6. It is the left valve of a small specimen, and has lost a part of the posterior superior angle, but shows the depressed anterior ear. The ribs are closer and more numerous than often occurs. De Koninck completely mistook the shell, the specimen figured and described by him as *Aviculopecten granosus*, Sow., probably not belonging to the same genus. The shell does occur in Belgium at Visé, and was described under the name of *A. nodulosus*, de Koninck. This author describes the ears of his *A. granosus* as being about of equal size, which is not the case. De Koninck criticises Phillips's figured specimen of *Pecten granosus*, and perhaps with some justice, unless, perchance, it was imperfect in the region of the ears. The description, however, meagre though it be, rather agrees with that of Sowerby's shell. Unfortunately the type has disappeared, so the matter cannot be now determined.

I have been fortunate enough to obtain specimens with both valves in contact, and one specimen showing the hinge-line (Pl. X, fig. 3). The right valve is almost flat, as de Koninck states to be the case in his shell, *A. nodulosus*. There is a certain amount of variation in the ornamentation of different specimens of this species, owing to the non-development of secondary or tertiary ribs, and the strength and number of the nodular swellings on them. Judging from the shape and condition of the very young shell of *P. granosus* as shown by the deeply marked line of growth in the specimen drawn in Pl. X, fig. 2, *Aviculopecten blandus*, de Koninck, represents this condition. The shape, alternate nodular ribs, and length of hinge-line are identical. I have therefore placed this specific name in the list of synonyms. De Koninck's type was obtained from Visé, the locality of *A. nodulosus*, de Kon. *P. granosus* is distinguished from *P. eximius* by the irregularity of the nodes on the ribs and their distance apart. These nodes are very numerous and close in the latter species, and its shell is altogether of less rugged character than that of the former.

PTERINOPECTEN EXIMIUS, *de Koninck*, sp., 1885. Plate X, figs. 4, 5; Plate XI, figs. 13, 14.

AVICULOPECTEN EXIMIUS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 211, pl. xxxvii, figs. 1, 2, 4, 5.

Specific Characters.—Shell of medium size, suborbicular, the right valve flattened, the left moderately gibbose. The margin of the valve orbicular, curved, without a break from the base of each ear. The hinge-line straight, long, produced posteriorly along the upper border of the posterior ear, and pointed. The anterior ear the shorter, triangular, marked off from the valve by a well-marked groove in the left, and by a slit in the right valve. The posterior ear not marked off from the rest of the valve, but represented by a compression and extension of the shell, so that in the upper part of the posterior border its contour is falcate.

Interior.—Unknown.

Exterior.—The surface is covered with radiating ribs, between each pair of which a second rib soon rises and gradually increases in strength; halfway across the valve a third set of ribs arises, one between each primary and secondary rib. The ribs are often in pairs, a large and a small one close together, and then an interval. They are studded with close, rounded nodules, less apparent over the posterior false ear. Concentric lines of growth are also seen passing across the ribs.

Dimensions.—De Koninck's type specimen measures—

Antero-posteriorly	85 mm.
Dorso-ventrally	75 mm.
Length of hinge-line	75 mm.

Localities.—England: the Carboniferous Limestone of Derbyshire. Ireland: Lower Limestone Shales of Clonakilty, and Carboniferous Limestone of Little Island, co. Cork; St. Doulagh's, co. Dublin.

Observations.—This species is distinguished from *P. granosus* solely by its ornament. Possessing the same general shape and size, the ornament is much more regular, the ribs closer and more numerous, and the nodules on the ribs rounder and closer than in the latter species. De Koninck describes the three classes of radiating ribs, but he does not state that the secondary ribs may very soon assume the same size as the primary ribs, so that at the margin of the valve they are not to be distinguished. I have only seen one British example—a specimen of a portion of the left valve from Derbyshire, in the Woodwardian Museum, Cambridge (Pl. X, fig. 4).

I am not persuaded of the value of *P. eximius* as a species, and think it very

likely to have been a rather ornamented form of *P. granosus*. De Koninck contrasts his species with *A. Ruthveni*, M'Coy, sp., with which it has no affinity, the latter shell belonging to another type of the genus, and *Aviculopecten nodulosus*, de Koninck, which is *P. granosus*, Sow., sp. A specimen from the Lower Limestone Shales of Clonakilty, co. Cork (Pl. XI, fig. 14), was erroneously identified by Baily as *Aviculopecten papyraceus*, and was so labelled in the collection of the Geological Survey of Ireland. Pl. XI, fig. 13, represents a fine specimen of a right valve in the Woodwardian Museum, Cambridge.

PTERINOPECTEN RIGIDUS, *M'Coy*, sp., 1844. Plate VIII, figs. 1—3.

ORTHIS UMBRACULUM, *Portlock*, 1843. Rep. Geol. Londonderry, p. 456, pl. xxxvii, fig. 5.

MELEAGRINA RIGIDA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 80, pl. xiii, fig. 16.

Cf. MALLEUS ORBICULARIS, *M'Coy*, 1844. Ibid., p. 87, pl. xix, fig. 2.

Specific Characters.—Shell of medium size, obliquely suborbicular, the left valve moderately convex. The anterior end small above but expanding below, with a very convex, thickened border. The inferior border rounded, the posterior border convex below, sinuous above, and thin. The hinge-line straight and prolonged backwards. The umbones moderately convex and pointed, that of the left valve slightly raised above the hinge-line and placed far forwards. The anterior ear in the left valve short, badly defined, its antero-superior angle pointed. That of the right valve unknown. The posterior ear not marked off from the valve, but the valve compressed and expanded into the prolonged hinge-line, and the posterior border concave just below the postero-superior angle.

Interior.—The adductor muscle-scar is shallow, large, and in the same position as in *Meleagrina*. The hinge-plate is broad and long, extending from the antero-superior angle for a little more than two-thirds the length of the hinge-line. It is marked by transverse ridges and grooves, three or four in number, which in the region of the umbo are bent upwards to form a very wide angle. This hinge-plate is placed obliquely, the lower edge projecting considerably more inwards than the upper edge. Immediately below the hinge-plate, in front, is a smooth, shallow furrow, which separates the thickened anterior edge from the plate and corresponds with the byssal opening in the right valve.

Exterior.—The surface is ornamented by numerous slightly raised, narrow, rough, rounded, radiating, distant ribs, which pass from the umbo to the margin. Between these primary ribs other finer ribs arise at intervals, and there may be from one to three of these between the original ribs, commencing at different levels

down the shell. The whole of the radiating ribs are crossed at intervals by more or less well-marked concentric lines of growth, which may be strong enough to interrupt the ribs. This condition is best marked on both ears.

Dimensions.—Pl. VIII, fig. 3, as restored, measures—

Antero-posteriorly	85 mm.
Dorso-ventrally	75 mm.
Convexity of left valve . . .	10 mm.

Localities.—Ireland: co. Fermanagh, in Shales at Enniskillen; Lisnapaste, Ballintra, co. Donegal; Millicent, co. Kildare.

Observations.—It is difficult to understand why Portlock referred this species to *Orthis*, as the Aviculoid character of the shell is very apparent, and it possesses no Brachiopod-like character. The type specimen is exceedingly valuable, and is preserved in the Museum of the Geological Survey, Jermyn Street. It is a specimen of a left valve (Pl. VIII, fig. 3), entirely free from matrix, but has lost some half-inch of the lower part of its circumference and the extremities of the ears. Its hinge-line, however, is intact, and a view of this is given in Pl. VIII, fig. 3 *a*. This hinge-line recalls very forcibly the hinge-plates of *Myalina* and *Naiadites*, and to a certain extent of *Leiopteria* and *Pterinea*. Hall figures a specimen of *Lyriopecten* (a genus which is characterised by a hinge-line of a length intermediate between that of *Pterinopecten* and *Aviculopecten*), *L. orbiculatus*, from the Upper Helderberg and Hamilton Groups of New York, and possessing a similar hinge-plate to that shown in *P. rigidus* ('Pal. New York, Lamellibranchiata,' vol. i, pl. iv, figs. 7 and 9). The shape of *P. rigidus* shows its strong resemblance to recent forms of *Meleagrina*, which possess a hinge-plate differing only slightly from their Palæozoic congener.

The type of *Meleagrina rigida*, M'Coy, is unfortunately not in the Griffith Collection of the Museum of Science and Art, Dublin, but I have no hesitation in referring Portlock's shell to M'Coy's species. M'Coy's description of the ribs is as follows:—"Surface with sixty-five rather distant, narrow, rough, radiating ridges, crossed by a few large irregular concentric wrinkles. . . . The radiating ribs are narrow, rough, and separated by broad flat spaces." His figure is a good one, and evidently drawn from a perfect specimen. It is much to be regretted that the specimen has disappeared. It seems to me not unlikely that *Malleus orbicularis*, M'Coy, may be the right valve of *P. rigidus*. Unfortunately the type has disappeared, and I have met with no other shell like it. *M. orbicularis* was founded on a flat right valve, with a much-produced and pointed posterior wing, very similar in shape to that of *P. rigidus*, the right valve of which has never been described.

I refer the original of Pl. VIII, fig. 1, with hesitation to the species, on account of its small posterior wing; but noting the lines of growth on the specimen shown

in Pl. VIII, fig. 3, it will be seen that the wing is comparatively smaller in young examples, though not so small as in the specimen under discussion. The general sculpture of the shell has induced me to place it with M'Coy's species for the present.

PTERINOPECTEN MELEAGRINOIDES, *M'Coy*, sp., 1844. Plate XVII, figs. 20—23.

PECTEN MELEAGRINOIDES, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 96, pl. xvi, fig. 3.

Specific Characters.—Shell of medium size, truncato-orbicular, convexity of the left valve more than that of the right valve. The anterior and lower borders rounded, the posterior truncate, nearly straight, slightly falcate above. The hinge-line straight, of moderate length. The umbones broadly tumid and pointed, placed in front of the centre of the hinge-line. The anterior ear of the left valve depressed and well defined from the valve, comparatively small and triangular. The anterior ear of the right valve separated from the valve by a deep and long byssal slit, the ear comparatively narrow and of moderate length. No posterior ear, but each valve compressed and flattened into the postero-superior angle, which is not produced, the hinge-line being only slightly pointed.

Interior.—Unknown.

Exterior.—The surface of both valves is ornamented with alternately large and small, round, radiating ridges, the larger ribs only rising at the umbo. The spaces between the ribs are crossed by concentric ridges, much less strong than the radiating ribs. Towards the posterior superior angle the ribs are wider apart and the intervening surface smoother. The anterior ears are almost smooth in the left valve, but concentrically imbricate in the right.

Dimensions.—Pl. XVII, fig. 22, from Thorpe Cloud, measures—

Antero-posteriorly	28 mm.
Dorso-ventrally	22 mm.

Localities.—England: the Carboniferous Limestone of Thorpe Cloud and Castleton, Derbyshire. Ireland: no locality is given in Griffith's list for this shell ('Journ. Geol. Soc. Dub.,' vol. ix, p. 106).

Observations.—Unfortunately the type of *P. meleagrinoides*, M'Coy, has disappeared, but, judging from the figure and description, I think there need be no doubt of the propriety of referring my specimens to this species. *P. meleagrinoides* is distinguished by its short hinge-line posteriorly, in this point differing from other species of the genus, to which, however, it must be referred, because it has no defined posterior ear.

I have been fortunate enough to find both valves, and, as in other species of the

genus, the ornament is practically the same on each, though its character is stronger on the left and more convex valve. From *P. rigidus*, *P. meleagrinoides* is distinguished by its smaller amount of obliquity, its tesselated ornament, and short posterior side.

PTERINOPECTEN TESSELLATUS, *Phillips*, sp., 1836. Plate IX, figs. 8—11.

AVICULA TESSELLATA, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 211, pl. vi, fig. 6.
— — *de Koninck*, 1843. Descr. Anim. Foss. Terr. Carb. Belg., p. 134, pl. vi, fig. 2.
MELEAGRINA TESSELLATA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 81.
AVICULA TESSELLATA, *Brown*, 1849. Illust. Foss. Conch., p. 162, pl. lxvi**, fig. 31.
AVICULOPECTEN TESSELLATUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 166.
— — *de Koninck* (pars), 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 218, pl. xxxiii, figs. 33, 34.

Specific Characters.—Shell small, somewhat semicircular, the left valve moderately gibbose, the right flattened, inequilateral. The anterior and inferior borders rounded, the posterior being broadly rounded below, slightly concave above. The hinge-line long and straight. The umbones placed in front of the middle line, the left one gibbose and slightly raised, pointed, the right small, flattened, and not raised. The anterior ear in the left valve well defined and rolled, in the right valve long, severed from the valve by a long, deep slit for the byssus. The posterior ears not well marked off from the valve, postero-superior angle produced.

Interior.—Unknown.

Exterior.—The surface of the valve is ornamented by few widely separate rounded ribs, slightly moniliform where crossed by lines of growth; rarely fine secondary ribs arise in the flattened, smooth spaces between the primary ribs, towards the lower margin. The ribs are crossed by well-marked, almost equidistant, concentric lines of growth, giving the valve a tesselated appearance, less well marked on the ears than elsewhere.

Dimensions.—A fairly perfect left valve, shown in Pl. IX, fig. 11, measures—

Antero-posteriorly	19 mm.
Dorso-ventrally	17·5 mm.
Elevation of valve	4 mm.

Localities.—England: the Carboniferous Limestone of Settle, and Shales above the "massif," Whitewell, Yorkshire; Castleton and Thorpe Cloud, Derbyshire. Ireland: Carboniferous Limestone of Little Island and Ballinabointra, co. Cork; Ardshanbally, co. Limerick.

Observations.—The type specimen of *P. tessellatus*, Phillips, sp., is preserved in the Gilbertson Collection, Natural History Museum, South Kensington, and I am permitted to re-figure it in Pl. IX, fig. 10. It is a left valve, not quite complete posteriorly, but the restored contour was correctly indicated in Phillips's figure already quoted. I have been fortunate enough to meet with a right valve in the Burrows Collection of the Woodwardian Museum, Cambridge, which, however, has lost its anterior ear. I have also figured (Pl. IX, fig. 9) a perfect but young example from the collection of Mr. J. Wright. It is rather smoother, but has a similar ornament to that possessed by the left valve.

Incomplete specimens of *P. tessellatus* may be easily confounded with *A. nobilis*, de Koninck, which has much the same ornament; but the latter shell has the shorter hinge-line of *Aviculopecten*, and belongs to that genus. Its shape is more generally ovate, and has a definite but shorter posterior ear than the present species.

PTERINOPECTEN CYCLOPTERUS, *Phillips*, sp., 1836. Plate XVII, figs. 15—19.

AVICULA CYCLOPTERA, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 211, pl. vi, fig. 5.

Specific Characters.—Shell small, the left valve gibbose, the right flattened, with flattened and produced ears, U-shaped. The hinge-line straight and produced at each end, the longest diameter of the shell. Umbo swollen, incurved, and pointed, twisted slightly forwards, placed a little in front of the centre. Ears not well defined, gradually compressed and expanded, the posterior larger than the anterior ear.

Interior.—Unknown.

Exterior.—The surface is ornamented with few distant, radiating ribs, hardly elevated above the rest of the valve, secondary ribs arising in large examples towards the lower margin of the valve. These ribs are crossed by strong, concentric, rounded, distant folds, which are continued up to the hinge-line, and strongly marked on each ear.

Dimensions.—Pl. XVII, fig. 15, the type, a left valve, measures—

Antero-posteriorly	23 mm.
Dorso-ventrally	23 mm.

Localities.—England: the Carboniferous Limestone of Yorkshire (Bolland). Ireland: the Carboniferous Limestone of Little Island, co. Cork; Dromore, co. Limerick.

Observations.—The type specimen is a left valve (Pl. XVII, fig. 15) preserved in the Gilbertson Collection, Natural History Museum, South Kensington. For a

long time I was doubtful as to the value of this species, and could find no other specimens. However, in Mr. Wright's cabinet I observed a series of four small shells which are certainly like Phillips's shell, and have a peculiar and characteristic ornament. The type seems to have lost most of its shell, and to be in the form of a cast of the interior, but the test over the posterior ear remains. The ornament is of a very open basket-work character. One of Mr. Wright's specimens shows both valves, and the right valve proves to be flat, with much the same ornament as the left valve.

The generic affinity of this species is not very certain, but the absence of posterior ear and the length of its hinge-line have induced me to place it for the present under *Pterinopecten*.

PTERINOPECTEN DUMONTIANUS, *de Koninck*, sp., 1843. Plate VIII, figs. 4—8; Plate XIV, figs. 1, 2.

PECTEN DUMONTIANA, *de Koninck*, 1843. Descr. Anim. Foss. Terr. Carb. Belg., p. 134, pl. iv, fig. 3.
AVICULA VALENCIENNESIANA, *de Koninck*, 1851. Ibid., Suppl., p. 681, pl. lvii, fig. 2.
AVICULOPECTEN DUMONTIANUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 164.
— — *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 212, pl. xxxvii, fig. 3.

Specific Characters.—Shell above medium size, the left valve subrotundato-trapezoidal, moderately convex, the right valve much less so. Antero-posterior diameter less than dorso-ventral diameter, but variable. Anterior margin more rounded than the posterior margin, which is sinuous above and falciform immediately below the upper margin. The hinge-line straight, elongate, produced backwards, and pointed. The umbones gibbose, small, pointed and incurved, much less marked in the right valve, and placed at the junction of the anterior and middle thirds of the hinge-line. The anterior ear depressed, well marked off from the valve, triangular, its margin rounded, of fair size; the posterior ear not marked off from the valve, but continuous with the compressed and expanded postero-superior angle of the valve, with which it is incorporated.

Interior.—Unknown.

Exterior.—The surface of the left valve is ornamented with many thick, nodular, radiating ribs, which alternate with somewhat thinner ones, crossed by occasional concentric undulations of growth. The anterior ear is marked transversely by about six radiating ribs, crossed by numerous concentric lines of growth. In the right valve the alternately large and small radiating ribs are more numerous, closer,

and finer in size, still nodulose. The anterior ear is crossed by radiating ribs, separated from the valve by a hollow space marked by concentric lines. On the posterior ear the ribs are large and further apart than on the valve.

Dimensions.—Pl. VIII, fig. 8, a specimen from Settle, in the Woodwardian Museum, Cambridge, measures—

Antero-posteriorly	61 mm.
Dorso-ventrally	68 mm.

Localities.—England: the Carboniferous Limestone of Settle, Yorkshire; Castleton, Derbyshire; Lowick, Northumberland.

Observations.—*P. Dumontianus* is more coarsely ribbed than *P. granosus*, and the ribs are not so regularly punctate. It is not so gibbose as *A. Ruthveni*. Fragments may be easily mistaken for *A. Murchisoni*, but the latter has markedly alternate strong and fine nodular ribs, while its hinge-line is comparatively short, with both ears, especially the posterior, well defined and much depressed. I have fortunately obtained a specimen with both valves (Pl. VIII, figs. 5, 5 *a*), whereas hitherto only the left valve has been described. The ornamentation varies to a considerable extent in different individuals. A fine specimen with both valves, in the Manchester Museum, Owens College, is figured on Pl. XIV, figs. 1, 2.

Genus Aviculopecten, *M'Coy*, 1851.

	Aviculopecten, *M'Coy*, 1851.	Ann. Mag. Nat. Hist., 2nd ser., vol. vii, p. 171.
	— — (pars), 1854.	Brit. Pal. Foss., p. 392.
	— *Hall*, 1883.	Pal. N. York, vol. v, pt. i, Lamell., p. xii.
Non	— *Zittel*, 1900.	Text-book Palæont. (Trans.), p. 380.

Generic Characters.—Shell inequivalve, almost equilateral, ovate. Umbones well marked, swollen, and pointed, especially in the left valve. Ears well defined and large, the posterior often produced along its upper border and pointed. Hinge-line moderately long.

Interior.—The hinge-plate is striated longitudinally and very narrow. The adductor scar is large, and placed high up in the valve and posterior to the middle line.

Exterior.—The surface of the valves is ornamented with radiating ribs and concentric lines, more or less well marked, and often nodular, punctate, or imbricated. The right valve nearly always marked somewhat differently from the left. The ears always marked by few radiating ribs, separated by smooth, hollow spaces, which show fine concentric lines of growth.

Observations.—The type species of *Aviculopecten*, M'Coy, was *A. planoradiatus*,

the left valve of the shell previously described by him as *Pecten tabulatus*. M'Coy included in his genus shells which are now separated under *Pterinopecten*, Hall, and, as understood by him, it evidently included shells of widely different characters. De Koninck followed M'Coy, and refused to accept Hall's genus *Pterinopecten*, or *Euchondria*, Meek; and Zittel, taking *P. papyraceus* as the type of *Aviculopecten*, seems to have been of the same view.

I think, however, there can be little or no doubt as to the wisdom of dividing ovate shells with well-marked posterior ears from semicircular forms with posterior ears undefined. In *Aviculopecten* the right valve is always flatter than the left, and has a different marking. The tendency is for the radiating ribs to be best marked in the left valve, and concentric lines in the right valve. In *Pterinopecten* the right valve is almost flat, but the ornament is essentially the same as that of the left valve, though it may be less strongly marked.

Aviculopecten seems to have been richer in species than any of the other Pectiniform genera found in Carboniferous rocks.

AVICULOPECTEN TABULATUS, *M'Coy*, 1844. Plate XII, figs. 1—4.

	PECTEN TABULATUS, *M'Coy*, 1844.			Synops. Carb. Foss. Ireland, p. 100, pl. xvi, fig. 12.
	AVICULOPECTEN PLANORADIATUS, *M'Coy*,		1851.	Ann. Mag. Nat. Hist., ser. 2, vol. vii, p. 171.
	—	—	— 1855.	Brit. Pal. Foss., p. 489, pl. 3 E, fig. 8.
?	—	—	*R. Etheridge, jun.*, 1876.	Geol. Mag., dec. 2, vol. iii, p. 151.

Specific Characters.—Shell of medium size, triangularly pyriform, left valve gibbose, the right valve much less so. The ears large and depressed, the anterior triangular, in the right valve separated from the body of the valve by a deep groove, and rolled, in the left valve flattened and depressed. The posterior ear large, flattened, much hollowed by an oblique groove at its junction with the body of the valve, and having the upper border much produced, and its border markedly falcate. The lower margin of the posterior ear descending and cutting the posterior border a little below half the dorso-ventral diameter. The lower margin of the valve rounded; the anterior margin below the ear almost straight, directed obliquely forwards and downwards. The hinge-line straight and very long. The umbones swollen, incurved, central in relation to the body of the valve; the left umbo the more swollen.

Interior.—The internal surface is smooth, except near the lower margin, where

it is obscurely ribbed, the ribs being broad and flat, separated by narrow grooves. The hinge-plate is narrow and long; starting from a point at each extremity, it very gradually widens as far as the middle line, apparently quite smooth. The adductor muscle-scar is large, ovate, and placed high up in the valve, but posterior to the median line.

Exterior.—The surface is adorned with many simple, unequal, smooth, broad, flattened, radiating ribs, separated by almost linear grooves. The two valves are very similar. The anterior ears are obscurely radiate; the posterior ears have many radiating ribs, but exhibit two or three stronger ribs near the upper border, the whole being concentrically striated.

Dimensions.—Pl. XII, fig. 1, the type specimen, measures—

Antero-posteriorly	55 mm.+
Dorso-ventrally	64 mm.

Localities.—England: the upper beds of the Carboniferous Limestone of Castleton and Park Hill, Derbyshire; Hill Bolton and Settle, Yorkshire; Poolvash, Isle of Man. Ireland: Carboniferous Limestone of Ballintrillick, Bundoran.

Observations.—I am convinced that *Pecten tabulatus*, M'Coy, the type of which is a portion of a right valve showing the ears, is the right valve of *A. planoradiatus* of the same author. I re-figure the specimen (Pl. XII, fig. 2). M'Coy's description reads: "Surface of the shell with about fifteen flat ribs, separated by very narrow, deep sulci." I regard the flattened broad ribs and the large posterior ears as very distinctive specific characters. The type of *A. planoradiatus*, M'Coy, is in the Woodwardian Museum, Cambridge, and I am permitted to re-figure it (Pl. XII, fig. 1). It is a left valve, which has lost part of its posterior ear and much of the valve, and therefore does not give a correct idea of the length of its hinge-line. Pl. XII, fig. 3, represents a left valve more perfect in this respect, and shows that the convexity of the lower border is continued until it meets the hollow separating the body of the valve from the posterior ear, and is not as is shown in M'Coy's original drawing. I have been able to examine the hinge-plate, and in this character *A. tabulatus* agrees with *A. semicostatus*, Portlock, sp. The right valve differs from the left in being somewhat flatter and having the anterior ear deeply slit for the byssus.

Mr. R. Etheridge, jun., describes the broad flattened ribs of this species as being "covered by concentric, somewhat irregular, wavy, more or less imbricating scales," and also as having colour-markings of a "widely zigzag pattern." I have not been able to recognise these characters in any of the numerous specimens of *A. tabulatus* which have passed through my hands, and think that a shell of some other species must have been mistaken for the one in question.

AVICULOPECTEN SEMICOSTATUS, *Portlock*, sp., 1843. Plate XIII, figs. 9—15.

PECTEN PLICATUS, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 212, pl. vi, fig. 21.
— SEMICOSTATUS, *Portlock*, 1843. Rep. Geol. Londonderry, p. 436, pl. xxxvi, fig. 9.
— FLEXUOSUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 93, pl. xviii, fig. 1.
AVICULOPECTEN DOCENS, *M'Coy*, 1855. Brit. Pal. Foss., p. 485, pl. 3 E, figs, 6, 7.
— ILLEGALIS, *M'Coy*, 1885. Ibid., p. 486.

Specific Characters.—Shell of medium size, the left valve moderately convex, the right much less so, nearly orbicular. Ears strongly defined, the anterior depressed, a little shorter than the posterior, falcate, and pointed. The anterior ear in the right valve small, rolled, and separated from the rest of the valve by a deep, broad depression for the byssus. The umbo of the right valve markedly triangular, pointed, and not raised, that of the left valve more gibbose, pointed, and slightly raised.

Interior.—The adductor muscle-scar is large and shallow, placed high up and just posterior to the middle line. The hinge-plate is broadly diamond-shaped, obscurely striated longitudinally. The internal surface is smooth in the umbonal region, but there are gradual indications of the radiating ribs, which become strongly marked near the margin.

Exterior.—The surface is ornamented with numerous simple, somewhat irregular, rounded, radiating ribs. Secondary ones often arising in the spaces between the primary, and continuing to the margin. The ribs are crossed by occasional concentric lines of growth. The posterior ear is crossed by markedly strong concentric folds parallel with the margin, and has three or four radiating ribs very lightly marked or almost obsolete. The anterior ear has both radiating and concentric striæ, the former faintly seen on the internal cast.

Dimensions.—Pl. XIII, fig. 9, the type specimen, measures—

Antero-posteriorly	40 mm.
Dorso-ventrally	38 mm.

Localities.—England: the Carboniferous Limestone of Lowick, and the Redesdale Ironstone, Northumberland; the Carboniferous Limestone of Castleton, Derbyshire, and Poolvash, Isle of Man. Ireland: the Carboniferous Limestone of Ballygasey, Loughgall, co. Armagh; Carnteel, co. Tyrone; St. Doulagh's, co. Dublin.

Observations.—The type of Portlock's *Pecten semicostatus* is the cast of the interior of a left valve, preserved in the Museum of the Geological Survey, Jermyn

Street (Pl. XIII, fig. 9). Its posterior ear, however, is wanting. On comparing this specimen with the type of M'Coy's *Aviculopecten docens* (Pl. XIII, fig. 14), which is in the Jenkinson Collection of the Woodwardian Museum, there can be no doubt of the identity of the two shells. M'Coy's type is also a cast of a left valve, and does not exhibit the radiating ribs on the posterior ear figured by him; but he figures another specimen from the Carboniferous Limestone of Derbyshire, which has some of the external characters preserved. In his account of *A. docens*, M'Coy mentions the fact that the shell is identical with his *Pecten flexuosus*, but owing to the preoccupation of that name it was necessary to introduce another. M'Coy's description is very good and accurate.

The specimen figured by Phillips as *P. plicatus* is no doubt the testiferous example of *A. semicostatus*. I have figured this shell (Pl. XIII, fig. 10), a left valve, almost perfect except part of the anterior ear. I have been fortunate to find a specimen showing a hinge-plate, in the collection of Mr. R. Law. It is a left valve (Pl. XIII, fig. 11), and was obtained at Poolvash, Isle of Man.

AVICULOPECTEN DISSIMILIS, *Fleming*, sp., 1828. Plate XIII, figs. 1—8.

PECTEN DISSIMILIS, *Fleming*, 1828. Hist. Brit. Anim., p. 387.
— — *Phillips*, 1836. Geol. Yorks., pt. ii, p. 212, pl. vi, fig. 17.
— ARENOSUS, *Phillips*, 1836. Ibid., p. 212, pl. vi, fig. 20.
— OTTONIS, *Portlock*, 1843. Rep. Geol. Londonderry, p. 436, pl. xxxvi, fig. 10.
— ARENOSUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 89.
— CŒLATUS, *M'Coy*, 1844. Ibid., p. 90, pl. xviii, fig. 2.
— CONCENTRICO-STRIATUS, *M'Coy*, 1844. Ibid., p. 91, pl. xiv, fig. 5.
— DISSIMILIS, *M'Coy*, 1844. Ibid., p. 91.
— RUGULOSUS, *M'Coy*, 1844. Ibid., p. 98, pl. xvii, fig. 7.
? — UNDULATUS, *M'Coy*, 1844. Ibid., p. 101, pl. xvii, fig. 12.
— SUBFIMBRIATUS, *de Verneuil*, 1845. Geol. Russie de l'Europe, p. 327, pl. xxi, figs. 5 *a*, *b*.
— ARENOSUS, *Brown*, 1849. Illust. Foss. Conch., p. 156, pl. lxv, fig. 10.
AVICULOPECTEN CŒLATUS, *M'Coy*, 1855. Brit. Pal. Foss., p. 483, pl. 3 E, fig. 5.
— — *R. Etheridge, jun.*, 1876. Ann. Mag. Nat. Hist., ser. 4, vol. xviii, p. 97.
— — *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 225, pl. xxxviii, figs. 5—8.
— TEXTILIS, *de Koninck*, 1885. Ibid., p. 225, pl. xxxiv, fig. 30.

Specific Characters.—Shell of medium size, suborbicular, with large ears. The right valve gently convex, the left more so. The margin subcircular. The

hinge-line straight. The umbones almost central, not elevated, triangularly acute, the left the more swollen. The anterior ear with its rounded margin joining the shell at an angle with the anterior border, well defined from the body of the valve. The posterior ear produced along its upper margin, falcate as to its posterior border, defined from the valve by a slight oblique groove.

Interior.—The internal surface is almost smooth, but with radiating ribs near the margin in the left valve, and with concentric rugæ in the right. The adductor muscle-scar is large, rounded, placed high up and posterior to the median line. The pallial line is well marked, remote from the border. The hinge-plate is narrow, elongate, and smooth.

Exterior.—The left valve is ornamented with numerous, close, radiating ribs, closely set with arched imbricated scales, the spaces between the ribs being also imbricate. The right valve, on the other hand, is marked by numerous, close, concentric, crenated ridges, which, in some examples, are decussated by obscure radiating lines.

The anterior ear is crossed by about five radiating ribs, diminishing in size from above downwards. The upper four ribs are placed in the upper half of the ear. The anterior ears are reticulate, having radiating ribs, crossed by well-marked concentric lines of growth.

Dimensions.—Pl. XIII, fig. 1, a left valve, from Corrieburn, measures—

Antero-posteriorly	56 mm.
Dorso-ventrally	61 mm.

The internal cast of a bivalved example of similar size measures 15 mm. from side to side.

Localities.—England: the Carboniferous Limestone of Lowick and the Four Laws Limestone, Northumberland; Castleton, Derbyshire; Narrowdale and Wetton, Staffordshire; the Red Limestone at the top of the Yoredale Series, Leyburn, Yorkshire; Underset and Main Limestone, Farcote Gill, Swarth Fell; same horizon, Nine Standards Rigg, Westmoreland; Poolvash, Isle of Man. Scotland: the Upper Limestone series of Garngad Road; the Lower Limestone series of Beith; Hind og Glen, Dalry; Corrieburn, Pathhead, Haddingtonshire; Arniston Glen, South Esk, Midlothian. Ireland: the Carboniferous Limestone of Armagh and Redbarn, co. Armagh; Cookstown, co. Tyrone; Cork and Little Island, co. Cork; Clogherbrian, co. Kerry; Ballingarrane, co. Limerick.

Observations.—Fleming gave no figures of his species, but his description is as follows:—"Suborbicular, slightly lengthened, right or lower valve with numerous ribs, slightly scaly. Ears nearly equal, ribbed transversely and longitudinally. Left or upper valve concave, regularly marked concentrically with flat obsolete ribs, which become scaly on crossing the longitudinally ribbed ears."

For right valve read left; and for left, right, and the description is exactly that

which describes *A. cœlatus*, M'Coy. I suppose that by a concave left or upper valve Fleming was either thinking of the interior, or had a crushed specimen, as I know of no Carboniferous Pectiniform shell with a valve concave externally. Phillips figured both valves of what he took to be *Pecten dissimilis*, one of which, the right valve, is preserved in the Gilbertson Collection of the Natural History Museum, South Kensington. This shell (Pl. XIII, fig. 5) has the peculiar marking of the right valve beautifully preserved, though unfortunately much of the ears has been broken off. Whether or no the specimen figured as the left valve belongs to the same species is doubtful, and Phillips placed a query before it. The specimen having disappeared, it is now impossible to say more about this point.

There can be no doubt that the shell described by M'Coy as *A. cœlatus* is the left valve of Fleming's species, for several specimens of bivalved examples from Beith, Ayrshire, in the collection of Mr. J. Neilson, of Glasgow, demonstrate the fact that the left valve of *A. cœlatus*, M'Coy, and the right valve of *Pecten dissimilis*, Fleming, are one and the same species. It is to be noted that *A. cœlatus*, M'Coy, was founded on a left valve, and that author makes no mention of the right valve. It is also noteworthy that M'Coy, referring to *P. dissimilis*, considers that Fleming's and Phillips's shells were not the same. There can be little or no doubt that *A. textilis*, de Koninck, is the right valve of *A. dissimilis*, although the former is from the Tournai beds and the latter from Visé. The shape and ornament of the ears, and the ornament of the body of the shell, are identical with what we know to be the right valve of *A. dissimilis*.

P. arenosus agrees with *A. dissimilis* in the character of the ornament of the two valves. The ribs of the former are more numerous, closer, and finer, and the concentric ribs of the right valve comparatively fewer and broader than in the latter. It is possible that the one may only be a juvenile condition of the other.

Mr. R. Etheridge recognised the peculiar character of the right valve, but retained the name *A. cœlatus*.

I consider that *P. subfimbriatus*, de Verneuil, should be referred to *A. dissimilis*, likewise the shell referred by Portlock to *P. ottonis*. In both of these cases the left valves only were figured or described.

Pecten concentrico-striatus, M'Coy, evidently, and *P. undulatus* probably, are the right valves of *A. dissimilis*. The latter has the posterior ear broken, which therefore appears too short. I also believe *P. rugulosus* to represent a left valve. All three types are in the Science and Art Museum, Dublin.

The type of *Pecten arenosus*, Phillips, has unfortunately disappeared, and I think it probable that it may have been the right valve of a young specimen of *A. dissimilis*, because the meagre description reads—"Radiating striæ very numerous, alternately larger; minutely crenulated with many sharp circular striæ." It is true that "rather short square ears" hardly agree with *A. dissimilis*, but it is

impossible to recognise the species; and there is no wonder that very different shells have hitherto been referred to Phillips's species in different collections.

AVICULOPECTEN PLICATUS, *Sowerby*, sp., 1823. Plate XII, figs. 5, 6, 8, 9.

PECTEN PLICATUS, *Sowerby*, 1823. Min. Conch., vol. iv, pl. dlxxiv, fig. 3.
Non — — *Phillips*, 1836. Geol. Yorks, pt. ii, p. 212, pl. vi, fig. 21.
— — *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 98.
— HIANS, *M'Coy*, 1844. Ibid., p. 94, pl. xvi, fig. 6.
— MICROPTERUS, *M'Coy*, 1844. Ibid., p. 96, pl. xv, fig. 12.
AVICULA PLICATA, *Brown*, 1849. Illust. Foss. Conch., p. 160, pl. lxv, fig. 8.

Specific Characters.—Shell of medium size, fan-shaped, the body of the valve triangularly ovate, the left valve only moderately convex, the right still less so. The lower margin broadly convex; the posterior margin sinuously curved, due to the falcate posterior ear. The anterior ear smaller, triangular, depressed; the posterior ear large, its upper border extended and pointed, marked off from the valve by an oblique sulcus, the lower part slightly convex, the upper flattened. The hinge-line straight and moderately long. The umbo of the left valve triangular, pointed, and moderately convex; that of the right valve flattened and almost obsolete.

Interior.—Smooth, with obscure radiating ribs towards the margin.

Exterior.—The surface of the left valve is marked with many fine, close, radiating ribs, between which new ones arise as they become separated in the passage across the shell, the whole of which are crossed by subimbricating striæ. The posterior ear is marked with frequent radiating striæ crossed by concentric lines of growth, the ribs being further apart in the centre of the ear than at the upper or lower margin. The anterior ear is adorned in the same manner. The right valve is very similarly ornamented, the secondary ribs, however, being often wanting. The ears partake of the same character of ornament as those of the left valve, but are smoother.

Dimensions.—Pl. XII, fig. 6, Sowerby's type specimen, measures—

Antero-posteriorly	37 mm.
Dorso-ventrally	35 mm.
Gibbosity of left valve	3 mm.

Localities.—England: the Carboniferous Limestone of Richmond, Yorkshire, and Castleton, Derbyshire. Ireland: the Carboniferous Limestone of Little Island, co. Cork; Rathkeale, Kilgrogan, and Nantinan, co. Limerick; Millicent, Clane, co. Kildare; Clonaboy, co. West Meath; St. Doulagh's, co. Dublin.

Observations.—The type of Sowerby's *Pecten plicatus* is preserved in the Sowerby Collection of the Natural History Museum, South Kensington. It is a left valve (Pl. XII, fig. 6), a little damaged at the umbo and posterior ear. It was obtained from Queen's County, Ireland. I have studied the right valve from specimens in the collection of Mr. Joseph Wright, of Belfast, and one of these is figured (Pl. XII, fig. 8). It lies on a slab only slightly separated from a left valve of the same species, and they probably belonged to each other. There is no doubt *Pecten hians*, M'Coy, is identical with Sowerby's species. The diagnosis of the latter is as follows:—"Longitudinally ovate, depressed; ears small, unequal; a very large fold beneath the posterior ear forming a hiatus in the margin. Surface with very numerous, rounded, radiating ridges, alternately larger and smaller, crossed by regular, concentric, imbricating striæ. This shell is rendered very remarkable by the large fold on the posterior side," etc. etc. The type of *P. hians*, M'Coy, is in the Griffith Collection, Museum of Science and Art, Dublin. It is a very imperfect example of the left valve, but shows the characteristic posterior fold, which is almost all that remains of the real shell. I have therefore not re-figured it. I regard this peculiarity as typical of *A. plicatus*, Sowerby, sp., and I have hitherto not met with this character in any other Carboniferous species. *P. micropterus*, M'Coy, is a name given to a young specimen of *A. plicatus*, and must be placed amongst the synonyms of this species.

Phillips doubtfully referred a shell to *Pecten plicatus*. I have been able to compare this with the type, and certainly they do not belong to the same species. Phillips's shell (Pl. XIII, fig. 10) is much more convex, the ribs are much stronger, the posterior ear is small and depressed. This shell shows doubtless the external characters of *P. semicostatus* of Portlock, a species founded on an internal cast, to which I now refer it.

AVICULOPECTEN ESKDALENSIS, sp. nov. Plate XII, figs. 7, 10, 11.

Specific Characters.—Shell inequivalve, of medium size, obliquely quadrato-ovate. The left valve moderately convex, the right valve flattened. The margin rounded. The hinge-line straight, almost as long as the transverse diameter. The anterior ear in the right valve well marked, separated from the rest of the valve by a slit for the byssus; the ear in the left valve depressed, rolled, and well defined from the body of the valve. In both valves the posterior ears seem to be merely a depressed portion of the valve, triangular, deep, with the upper border prolonged backwards and the posterior margin falcate. The umbones obtuse, subcentral, not raised.

Interior.—Unknown.

Exterior.—The surface of both valves is covered with numerous somewhat irregular, radiating, angular ribs, a finer rib often arising between two larger ones. In the right valve the ribs are finer and more regular and more uniform in size, and crenulated. The posterior ears are ornamented in the same way as the rest of the valve, there being no real break between the valve and the posterior ear. The anterior ear of the left valve is also crossed by several radiating ribs. The anterior ear of the right valve has its ribs interrupted by scalariform lines.

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

Antero-posteriorly	33 mm.
Dorso-ventrally	32 mm.

Localities.—Scotland: the Calciferous Sandstone series of river Esk, Glencartholm, Dumfriesshire.

Observations.—This species occurs abundantly and in all stages of growth, in a series of shales at Glencartholm, on the banks of the river Esk, with a very peculiar fauna, which, as a group, has not yet been recognised elsewhere. Fortunately, specimens showing the right and left valves still joined have been obtained. The peculiar nature of the posterior ears of the valve has a good deal in common with that which obtains in *A. plicatus*, Sow., sp., the line of depression marking the ear from the valve being very oblique, and reaching the posterior margin low down. The ribs in *A. plicatus* are much finer, more numerous and regular; and the shape of the valve is more nearly circular and less gibbose than in this new species.

AVICULOPECTEN FALLAX, *M'Coy*, sp., 1844. Plate XVII, figs. 28—30.

PECTEN FALLAX, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 92, pl. xiv, figs. 2, 2 *a*.

Specific Characters.—Shell of only medium size, triangularly suborbicular, very moderately convex, the right valve less so than the left. Margin regularly rounded. Hinge-line straight and long. Umbones central, small, pointed, not raised, gibbose in the left valve, but flattened and almost obsolete in the right. Ears well defined on both sides; the posterior prolonged along its upper border and pointed posteriorly; the anterior ear in the right valve depressed and narrow, separated from the valve by an elongate slit for the byssus, in the left valve triangular, its margin falciform, not reaching as far forwards as the anterior margin of the valve.

Interior.—Smooth, the adductor muscle-scar shallow, rounded, placed high up in the valve and posterior to the middle line.

Exterior.—The right valve is ornamented with several somewhat irregular, coarse, radiating ribs, few and almost obsolete near the umbo, and fresh ribs arise

between each original pair a short distance from the umbo. I cannot make out the ribs to be nodulose, but they are often imbricate near the lower margin. The ribs are present over the posterior ears, but less marked, and are crossed by subimbricating concentric lines.

In the right valve the radiating ribs are more numerous and finer, and almost obsolete radiating ribs are seen on the posterior ear. The anterior ear is concentrically striated.

Dimensions.—Pl. XVII, fig. 29, a right valve from Millicent, co. Kildare, in the Woodwardian Museum, Cambridge, measures—

Antero-posteriorly	42 mm.
Dorso-ventrally	35 mm.

Localities.—Ireland: the Carboniferous Limestone of Millicent, co. Kildare; and Castleconnell, Doohylebeg, and Gortnagrour, co. Limerick.

Observations.—Two shells, a right and left valve, labelled *Pecten fallax*, are in the Griffith Collection, Museum of Science and Art, Dublin. It seems to me possible that these two specimens may not have originally served as M'Coy's types. They are very poor specimens. The figures must have been largely hypothetical, which to some extent may account for their partial inaccuracy. Although the contour and the hinge-line are correctly drawn in both figures, these details are not shown in the shells. The ears of both valves are well defined and marked off from the valve by an acute angular fold, a character not indicated in M'Coy's figures, and I am unable to see the nodulose character given to the ribs of the left valve in the plate in the (?) original specimen, or in any others which I have examined.

I figure in Pl. XVII, figs. 28—30, the cast of the interior of right and left valves from the collection of the Geological Survey of Ireland, and a fairly perfect right valve in the collection of the Woodwardian Museum, Cambridge.

AVICULOPECTEN SUBCONOIDEUS, *R. Etheridge, jun.*, 1876. Plate XVII, figs. 1—5.

AVICULOPECTEN SUBCONOIDEUS, *R. Etheridge, jun.*, 1876. Ann. Mag. Nat. Hist., ser. 4, vol. xviii, p. 96, pl. iv, figs. 1, 2.

Specific Characters.—Shell of medium size, ovato-quadrate, antero-posterior less than the dorso-ventral diameter. The left valve convex, the right valve flattened. The ears moderately well defined, except the right anterior ear, which is very well marked. The anterior margin sinuous, the inferior broadly curved, the posterior sinuous. The hinge-line straight, not quite as long as the greatest antero-posterior diameter. The umbones small, compressed, flattened, placed a little in front of

the centre of the hinge-line. The anterior ear of the right valve short, triangular, its upper margin prolonged to a point, separated from the valve by a deep, wide byssal notch; the posterior ear flattened, its posterior border falcate, not separated from the valve by a groove, but formed by a gradual compression of the valve. The left anterior ear better defined, compressed, its upper border prolonged and pointed, its anterior margin falcate. The left posterior ear as in the right valve.

Interior.—The hinge-plate is broadly triangular, crossed by transverse grooves. Internal surface smooth near the umbo, but with radiating ribs and sulci near the periphery. Adductor scar large, rounded, placed high up and posterior to the middle line.

Exterior.—The surfaces of the left valve and both ears are marked by many close, raised, flattened, unequal, radiating ribs, which are not so close or numerous on the ears, crossed here and there by concentric lines of growth more frequent on the ears. The right valve has the same character of ornament, but is much less strongly marked, and the anterior ear is almost free from radiating lines.

Dimensions.—Pl. XVII, fig. 5, a left valve, measures—

Antero-posteriorly	32 mm.
Dorso-ventrally	35 mm.
Length of hinge-line	27 mm.

Localities.—Scotland: Calciferous Sandstone series of Newton Quarry, Knockhill, Fife; Wardie Shales, Craigleith Quarry; Carboniferous Limestone series, West Quarry, Salton, and Beucloich, Millburn, Lennoxtown; Gawkhall Scar, Kirtle Water, Ecclefechan; Whitefield Quarry, west of Machbie Hill Station. Ireland: Carboniferous Sandstone, Carnteel, co. Tyrone; Carboniferous Slate, Lehenagh, co. Cork.

Observations.—*A. subconoideus* is fairly common in the shell beds of Newton Quarry, Knockhill, Fife, whence Mr. Etheridge obtained the specimens he described and figured. The types are small, however, and the left valve is a cast of the interior, while the right valve has only the posterior ear not freed from the matrix. The figured specimens (Pl. XVII, figs. 1—3) are in the Museum of the Geological Survey of Scotland. Mr. Etheridge was correct in separating this species from *Pecten conoideus*, M'Coy, which is distinct. This species passes up into the Carboniferous Limestone series. It has been reported from several localities ('Mem. Geol. Surv. Scotland;' 'Geol. Eastern Fife,' 1902, p. 368) both in the Calciferous Sandstone and Carboniferous Limestone series of the east of Scotland.

When large and crushed the shell becomes somewhat distorted, and the line limiting the ears is obliterated.

AVICULOPECTEN PERA, *M'Coy*, sp., 1844. Plate XV, figs. 13—15.

PECTEN PERA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 97, pl. xv, fig. 19.
Non AVICULOPECTEN PERA, *M'Coy*, 1855. Brit. Pal. Foss., p. 488.

Specific Characters.—Shell small, quadrato-ovate, inequivalve. The left valve more convex than the right; slightly oblique. Ears large, deep, and well defined; the anterior rectangular, the larger; the posterior pointed. The lower margin rounded; the posterior border more oblique than the anterior border. The hinge-line straight, moderately long. The umbones triangular, moderately gibbose, pointed, subcentral.

Interior.—Unknown.

Exterior.—The left valve is ornamented by numerous irregular, often unequal, radiating ribs, obscurely nodular at intervals, especially towards the margin, often alternately large and small. The anterior ear has many radiating ribs, crossed by concentric lines of growth; the posterior ear has fewer thicker radiating ribs. The right valve is almost smooth, but towards the margin there is evidence of fine radiating ribs.

Dimensions.—Pl. XV, fig. 14, a left valve in the collection of the Geological Survey, Jermyn Street, No. 7256, measures—

Antero-posteriorly	21 mm.
Dorso-ventrally	21 mm.

Localities.—England: the Carboniferous Limestone of Wetton and Narrowdale, Staffordshire. Ireland: the Carboniferous Limestone of Town Plots, Killala.

Observations.—The specimen labelled *Pecten pera* in the Griffith Collection, Museum of Science and Art, Dublin, can hardly be the original type, for it is much larger than the figure. M'Coy re-described this species and referred to it some shells from the Black Limestone of Derbyshire; but if these be the shells labelled *A. pera* in the Woodwardian Museum, he has confused *A. Knockonniensis*, M'Coy, with the *Pecten pera* of his previous work.

Remarking on the specimens in the Woodwardian Museum, M'Coy makes the following curious statement:—"From the greater perfection of the English specimens, I have no doubt a portion of the ventral margin must have been absent in the specimens I originally figured, making the ears appear too large." Only one specimen appears to have been figured. It is thus difficult to determine this species with certainty, owing to the confusion by its author of two descriptions based on different shells, and by the loss of the type. I rely on the original description, and especially on the character of the ears, which M'Coy states to be

marked "with about ten or twelve sharp radiating striæ similar to those of the body, and crossed by very delicate striæ."

AVICULOPECTEN DECUSSATUS, *M'Coy*, sp., 1844. Plate XVIII, figs. 19, 20.

LIMA DECUSSATA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 87, pl. xv, fig. 3.
Cf. — CONCINNA, *M'Coy*, 1844. Ibid., p. 87, pl. xv, fig. 6.
Cf. PECTEN TRIPARTITUS, *M'Coy*, 1844. Ibid., p. 101, pl. xvi, fig. 8.

Specific Characters.—Shell below medium size, ovate, acute, moderately gibbose. The margin regularly rounded. The hinge-line straight, of moderate length. Umbones small, pointed, subcentral. Ears well defined; the anterior large, depressed, deep, and rectangular; the posterior small and triangular.

Interior.—Unknown.

Exterior.—The surface is ornamented with very close, fine, radiating lines, best seen on the sides in the young, but present all over the lower part of the valve. The ears have the same ornament decussated by concentric lines of growth.

Dimensions.—Pl. XVIII, fig. 19, the type of *Lima decussata*, M'Coy, measures—

Antero-posteriorly	13 mm.
Dorso-ventrally	16 mm.

Localities.—Ireland: the Carboniferous Limestone of Killymeal, co. Tyrone; Ballinglen, co. Mayo.

Observations.—The types of *L. decussata*, *L. concinna*, and *Pecten tripartitus* are all present in the Griffith Collection, Museum of Science and Art, Dublin. The first shell is puzzling, for while it is a left valve, incomplete on the posterior edge of the valve, the figure shows a whole shell; but the description, on the other hand, reads—"Obliquely ovate, . . . ears very small, equal; hinge-line oblique; surface radiated with numerous, unequal, obtuse, smooth ridges; the spaces between each are strongly striated transversely." The figure and type are not oblique, have each unequal, rather large ears, a straight horizontal hinge-line, and I cannot detect any transverse striations. I think, therefore, M'Coy's description must be disregarded, and as figure and specimen agree fairly well, it may be assumed to be the original type.

I think it probable that *L. concinna*, M'Coy, was a juvenile form of the same species, but I have no doubt that *P. tripartitus*, M'Coy, is a very young example of *A. decussatus*, and that the peculiar arrangement of the radiating lines, supposed to be typical of *P. tripartitus*, is either accidental or due to an early condition of growth.

AVICULOPECTEN LOSSENI, *von Koenen*, sp., 1879. Plate XVIII, figs. 1, 2.

PECTEN LOSSENI, *von Koenen*, 1879. Neues Jahrb. f. Min., p. 328, pl. vi, figs. 1 *a—d*.

Specific Characters.—Shell of very moderate size, triangularly ovate, almost equilateral. The anterior and posterior borders very oblique and nearly straight, the inferior border broadly rounded. The hinge-line short. The ears triangular, well marked off from the valve, produced and pointed along the upper border, the margins falcate; the posterior larger than the anterior ear. The umbones small, pointed, and incurved.

Interior.—Unknown.

Exterior.—The right valve is marked with concentric lines and striæ of growth; the ears possessing few but well-marked radiating ribs, decussated by concentric lines of growth. The left valve is ornamented with numerous close, fine, distinct, radiating ribs, new ones arising between each original pair as they pass over the shell. The ribs are crossed by fine concentric lines and striæ of growth. Ears with radiating ribs, fewer and wider apart in the posterior ear.

Dimensions.—Pl. XVIII, fig. 1, a crushed specimen from Angram Brook, measures—

Antero-posteriorly	27 mm.
Dorso-ventrally	27 mm.

This would be probably much narrower in a normally gibbose specimen.

Localities.—The Pendleside series of Angram Brook, Pendle Hill, Lancashire.

Observations.—Unfortunately all my examples of this species are crushed flat in a shaly matrix, but I have no hesitation in referring them to *A. Losseni* of von Koenen, who gives excellent figures of this species.

I have been able to make out that the right valve has no radiating ribs, for in two specimens the valves have been crushed on each other.

Von Koenen refers *P. lineatus*, Sarres, to his species, which he considers to be distinct from *P. lineatus*, Goldfuss. I have no knowledge of the original shells of these authors, and am therefore unable to advance any opinion on the question of the synonymy of the species.

I think the species should be placed in the genus *Aviculopecten*, to the other species of which it has a general resemblance.

A. Losseni is another shell common to the Pendleside series of England and the Culm of the European continent.

AVICULOPECTEN INTERMEDIUS, *M'Coy*, sp., 1844. Plate XV, figs. 19, 20, 24, 25.

PTERINEA INTERMEDIA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 82, pl. xiii, fig. 1.

Specific Characters.—Shell small, triangularly gibbose, very slightly oblique posteriorly; right valve unknown. The hinge-line long, produced posteriorly along the pointed ear. The umbones narrow, gibbose, pointed, and placed a little in front of the centre. The ears well formed and depressed, comparatively large, the posterior much larger and deeper than the anterior ear; the upper border of the posterior ear prolonged and pointed, its posterior margin markedly falcate.

Interior.—Unknown.

Exterior.—The left valve is ornamented with many fine, close, angular, radiating ribs, which become larger and farther apart as they cross the valve; and secondary fine angular ribs arise between each primary pair. Towards the lower margin the ribs are crenulate. The posterior ear has a few distant, obsolete, radiating lines, crossed by concentric lines. The anterior ear has also almost obsolete radiating ribs.

Dimensions.—A small specimen from Hill Bolton, Yorkshire, in my collection, measures—

Antero-posteriorly	11 mm.
Dorso-ventrally	12 mm.
Gibbosity of valve	2·5 mm.

Localities.—England: the Carboniferous Limestone of Settle and Hill Bolton, Yorkshire; Castleton, Derbyshire; and Poolvash, Isle of Man. Ireland: no locality is given for this shell in Griffith's list of localities ('Journ. Geol. Soc. Dub.,' vol. ix, p. 106).

Observations.—This species was referred by M'Coy to *Pterinea*, but the long posterior ear and the well-marked anterior ear show its affinities to be rather with *Aviculopecten* than with that genus. I have been able to examine about half a dozen specimens, one of which, from Settle, is in the Woodwardian Museum. This (Pl. XV, fig. 24) shows the posterior ear very well. Pl. XV, fig. 19, represents the left valve of a much younger shell, but unfortunately lacks the prolonged portion of the posterior ear.

The type specimen is not in the Griffith Collection at the Museum of Science and Art, Dublin. M'Coy's description and figure, however, are sufficiently distinctive and full, and there is no difficulty in recognising the peculiar characters of the species.

The ribs in older shells are coarse, irregular, and tend to be compound and to lose the crenulate marking of the younger stages.

AVICULOPECTEN CLATHRATUS, *M'Coy*, sp., 1844. Plate XV, figs. 1—7.

PECTEN CLATHRATUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 90, pl. xiv, fig. 12.
— INTERCOSTATUS, *M'Coy*, 1844. Ibid., p. 95, pl. xviii, fig. 4.

Specific Characters.—Shell of medium size, slightly oblique, transverse, triangularly fan-shaped, moderately gibbose, and very inequivalve, the right being almost as flat as the left valve. The ears, especially the anterior, small and depressed. The hinge-line short and straight. The lower margin broadly convex, and the anterior and posterior margins almost straight, inclined obliquely inwards and upwards to the base of the ears. The umbo in the left valve small, pointed, swollen, and incurved, subcentral, that in the right valve almost obsolete.

Interior.—Unknown.

Exterior.—The left valve is ornamented with from fifteen to eighteen strong radiating ribs, and between each pair are three other finer ribs, of which the centre is the stronger and extends further towards the umbo. It may happen these secondary strong ribs become so well marked that the valve appears to have alternate strong and weak ribs. The valve is also crossed by close concentric lines, which are best marked in the spaces between the ribs and on the surface of the finer ribs. The ears have radiating ribs and concentric striæ. The right valve is smooth both on the body and on the ears.

Dimensions.—Pl. XV, fig. 1, a specimen in the collection of Mr. Joseph Wright, measures—

Antero-posteriorly	27 mm.
Dorso-ventrally	23 mm.

Localities.—England: the Carboniferous Limestone of Castleton, Derbyshire; Narrowdale, Staffordshire; Settle, Yorkshire. Ireland: the Carboniferous Limestone of Little Island and Ballydaniel, co. Cork; Drumkeeran, co. Fermanagh.

Observations.—This species was founded on the peculiar ornament of a left valve. The right valve proves to be quite smooth, as is indicated by a very young bivalved example in Mr. Joseph Wright's collection, from Little Island, co. Cork (Pl. XV, fig. 4). The peculiar marking described by M'Coy is only well developed in the full-grown shell. As the primary ribs, starting from the umbo, pass across the valve, one new rib arises between each pair, and some little way further on another rib becomes developed between each primary and secondary. If the secondary ribs are well developed there is a condition of alternate large and small ribs, the normal condition near the umbo; but occasionally all three sets of ribs remain a different size, which is the condition described by M'Coy.

I think it possible that *Pecten orbiculatus*, a species founded on a right valve, may belong to the species under discussion, judging from the likeness of that figure to the right valve of *A. clathratus*.

P. intercostatus, M'Coy, is a left valve of *A. clathratus*. The type is still preserved in the Griffith Collection, Museum of Science and Art, Dublin, where I have examined it; but I cannot see the spines on the ribs which M'Coy regarded typical of the species. They may have been there, and M'Coy states that "this beautiful little shell appears very closely allied to *P. interstitialis*, Phill., but the number of small ribs between every two large ones, instead of being regularly three, is seldom less than five, and as frequently nine on the one specimen. . . . It is seldom that any of the delicate spines are preserved, the ribs more frequently presenting a roughened or tuberculated aspect." In the figured specimen (Pl. XV, fig. 7) there appears to be three fine ribs between each pair of larger ones, and not, as M'Coy states, five or nine.

AVICULOPECTEN FORBESII, *M'Coy*, sp., 1844. Plate XVIII, figs. 3—7.

PECTEN FORBESII, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 93, pl. xv, fig. 20.
AVICULOPECTEN FORBESI, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 223, pl. xxxv, figs. 14, 15.

Specific Characters.—Shell small, suborbicular, slightly convex, the right valve a little less so than the left valve. The margin fairly regularly rounded from ear to ear. The hinge-line straight and comparatively long. Umbones small, pointed, subcentral. The ears small, triangular; the right anterior ear deeply slit for the byssus; the posterior ears larger than the anterior, the upper border prolonged and pointed, posterior margin falcate.

Interior.—Unknown.

Exterior.—The surface is ornamented with strong radiating ribs, alternately larger and smaller, the latter not starting at the umbo. The ribs are cancellated by distant concentric ridges. The ears have a somewhat similar ornament.

Dimensions.—Pl. XVIII, fig. 7, a right valve, the type of *Pecten Forbesii*, M'Coy, measures—

Antero-posteriorly	10 mm.
Dorso-ventrally	9·5 mm.

Localities.—Ireland: the Carboniferous Limestone of Millicent, co. Kildare; Little Island, co. Cork. Scotland: Currielee Quarry, Tynewater.

Observations.—This species was founded on a right valve, which is in the Griffith Collection, Museum of Science and Art, Dublin. Curiously enough, the

figure of this specimen seems to be the only one which was reversed on the stone and consequently shows correctly on the plate. This does not excuse the author of the description of the species in de Koninck's work for the statement that "the right valve is unknown." Mr. J. Wright has a series of four specimens in his collection from Little Island, co. Cork, two of which are right and two left valves.

Pecten Hardingii, M'Coy, judging from the figure, is probably the same species, but the type has disappeared, and it is impossible to say what the original may have been.

AVICULOPECTEN MACROTIS, *M'Coy*, sp., 1844. Plate XVIII, figs. 15—18.

PECTEN MACROTIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 96, pl. xvi, fig. 13.

Specific Characters.—Shell small, only moderately convex, transverse diameter rather large compared with the size of the shell. The anterior border short, descending obliquely downward and forward; the lower border broad and convex; the posterior border descending obliquely from the umbo backwards and downwards and nearly straight. The hinge-line long and produced above the upper border of each ear. The umbones small and pointed. The ears large, well defined, and depressed, with the margins of both falcate.

Interior.—Unknown.

Exterior.—The surface is ornamented with numerous fine ribs. The ears are almost smooth, but have delicate concentric lines of growth.

Dimensions.—Pl. XVIII, fig. 16, measures—

Antero-posteriorly	17 mm.
Dorso-ventrally	13 mm.

Localities.—Ireland: the Carboniferous Limestone of Little Island, co. Cork; Bruckless, Dunkineely, co. Donegal.

Observations.—It is uncertain whether this species is not the very young stage of *A. fallax*. I have found six specimens in the cabinet of Mr. J. Wright which appear to be about the size of the type (Pl. XVIII, fig. 18). The type is preserved in the Griffith Collection, Museum of Science and Art, Dublin, and is a right valve.

AVICULOPECTEN KNOCKONNIENSIS, *M'Coy*, sp., 1844. Plate XIV, figs. 8—13.

PECTEN KNOCKONNIENSIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 95, pl. xvii, fig. 4.

Cf. — BELLIS, *M'Coy*, 1844. Ibid., p. 89, pl. xv, fig. 15.

AVICULOPECTEN PERA, *M'Coy*, 1855. Brit. Pal. Foss., p. 488.

Specific Characters.—Shell small, longitudinally ovate, moderately convex; ears comparatively large; both valves with somewhat similar ornament, the right flat, the left convex. The anterior margin of the left valve and the posterior margins of both somewhat falcate. The anterior margin of the right valve deeply slit for the byssus below the ear. The lower margin rounded. The hinge-line comparatively short, produced along each ear and pointed. The umbones small, triangular, and pointed, almost central. The anterior ear of right valve large, its margin rounded, separated from the rest of the valve by a hollow sulcus; that of the left valve triangular and well defined. The posterior ears comparatively large, well defined, the posterior border falcate.

Interior.—Unknown.

Exterior.—The surface is ornamented with numerous radiating ribs, closely set with imbricating scales; and between each pair smaller ones arise, with here and there certain ribs stronger than others. These ribs are crossed occasionally by concentric lines of growth. The posterior ears and left anterior ear are crossed by numerous radiating ribs; the right anterior ear is crossed by three strong ribs, but has concentric lines of growth strongly marked.

Dimensions.—Pl. XIV, fig. 11, a left valve, measures—

Antero-posteriorly	30 mm.
Dorso-ventrally	28 mm.

Localities.—England: Black Limestone of Derbyshire; above the Underset Limestone, Farcote Gill, Westmoreland. Scotland: Carboniferous Limestone series of West Quarry, Salton; Cateraig Sea Quarry, Dunbar; Carrielee Quarry, Tynewater. Ireland: Arenaceous Limestone of Knockonny, Ballygawley, co. Tyrone.

Observations.—M'Coy's types are probably preserved in the Griffith Collection, Museum of Science and Art, Dublin, where I have been permitted to examine them. The specimens are not good and have been crushed, but still the characters of the species are fairly definite and can be recognised. M'Coy's account is somewhat confusing:—"Valves dissimilar, the one marked with close, fine, smooth, radiating striæ, slightly flexuous, and nearly equal in size; the other radiated with about twelve larger, rounded ribs, each having a very fine sharp ridge on each side, each set of ribs being separated from the rest by a narrow flat space; all the radiating ridges on this valve are closely set with small, imbricating, scale-like laminæ of growth." He does not say which valve has the special ornament mentioned. There are three specimens in the collection, and neither on them nor in the figure can I distinguish the ornament described above. The fact is that, as in most of the species of this size, there is much irregularity in the growth and size of individual ribs, and in the majority of ribbed Pectiniform shells the large or primary rib, which starts from the umbo, is associated with a narrow secondary rib on each side.

Several specimens from localities in East Lothian are in the collection of the Geological Survey of Scotland, and among these are some with fewer and rather coarser ribs. The left valve of *A. gentilis*, Sow., sp., may be mistaken for *A. Knockonniensis*, but the former shell has a smooth right valve.

I consider *P. bellis*, M'Coy, to represent a young uncrushed example of the species under discussion. The shape of the ears and general similarity of the valve are very striking.

AVICULOPECTEN GENTILIS, *J. de C. Sowerby*, sp., 1840. Plate XVII, figs. 6—10.

PECTEN GENTILIS, *J. de C. Sowerby*, 1840. In Prestwich's Geol. Coalbrookdale, Trans. Geol. Soc., ser. 2, vol. v, pl. xxxix, fig. 19.
— SCALARIS, *J. de C. Sowerby*, 1840. Ibid., pl. xxxix, fig. 20.
AVICULOPECTEN FIBRILLOSUS, *Hind*, 1902. Trans. N. Staffs. Field Club, vol. xxxvi, p. 80, pl. ii, figs. 4, 5.

Specific Characters.—Shell small, the left valve convex, the right much less so, obliquely ovate. The anterior margin short and convex; the lower expanded and rounded; the posterior almost straight and oblique. The hinge-line medium size. Umbones small, subcentral. Ears depressed, well defined from the shell both in front and behind, the posterior prolonged and somewhat pointed.

Interior.—Unknown.

Exterior.—The right valve is smooth, with very fine microscopic concentric lines, the ears with several radiating ribs, fewer and coarser on the anterior ear, both crossed by fine concentric lines. The left valve is ornamented with numerous fine raised ribs, between each pair of which soon arises a secondary rib. Occasionally very fine concentric lines of growth are to be found. Both ears are ornamented in a similar manner. The ribs on the anterior ear fewer and coarser than on the right ear.

Dimensions.—Pl. XVII, fig. 9, a specimen from Congleton Edge, Cheshire, measures—

Antero-posteriorly	15 mm.
Dorso-ventrally	14 mm.

Localities.—Pennystone Ironstone, Coalbrookdale; below Third Grit, Congleton Edge, Cheshire; below Third Grit, Eccup, Leeds.

Observations.—The figure of J. de C. Sowerby's *Pecten gentilis* in Prestwich's memoir above cited is very well drawn, and shows the peculiar form of the left valve very well. No mention is made of the right valve. A shell, said to be the type, is in the collection obtained from the late Sir Joseph Prestwich at the

Natural History Museum, but this can hardly have served for the figure, as the ears are not well developed from the matrix, the anterior not being at all visible.

Two other figures of a Pectiniform shell are given in the same work as *P. scalaris*. These I consider to represent the same species as the former shell, the only apparent difference in the figures being the number of ribs; but the descriptions of both shells state that the number is fifteen in each case.

In 1902 (*loc. cit.*) I figured both valves of a little shell from a richly fossiliferous bed on Congleton Edge, about 500 feet below the Third Millstone Grit, as Salter's species, *A. fibrillosus*. Right and left valves occur close behind each other on the same slab; but I am convinced that my shells are identical with *A. gentilis*, and that I was wrong to trust to the published figure of Salter's species, from which it is quite distinct, as may be seen on reference to the figures of *Pseudamusium fibrillosum* now given (Pl. XVI, figs. 16—22).

AVICULOPECTEN PERRADIATUS, *de Koninck*, 1885. Plate XV, figs. 16—18.

AVICULOPECTEN PERRADIATUS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 229, pl. xxxiv, figs. 12, 13.

Specific Characters.—Shell small, suborbicular, left valve very gently convex. The margin of the valve almost circular from ear to ear. The hinge-line straight. Umbones small, pointed, subcentral. Ears well defined; the left anterior ear triangular, narrow, and small, well marked off from the valve by a groove, its anterior margin gently rounded; the left posterior ear longer and deeper, and larger than the anterior, pointed, its posterior margin falcate. A shallow oblique depression in the valve both in front and behind just below the folds for dividing off each ear.

Interior.—Unknown.

Exterior.—The surface of the left valve is ornamented with numerous, fine, unequal, radiating ribs, secondary ribs arising between each primary pair. The ribs are traversed by four concentric lines of growth and are finely reticulate. Both ears are crossed by several radiating ribs decussated by lines of growth.

Dimensions.—Pl. XV, fig. 17, a specimen in the collection of the Geological Survey Museum, Jermyn Street, from Narrowdale, measures—

Antero-posteriorly	17 mm.
Dorso-ventrally	16 mm.

Localities.—The Carboniferous Limestone of Narrowdale, Staffordshire, and Park Hill, Derbyshire.

Observations.—This species was founded by de Koninck on a specimen from the Limestone of Visé, and his description is very full and accurate, with a good

figure. The right valve is stated by him to be unknown, and I have not been able to identify it. The small ears and circular shape, with the numerous radiating ribs, are characters which serve to distinguish the species.

AVICULOPECTEN STELLARIS, *Phillips*, sp., 1836. Plate XVI, figs. 7—11.

PECTEN STELLARIS, *Phillips*, 1836. Geol. Yorks., vol. ii, p. 212, pl. vi, fig. 18.
— VILLANUS, *de Koninck*, 1851. Descr. Anim. Foss. Belg., App., p. 684, pl. lvii, fig. 4.
AVICULOPECTEN VILLANUS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 218, pl. xxxiii, figs. 7, 8; pl. xxxiv, fig. 22.
— INGRATUS, *de Koninck*, 1885. Ibid., p. 224, pl. xxxv, figs. 33, 34.

Specific Characters.—Shell below medium size, quadrato-orbicular, the left valve moderately gibbose, the right less so. The margin of the valve from ear to ear regularly curved, almost circular. The hinge-line long, rolled, extending almost as far forward as the anterior margin, and posteriorly somewhat beyond the posterior margin. The umbo central as regards the body of the valve, gibbose and pointed in the left valve, and not elevated. Anterior ears depressed, deeply marked off from the rest of the valve by an angular groove; the posterior ears long and gradually compressed, falcate.

Interior.—Unknown.

Exterior.—The convex surface of the left valve is adorned with simple, rounded, radiating ribs, which may or may not have secondary ribs arising between each pair as they approach the margin. The ribs are quite absent on the ears, which are only concentrically striated by fine lines of growth. The body of the valve is crossed by very fine concentric striæ, one of which is sometimes fairly deep, making the ribs along this line imbricated. The sulci between the ribs are very finely striated concentrically.

Dimensions.—Pl. XVI, fig. 8, a left valve from Castleton, measures—

Antero-posteriorly	25 mm.
Dorso-ventrally	25 mm.
Length of hinge-line	27 mm.
Convexity of valve	7 mm.

Localities.—England: the Carboniferous Limestone of Castleton and Park Hill, Derbyshire; Hill Bolton and Settle, Yorkshire; above Main Limestone, Nine Standards Rigg, Westmoreland; the White Limestone, Poolvash, Isle of Man. Ireland: the Carboniferous Limestone of Little Island, co. Cork.

Observations.—The type of *Pecten stellaris*, Phillips, is preserved in the Gilbertson Collection, Natural History Museum, South Kensington. It is a left

valve (Pl. XVI, fig. 7), with the posterior ear broken off and the anterior ear only half developed, but shows well the bold character of the radiating ribs. It will be noticed, on examining the specimen, that the secondary ribs are few, and commence low down on the valve. This I regard as an abnormality, due probably to insufficient nourishment or want of carbonate of lime. It is owing to this fact, probably, that de Koninck and M'Coy described this species under other names.

Aviculopecten villanus, de Kon., has the peculiar circular-shaped valve, the large ears, and long hinge-line pointed at each end, and simply varies from Phillips's shell in that the secondary ribs start regularly high up, not far from the beak, and rapidly become equal in size to the primary ones. De Koninck figures the right and left valves. He points out that the former has more numerous and finer radiating ribs, and is flatter than the left valve.

AVICULOPECTEN INCRASSATUS, *M'Coy*, sp., 1844. Plate XVI, figs. 12—15.

PECTEN INCRASSATUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 94, pl. xvi, fig. 1.
AVICULOPECTEN ILLEGALIS, *M'Coy*, 1855. Brit. Pal. Foss., p. 486.
— MEGALOTIS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 230, pl. xxxvi, fig. 25.

Specific Characters.—Shell below medium size, inequivalve, suborbicularly quadrate, the left valve regularly and moderately convex, the right valve less so. The curvature of the margin from ear to ear oblate. The hinge-line straight and prolonged specially backwards, rolled. The umbones subcentral, that of the left valve moderately convex, pointed, very slightly raised; the right much less pronounced, triangular, and pointed. The anterior ears depressed, separated from the body of the valve by an oblique sulcus, more linear and acute in the right valve. The anterior margin of this ear rounded. The posterior ears long, pointed, falcate, formed by a gradual compression of the valve.

Interior.—Unknown.

Exterior.—The surface of the valve is adorned with many thick radiating ribs, between each pair of which a secondary rib arises, about halfway across the valve or sooner. The ears are almost smooth, the posterior marked with faint concentric lines and striæ, but no radiating ribs. The right valve is very similar to the left valve.

Dimensions.—Pl. XVI, fig. 15, the type, measures—

Antero-posteriorly	33 mm.
Dorso-ventrally	31 mm.

Localities.—England: the Carboniferous Limestone of Settle and Malham

Moor, Yorkshire; Castleton, Derbyshire. Ireland: the Carboniferous Limestone of Little Island and Cork, co. Cork; Lisnapaste, Ballintra, co. Donegal.

Observations.—The type of *P. incrassatus*, M'Coy, is preserved in the Griffith Collection, Museum of Science and Art, Dublin, and is a fine example of the left valve of a full-grown shell (Pl. XVI, fig. 15). This species belongs to a group with large ears, which are almost smooth, and have no radiating ridges. The right valve is flatter than the left valve, but has an almost identical ornament, the right anterior ear being divided from the valve by a slit for the byssus.

M'Coy unknowingly described this species under two names, for in 1855 he referred specimens in the Woodwardian Museum to *P. illegalis*, de Koninck, while assigning *Pecten plicatus*, of Phillips *nec* Sowerby, to this species. De Koninck had made the same mistake in 1842; but he termed the shell *Pecten Phillipsianus*, subsequently corrected to *P. illegalis*, neither of which names is mentioned in his later work.

It seems to me that the species is most frequently found in collections named *A. megalotis*, M'Coy. The latter species was founded on a small fragment, showing the posterior ear and a small portion of the adjacent part of the valve. Its ribs were not nearly as coarse as those of *A. incrassatus*, and in my opinion the shell was much too fragmentary for the foundation of a species. A second figure was given, but this is not from any shell in the collection, and was probably a restoration. At any rate, the name *P. incrassatus* appears in M'Coy's work before that of *P. megalotis*, and therefore has the right of priority.

AVICULOPECTEN NOBILIS, *de Koninck*, sp., 1842. Plate XVI, figs. 1—6.

PECTEN NOBILIS, *de Koninck*, 1842. Descr. Anim. Foss. Belg., p. 132, pl. iii, fig. 24.
-- CANCELLATULUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 89, pl. xiv, fig. 9.
— ÆQUALIS, *M'Coy*, 1844. Ibid., p. 89, pl. xv, fig. 13.
— COGNATUS, *M'Coy*, 1844. Ibid., p. 90, pl. xix, fig. 4.
AVICULOPECTEN CANCELLATULUS, *M'Coy*, 1855. Brit. Pal. Foss., p. 483, pl. 3 E, fig. 3.
— NOBILIS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 217, pl. xxxvi, figs. 27, 28, 30.

Specific Characters.—Shell small, triangularly suborbicular, inequilateral, the left valve slightly more convex than the right valve. The margin of the valve regularly rounded. The hinge-line straight, prolonged only slightly backwards. The anterior ears moderately large, depressed, well marked off from the body of the valve, the anterior margin falcate; the posterior ears gently compressed and expanded, also falcate. The umbones triangular, pointed and swollen, slightly raised, subcentral.

Interior.—Unknown.

Exterior.—The surface is ornamented with 15 to 20 radiating ribs, not always of equal strength, crossed at regular intervals by about 13 concentric ribs, dividing the surface into distinct quadrilateral spaces. The ears marked by imbricating, concentric lines. In the right valve the concentric ribs are less well marked and are often obsolete.

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

Antero-posteriorly	19 mm.
Dorso-ventrally	17 mm.
Convexity of left valve	2 mm.

Localities.—England: the Carboniferous Limestone of Settle, Yorkshire; Castleton, Derbyshire; Lowick, Northumberland. Ireland: the Carboniferous Limestone of Little Island, co. Cork; Killymeal, Dungannon, co. Tyrone.

Observations.—De Koninck's species, *Pecten nobilis*, has the right of priority over M'Coy's *P. cognatus*, which de Koninck recognised as a synonym of his shell. At first glance this species might be mistaken for *Pterinopecten tessellatus*, Phill., sp., but the latter is much broader, has no distinct posterior ear, and obviously fewer concentric lines and ribs. The two species are therefore generically distinct.

Specimens of *A. nobilis* vary considerably as to the number and strength of the radiating and concentric ribs. I am not at all sure that *Aviculopecten Forbesii* of de Koninck belongs to the species under discussion.

A. cancellatulus, M'Coy, is the young form of de Koninck's species. The Woodwardian Museum, Cambridge, possesses a fine series from Settle, showing both right and left valves in various stages of growth. The confusion of the various species now referred to *A. nobilis* has doubtless arisen from the varying characters of the ornament due to the strength, number, and degree of development of the radiating ribs and concentric ridges. M'Coy states that *A. cancellatulus* is distinguished from all other species "by the very large spherical or conoidal nodules at the intersection of the concentric and radiating ridges." I have noted this character in *A. nobilis*, especially in the younger part of the valves. I think that *P. æqualis*, M'Coy, the type of which is a very poor specimen, is only the young of *A. nobilis*. The types of both *P. æqualis*, M'Coy, and *P. cancellatulus*, M'Coy, are from the same locality and horizon, Killymeal, Dungannon.

AVICULOPECTEN PLANOCLATHRATUS, *M'Coy*, sp., 1844. Plate XV, figs. 8—12.

PECTEN PLANOCLATHRATUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 98, pl. xvi, fig. 2.

Cf. AVICULOPECTEN TENUILINEATUS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 224, pl. xxxv, fig. 31.

Specific Characters.—Shell small, oblique anteriorly, ovate, acute, the left valve convex, the right less so. The margin rounded, the curvature starting at a lower point in front than behind owing to the larger size of the anterior ear, which is much and rapidly depressed from the body of the valve. The hinge-line straight, of moderate length. The umbones triangular, pointed, convex, central. The anterior ear of the right valve separated from the rest of the shell by a slit for the byssus. The posterior ear small, rapidly compressed, and triangular.

Interior.—Unknown.

Exterior.—The left valve is ornamented by close concentric lines and radiating ribs of almost the same strength, giving a fine reticulated appearance. The ears seem to possess somewhat the same character, only less well marked. The ornament of the right valve is not essentially different from that of the left valve.

Dimensions.—Pl. XV, fig. 11, measures—

Antero-posteriorly	15·0 mm.
Dorso-ventrally	15·0 mm.
Convexity of left valve	2·5 mm.

Localities.—England: the Carboniferous Limestone of Castleton, Derbyshire; Poolvash, Isle of Man. Scotland: Buriebrae Burn, near Milton of Campsie; Annick Water, near Stewarton. Ireland: the Carboniferous Limestone of Little Island, co. Cork; Bundoran, co. Donegal.

Observations.—This species was founded on a single imperfect example from which the ears were wanting, and it is impossible to say which valve it is. The type is preserved in the Griffith Collection, Museum of Science and Art, Dublin. The cabinet of Mr. Joseph Wright contains six good examples of *A. planoclathratus* from the Limestone of Little Island, co. Cork, four of which are right and three left valves. The anterior ears are well preserved in all the specimens, but the posterior are lost. The characters of the shell are very marked, and I have no hesitation in retaining the species.

I think it possible that *Aviculopecten tenuilineatus*, de Koninck, may represent *A. planoclathratus*. Its antero-posterior and dorso-ventral diameters are the same, and its ornament is similar; but the specimen figured is much larger than any I have yet seen. In the enlarged view of the surface the concentric lines are shown to be less strongly marked than the radiating ribs. I am unable to see by what essential characters *A. tenuilineatus* is distinguished from *A. perplicatus*, de Koninck, the latter being only a larger shell.

AVICULOPECTEN QUINQUELINEATUS, *M'Coy*, sp., 1844.

PECTEN QUINQUELINEATUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 98, pl. xvii, fig. 6.

Specific Characters.—Shell large, orbicular, right valve only slightly convex. The lower margin almost circularly rounded. Ears and hinge-line unknown.

Interior.—A large posterior adductor scar in the normal position.

Exterior.—The surface is ornamented with many narrow, uneven, radiating ridges, between each pair usually fine, smaller, radiating striæ, the middle one of which is largest; interstitial spaces flat.

Locality.—Ireland: the Carboniferous Limestone of Mohill, co. Leitrim.

Dimensions.—Too imperfect to measure.

Observations.—The species was founded on a fragment of a left valve, the ears and upper part of which were absent. The type is present in the Griffith Collection, Museum of Science and Art, Dublin; hence I have retained the species. The ornamentation is very like that of *A. interstitialis* in the adult form, but the fragment is much too flat for this species. Possibly a specimen will some day be found showing the real affinity of this shell and its value as a species. It is to be noted that M'Coy's figure shows three smaller radiating ribs between each pair of large ones, not, as he states, five.

AVICULOPECTEN FIMBRIATUS, *Phillips*, sp., 1836. Plate XII, figs. 12, 13.

PECTEN FIMBRIATUS, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 213, pl. vi, fig. 28.

Specific Characters.—Shell of medium size, both valves very moderately convex, the right very little the less so, ovato-orbicular. The hinge-line short and straight. The umbones central, pointed, moderately swollen. The anterior ears short, depressed, well marked off from the rest of the valve, with a slit below the right anterior ear for the byssus. The posterior ears small, depressed, well defined, the sharp margin from the umbo to the anterior border somewhat concave upwards.

Interior.—Smooth. The decorticated shell shows many radiating and concentric ribs.

Exterior.—The surface is ornamented with many sinuously imbricate, concentric ridges, and similar radiating ribs, which give rise to a cancellated appearance in the right valve, the concentric markings being less rugose and somewhat more regular. The ears appear to be almost smooth.

Dimensions.—Pl. XII, fig. 13, a right valve from Settle, in the York Museum, measures—

Antero-posteriorly . . .	53 mm. estimated.
Dorso-ventrally	53 mm.

A bivalved example of almost the same size measures 18 mm. from side to side.

Localities.—England: the Carboniferous Limestone of Settle, Yorkshire; Castleton, Derbyshire; Narrowdale and Wetton, Staffordshire.

Observations.—The type of *Pecten fimbriatus*, Phillips, is unfortunately missing, but the figure is good, and the description, though meagre, is sufficiently detailed for the identification of the species. The original description is as follows:—"Oblong, depressed, with small plain ears; surface radiated with obtuse ribs and furrows, all sinuoso-imbricate." Apparently a left valve was figured. The right valve differs very little, both in convexity and ornament, from the left valve. Pl. XII, fig. 12, represents a semi-decorticated specimen of a bivalved example. A small patch of the outer shell remains on the left valve. The specimen is figured to show how easily a shell in this condition might be referred to an entirely different species.

The ornament on the right valve of *A. dissimilis*, Flem., sp., resembles somewhat that of *A. fimbriatus*, but the shape of the valve and the ears are quite different. The locality given for the type specimen is Castleton, probably Derbyshire.

A fine right valve in the York Museum is figured (Pl. XII, fig. 13), and this is almost entire, only the anterior ear being wanting.

AVICULOPECTEN INTERSTITIALIS, *Phillips*, sp., 1836. Plate XIV, figs. 16—21.

PECTEN INTERSTITIALIS, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 212, pl. vi, fig. 24.
— SEGREGATUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 99, pl. xvii, fig. 3.
— KOKCHAROFI, *de Verneuil*, 1845. Géol. Russie de l'Europe, p. 325, pl. xx, fig. 16.
— BOUEI, *de Verneuil*, 1845. Ibid., p. 326, pl. xxi, fig. 6.
AVICULOPECTEN SEGREGATUS, *M'Coy*, 1855. Brit. Pal. Foss., p. 489, pl. 3 E, fig. 1.
LIMATULINA SELECTA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 244, pl. xxxvi, figs. 1—5.
Non AVICULOPECTEN INTERSTITIALIS, *de Koninck*, 1885. Ibid., p. 227, pl. xxxiii, fig. 21.
— BOUEI, *de Koninck*, 1885. Ibid., p. 220, pl. xxxv, figs. 8, 9.

Specific Characters.—Shell below medium size, longitudinally and obliquely subtrigonal, with sharply defined, depressed ears; the left valve gibbose, the right

slightly convex. The hinge-line straight and elongate. The umbones swollen and pointed, subcentral. The anterior ear in the left valve triangular, its anterior superior angle produced, marked off by an angular groove from the valve; the posterior ear falcate.

Interior.—The surface is smooth, showing radiating grooves corresponding with the strong external ridges. Adductor scar shallow, round, and placed high up in the valve, just posterior to the middle line.

Exterior.—The surface of the left valve is marked with about six strong, rugged, radiating ridges, between each pair of which are three or more finer radiating lines, which become more apparent as the lower border of the valve is approached. The centre ridge may reach the umbo. There are obscure concentric folds. The anterior ear has a few obscure radiating folds, but the concentric striæ are well marked. The posterior ear is marked by concentric lines of growth parallel with the contour of the ear. The right valve is ornamented with numerous close, equal, rounded, radiating ribs, which bifurcate as they pass across the valve.

Dimensions.—Pl. XIV, fig. 16, measures—

Antero-posteriorly	35 mm.
Dorso-ventrally	32 mm.
From valve to valve	15 mm.

Localities.—England: the Carboniferous Limestone of Castleton, Derbyshire; Wetton, Staffordshire; Hill Bolton and Settle, Yorkshire; Lowick, Northumberland; Underset Limestone, Farcote Gill and Goodham Gill, Swarth Fell, Westmoreland; Poolvash, Isle of Man. Scotland: the Upper Limestone series of Garngad Road, Glasgow, and Bowertrapping, Shield; New Cumnock, Ayrshire; Lennox Burn Quarry, Haddingtonshire; shore east of Dalskelly Craig, Boglehill, Longniddry; Smallburn, Kilsyth. Ireland: the Carboniferous Limestone of Manor Hamilton, co. Leitrim; Cornfield, co. Clare; Clogherbrian, co. Kerry.

Observations.—*A. interstitialis* has been established on the peculiar characters of the left valve. Phillips only describes this valve, and M'Coy, speaking of *A. segregatus*, simply mentions that the right valve is "slightly convex." I have been fortunate enough to obtain one specimen with the valves in contact, and although much weathered, the contour and markings of the right valve are preserved. It occurred in the upper beds of Carboniferous Limestone at Castleton, Derbyshire (Pl. XIV, figs. 16, 17). M'Coy's original figure appears as a right valve, but this is an error due to the fact that no allowance was made for the reversal of the figure when drawn on the stone. I quite agree with M'Coy that *P. Kokcharofi*, de Verneuil, is identical with his species, and should therefore be referred to *A. interstitialis*. I also think *Pecten Bouei* of that author is a younger specimen of the same shell. De Koninck has placed *A. segregatus*, M'Coy, as a synonym of

de Verneuil's species, showing his view of the matter. *A. interstitialis* has much the same general characters as *A. Murchisoni;* the latter is, however, easily distinguished by possessing a single fine rib between each pair of strong ones in the left valve. M'Coy's very accurate description under the name *A. segregatus* is perhaps a little too exact with regard to the number of strong ribs, and also of the finer ones between them. The number varies with the growth of the valve; in very large examples there may be as many as five secondary ribs in the broadest spaces, which are the fifth and sixth from the anterior end.

I have no hesitation whatever in placing *Limatulina selecta*, de Koninck, as a synonym of M'Coy's shell. De Koninck figures both valves, and describes the peculiar character of the external surface of the right valve.

Although, unfortunately, the type of *Pecten interstitialis* has disappeared, and the figure is quite unrecognisable, yet Phillips's description is sufficiently definite to leave no doubt as to the real character of the shell. The original description is as follows:—"With about sixteen narrow, sharp, rough, radiating ribs, the intervening spaces with three striæ or finer ribs. A specimen in Mr. Gilbertson's collection has stronger ribs. Near the beak the ribs are alternately larger and smaller, ears acute." M'Coy retained Phillips's species, but unfortunately gave no illustrations, in his second account. In his 'Brit. Pal. Foss.,' page 48, however, he evidently describes a different shell. He states that this form possesses nine to eighteen narrow, sharp, radiating ribs, between which are three to nine smaller, and that the ribs have hooked spines at close regular intervals, and he makes *Pecten intercostatus* a synonym of Phillips's *P. interstitialis*. I think M'Coy was in error as to the true characters of Phillips's *P. interstitialis*. In the account of *A. segregatus* M'Coy draws attention to the distribution of the radiating ribs of the left valve as follows:—"Surface radiated with about six strong, narrow, obscurely rugged ridges, between each pair of which are three smaller, the middle one largest and alone extending to the beaks along with the six primary ridges, which they there nearly equal in size." This account is practically identical with that of Phillips. M'Coy's type specimen is so crushed and so faint as to be scarcely recognisable; I do not propose to reproduce it. De Koninck's *Aviculopecten interstitialis* is quite different from Phillips's species; the surface is stated to be "ornamented with radiating ribs, alternately thick and thin." This author draws attention to the fact that M'Coy has quite mistaken the shell; a fragment in the Gilbertson Collection labelled *Pecten interstitialis* should be referred to *A. Murchisoni*, M'Coy. De Koninck thinks it improbable that *P. Kokcharofi* and *P. Bouei*, de Verneuil, can be the same species. He considers the former a Permian and the latter a Carboniferous shell. Eichwald, however, who would have had more experience of Russian specimens, and probably access to the types, considered the two species as identical. De Koninck says:—"*P. Kokcharofi*, de Vern., has a more pronounced shape, and the ribs on

the posterior ear are made rugose by striæ of growth near the junction with the valve, but this portion of the valve in *P. Bouei* is smooth," and he says there is a difference in the number of thin radiating ribs intercalated between the principal ones, but is not more explicit on the matter. I have followed Eichwald, and consider the specific names as synonyms.

AVICULOPECTEN RUTHVENI, *M'Coy*, sp., 1851. Plate XIV, fig. 22.

AVICULOPECTEN RUTHVENI, *M'Coy*, 1851. Ann. Mag. Nat. Hist., ser. 2, vol. vii, p. 172.
— — — 1855. Brit. Pal. Foss., p. 489, pl. 3 E, fig. 4.
PECTEN GRANOSUS, *Roemer*, 1876. Lethæa Geogn., Atlas, taf. xliv, fig. 4.
AVICULOPECTEN RUTHVENI, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 213, pl. xxxvii, figs. 7, 10, 11; pl. xxxviii, figs. 17, 18.

Specific Characters.—Shell of medium size, suborbicular, moderately convex. Ears large and depressed, hinge-line straight, of moderate length.

Interior.—Unknown.

Exterior.—Surface with about twelve thick, rugged, radiating ribs, between each pair of which are usually three smaller ribs.

Dimensions.—Pl. XIV, fig. 22, the type specimen, measures—

Antero-posteriorly . . .	48 mm.
Dorso-ventrally	55 mm. (estimated).

Locality.—England: the Carboniferous Limestone of Dent, Yorkshire.

Observations.—I am not convinced of the value of *A. Ruthveni* as a species. The type, a left valve in the Woodwardian Museum, is imperfect, the umbones and that region of the shell being lost; but the markings and the large depressed ears make me suspect that the specimen is a large shell of *A. interstitialis*, which has exactly the same ornament and ears.

I would again draw attention to the inaccuracy of M'Coy's figures. That of *A. Ruthveni* apparently represents a perfect specimen, whereas the whole of the umbonal region and the greater part of the left ear have disappeared.

AVICULOPECTEN CARROLLI, sp. nov. Plate XVII, figs. 24—27.

Specific Characters.—Shell of medium size, obovate, dorso-ventral much greater than the antero-posterior diameter; the left valve convex, the right flattened. The anterior and posterior margins almost straight, but oblique; inferior margin

rounded. The hinge-line straight and comparatively short. The umbones gibbose, pointed, incurved, almost central. The anterior ears larger than the posterior ears, well defined, compressed-triangular, with margin rounded; the posterior ears narrow but deep and compressed.

Interior.—Unknown.

Exterior.—The surface of both valves is ornamented by several unequal, flattened, broad, radiating ribs, the majority of which pass from umbo to margin. Every second or fourth rib is more prominent and larger than the others. The ribs are crossed by fine crenulate lines visible under the microscope, and one specimen shows six radiating colour-bands, the strong ribs dividing the bands and apparently being free from colour. The anterior ear has unequal radiating ribs crossed by concentric striæ of growth.

Dimensions.—Pl. XVII, fig. 26, from Castleton, Derbyshire, measures—

Antero-posteriorly	26 mm.
Dorso-ventrally	21 mm.

Localities—England: the Carboniferous Limestone of Castleton, Derbyshire. Ireland: the Carboniferous Limestone of Little Island, co. Cork; Caherass, co. Limerick; St. Doulaghs, co. Dublin.

Observations.—I have founded this species on several specimens, two from the collection of Mr. Joseph Wright, of Belfast, and three in my own. Mr. Wright has appended the MS. name of *Carrolli* in honour of his friend Mr. Isaac Carroll, the botanist; and I have been glad to adopt it. Thespecies is easily identified by the irregular flattened ribs. It has the same general shape as *A. Murchisoni*. I have, I think, identified correctly as a right valve a specimen in the Geological Survey Collection, Dublin. It has very similar marking to the left valve. The Derbyshire specimen has colour-bands and every fourth rib large, but does not show the crenulations on the ribs, which are present in the Irish examples, and the latter show every second rib to be enlarged. Since writing this description and arranging the plates, some much larger examples have occurred to me from St. Doulaghs.

AVICULOPECTEN MURCHISONI, *M'Coy*, sp., 1844. Plate XIV, figs. 3—7.

PECTEN MURCHISONI, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 97, pl. xviii, fig. 3.
— OVATUS, *M'Coy*, 1844. Ibid., p. 97, pl. xiv, fig. 11.
AVICULOPECTEN MURCHISONI, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 219, pl. xxxvi, fig. 21.

Specific Characters.—Shell below medium size, triangularly ovate. The left valve convex, the right flattened. The anterior margin almost straight, oblique.

The lower border rounded, its curvature being continued up to the base of the posterior ear. Hinge-line short and straight. Umbones triangular, pointed, central, incurved. Anterior ear much compressed, sharply defined from the valve by a curved groove, the right ear slit for the byssus. Posterior ears small, triangular, depressed, and flattened, also separated from the valve by a deep groove.

Interior.—Unknown.

Exterior.—The left valve is ornamented with from twelve to twenty thick, radiating, nodular, distant ribs, which project as spines below the lower margin of the shell in front; between each pair of ribs is a thin, irregular, moniliform, linear rib. The spaces between the ribs are smooth, but the whole surface of the valve is irregularly nodular. The anterior ear has four or five radiating ridges, the posterior also several. The latter has several spines projecting obliquely backwards and upwards along its upper border. The right valve has numerous close, rounded, radiating ribs, on which are nodular swellings, caused by concentric undulations crossing the ribs. The right anterior ear has about six distant, nodulose, radiating ribs, the intervals between them showing close concentric lines.

Dimensions.—Pl. XIV, fig. 3, the type, measures—

Antero-posteriorly	35 mm.
Dorso-ventrally	40 mm.

Localities.—England: the Carboniferous Limestone of Castleton, Derbyshire; Poolvash, Isle of Man. Ireland: the Carboniferous Limestone of Little Island and Black Rock, co. Cork; Tankardstown and Ardshanbally, co. Limerick.

Observations.—The type of M'Coy's *Pecten Murchisoni* is preserved in the Science and Art Museum, Dublin. It is a fine specimen of a left valve (Pl. XIV, fig. 3). The marking on the left valve is identical with that of *Pterinopecten Dumontianus*, de Kon., sp., but the latter shell is at once distinguished by its long hinge-line, the long, gradually compressed posterior ear, and the numerous ribs on both ears. The nodulose character of the ribs is not very marked in the type. I have noticed much variation in a suite of specimens from Castleton and Poolvash.

An examination of the type of *Pecten ovatus*, M'Coy, preserved in the Museum of Science and Art, Dublin, in the Griffith Collection, has led me to the conclusion that the shell is the young of *A. Murchisoni*. The contour is the same, and so is the general character of the ornament. M'Coy figures the secondary thin rib between a pair of large ones in an enlarged view. The shell is so small that only one secondary rib is figured.

AVICULOPECTEN INEQUALIS, sp. nov. Plate XIV, figs. 14, 15.

Specific Characters.—Shell of medium size, inequivalve, the right being much smaller than the left valve, and somewhat flatter, slightly oblique. Antero-posterior

diameter much less than the dorso-ventral diameter, ovato-rectangular. The anterior margin of the valve slightly convex, the lower margin much more so, the posterior margin almost straight. The hinge-line straight. Ears large and depressed, pointed, with each margin falcate; the right anterior ear deeply grooved for the byssus. The posterior ears very deep and long, the fold separating them from the valve reaching the margin low down. Umbones small and pointed, placed in front of the centre of the hinge-line.

Interior.—Unknown.

Exterior.—The surface is ornamented with several distant, obscure, broad, radiating ribs, separated by shallow grooves. The whole surface seems to be smooth. Occasionally there are concentric lines and rugæ of growth. The ears have much the same characters as the rest of the valve.

Dimensions.—Pl. XIV, fig. 14, a left valve, measures—

Antero-posteriorly	37 mm.
Dorso-ventrally	53 mm.

Locality.—Scotland: the Carboniferous Limestone series of Chance Pit 21, Kinneil, near Boness (roof of Smithy Coal).

Observations.—This very characteristic species is founded on a right and left valve on one surface of a slab of shale, and a smaller left valve on the other surface. It would seem that this specimen is referred to in the memoir of the Geological Survey of Scotland, explanation of sheet 31, p. 70, as *Aviculopecten* (near *A. planocostatus*, M'Coy, sp.). It is accompanied by a marine fauna, but many of the species mentioned in the list are not named with certainty. Of course this shell has no affinity with *A. planocostatus*, M'Coy, sp., which has quite distinct characters; but the original drawing is so hypothetical that it is not to be wondered that other shells have been confused with it. This species is now referred to the genus *Amusium* (see p. 123).

The left valve of *A. inequalis* seems to have been much larger than the right valve, and to have overlapped this on all sides except that of the hinge-line. I have not noticed this character in any other Carboniferous Pectiniform shell; otherwise the shape of the left valve is very similar to that of *A. Murchisoni*.

AVICULOPECTEN DEORNATUS, *Phillips*, sp., 1836. Plate XVIII, figs. 10—14.

PECTEN DEORNATUS, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 213, pl. vi, fig. 26.
— — *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 91.
AMUSIUM ? DEORNATUM, *M'Coy*, 1855. Brit. Pal. Foss., p. 478.

Specific Characters.—Shell small, broadly ovate, moderately convex, equivalve, almost equilateral. The lower margin almost semi-circularly curved. The hinge-

line straight, of moderate length. Umbones small, acute, central. Ears large, well defined, compressed, the anterior the larger; that of the right valve deeply slit for the byssus; the posterior ear elongate, narrow, and acutely pointed. Shell very thin.

Interior.—Seems to be normal, smooth, without traces of the concentric sulci.

Exterior.—The surface is smooth, crossed by two or three distant, deep sulci, the upper margin of which is at times converted into a concentric ridge.

Dimensions.—Pl. XVIII, fig. 10, a right valve, measures—

Antero-posteriorly	9 mm.
Dorso-ventrally	10 mm.

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

Observations.—Phillips's poor figure is accompanied by an even more meagre description, which reads as follows:—"This has scarcely distinguishable characters, yet contrasts with the others by its smooth concentric furrows;" and it is on the latter character alone that I have considered it well to retain the species. M'Coy's description is a little more detailed.

I refer to *A. deornatus* a number of specimens from Little Island, co. Cork, in the cabinet of Mr. Joseph Wright, of Belfast. The majority of the specimens consist of right valves, but the left valve is represented. The long hinge-line and pointed ears demonstrate the affinity of the shell to *Aviculopecten.*

A. deornatus is easily diagnosed from *A. Sedgwicki*, the angular concentric ridges of the latter being absent, and the valve being more orbicular and less regularly ovate. *A. interlineatus*, Meek and Worthen, is very similar in appearance to *A. deornatus.*

AVICULOPECTEN SEDGWICKI, *M'Coy*, sp., 1844. Plate XVI, figs. 28—33.

PECTEN SEDGWICKII, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 99, pl. xiv, fig. 4.

AVICULOPECTEN SEDGWICKII, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 165.

Specific Characters.—Shell small, longitudinally ovate, the left valve moderately convex, the right flattened. Ears well marked, the anterior depressed, rolled, and pointed, the posterior rapidly compressed and pointed. The hinge-line straight and long, the umbo in the left valve gibbose, pointed, and raised above the opposite valve; the right umbo small, flattened, and placed below the left, below which there seems to be a notch to receive it when the valves were open.

Interior.—Unknown.

Exterior.—The surface is ornamented by a few distant, concentric, acute ridges, not quite so well marked in the right valve, separated by broad, concave, concentric, smooth grooves. The ridges pass on to the ears, the contour of which they follow. Very obscure radiating striæ are at times seen crossing the grooves.

Dimensions.—Pl. XVI, fig. 28, a left valve from Cork, measures—

Antero-posteriorly	18 mm.
Dorso-ventrally	24 mm.

Localities.—England: the Carboniferous Limestone of Narrowdale, North Staffordshire; Park Hill, Derbyshire. Ireland: the Carboniferous Limestone of Cork and Little Island, co. Cork.

Observations.—This very characteristic shell is rare, but Mr. Joseph Wright's cabinet contains five specimens, one of which is a bivalved example, though unfortunately not perfect in the neighbourhood of the ears. It shows the left valve to overlap the right valve considerably, and to be much more convex than the latter. The concentric folds are triangular in section, and not rounded as in *Pseudamusium auriculatum*.

Genus PSEUDAMUSIUM, *H. and A. Adams*, after *Klein*, 1858; emend *Verrill*, 1897.

PSEUDAMUSIUM, *Klein*, 1753.
— *H. and A. Adams* (pars), 1858.
— *Verrill*, 1897. Trans. Connecticut Acad., vol. x, p. 60.

Generic Characters.—Shells nearly equal, the right flatter than the left, ovate or subcircular; margins simple. Ears well defined, small, straight, obtuse-angled. Exterior smooth, or with lightly marked radiating striæ or grooves.

Observations.—Prof. Verrill has given a long account of this genus and its limitations in his paper on "A Study of the Family *Pectinidæ*" above cited, and it is unnecessary to refer much to the synonymy here. The distribution, according to him, is Recent to Cretaceous. This genus is more closely allied to *Camptonectes*, Meek, most of the species of which are Mesozoic. Prof. Verrill remarks that the latter "is generally regarded as only a section of *Pseudamusium*." At any rate the relationship between the two genera is so close that it would be impossible to decide to which the Carboniferous examples might the more appropriately be referred. I have therefore adopted that genus which has the right of priority.

PSEUDAMUSIUM ELLIPTICUM, *Phillips*, sp., 1836. Plate XX, figs. 11—18.

PECTEN ELLIPTICUS, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 212, pl. vi, fig. 15.
— — *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 92.
— ELONGATUS, *M'Coy*, 1844. Ibid., p. 92, pl. xvi, fig. 9.
— DEPILIS, *M'Coy*, 1844. Ibid., p. 91, pl. xvi, fig. 11.
— FILATUS, *M'Coy*, 1844. Ibid., p. 93, pl. xiv, fig. 10.
— ELLIPTICUS, *de Verneuil*, 1845. Géol. Russie de l'Europe, p. 329, pl. xxi, fig. 8.
AVICULOPECTEN ELLIPTICUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 164.
PECTEN ELONGATUS, *de Koninck*, 1877. Recherches Foss. Pal. New South Wales, p. 155, pl. xxii, fig. 5.
STREBLOPTERIA ELONGATA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 205, pl. xxxii, fig. 8.

Specific Characters.—Longitudinally ovate, below medium size, moderately and regularly convex. The margin one unbroken curve from ear to ear. Hinge-line small and straight. Anterior ears small, triangular, depressed, that of the right valve separated from the margin of the valve by a deep groove. Posterior ears small, triangular, depressed. Umbones pointed, central, moderately swollen.

Interior.—The hinge-plate is triangularly elongate, smooth (only the anterior third has been seen). Adductor muscle-scar normal.

Exterior.—The surface, including the ears, is smooth. Occasionally concentric striæ or irregularities of growth are seen, and some examples have obscure, radiating, obsolete ribs, especially near the anterior margin, often marked with radiating colour-bands on the left valve.

Dimensions.—Pl. XX, fig. 13, the type of Phillips's *Pecten ellipticus*, measures—

Antero-posteriorly	25 mm.
Dorso-ventrally	31 mm.

Localities.—England: the Carboniferous Limestone of Thorpe Cloud, Park Hill, and Castleton, Derbyshire; Narrowdale, North Staffordshire; Hill Bolton, Yorkshire. Scotland: the Upper Limestone series of Bowertrapping; Genwhappleburn, Craigenglen. Ireland: the Carboniferous Limestone of Rathkeale, Askeaton, and Curraghbeg, co. Limerick; Little Island, co. Cork; Townplots, Killala, co. Mayo; Millicent, co. Kildare.

Observations.—The type of *Pecten ellipticus*, Phillips, is preserved in the Gilbertson Collection, Natural History Museum, South Kensington, and I figure it in Pl. XX, fig. 13. It is a left valve, imperfect in front, and shows the short ears and general contour of the valve. It does not show, however, the radiating lines and colour-bands so commonly found in examples of this species. The type is rather more elliptical than most of the specimens I have studied, and perhaps for

this reason M'Coy did not recognise that his *Pecten elongatus* belonged to Phillips's species. The shell in the Gilbertson Collection labelled *P. elongatus* (Pl. XX, fig. 14) can hardly have been the figured specimen, as it is so much smaller than the figure, but both figure and specimen are left valves. Both Phillips's and M'Coy's specimens are so smooth that I think it likely they were casts. De Koninck adopted M'Coy's name, and does not appear to have considered that Phillips's shell occurred in Belgium.

After examination of the types in the Science and Art Museum, Dublin, I cannot but refer *P. depilis*, M'Coy, to Phillips's species. It is a smaller shell, but the contour of the valve and general shape show its close affinity to *P. ellipticum*. I think *P. filatus* of the same author also belongs to Phillips's species. I am unable to identify the radiating lines, as shown in the enlarged figure, in the specimen which is now considered to be the type. It is not *P. anisotum*, for the ears are not ribbed, but are plain.

PSEUDAMUSIUM ANISOTUM, *Phillips*, sp., 1836. Plate XXI, figs. 13—20.

PECTEN ANISOTUS, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 212, pl. vi, fig. 22.
— CONSIMILIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 91, pl. xv, fig. 16.
— VARIABILIS, *M'Coy*, 1844. Ibid., p. 101, pl. xvi, fig. 7.
LIMA OBLIQUA, *M'Coy*, 1844. Ibid., p. 88, pl. xv, fig. 7.
cf. PECTEN SIBERICUS, *de Verneuil*, 1845. Geol. Russie de l'Europe, p. 329, pl. xxi, fig. 7.
— ANISOTUS, *Brown*, 1849. Illust. Foss. Conch., p. 156, pl. lxv, fig. 24.
AVICULOPECTEN ANISOTUS, *Morris*, 1854. Cat. Brit. Foss., 2nd ed., p. 164.
— — *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 237, pl. xxxix, fig. 22.
cf. STREBLOPTERIA RENARDI, *de Koninck*, 1885. Ibid , p. 203, pl. xxxiv, fig. 27.

Specific Characters.—Shell below medium size, almost equivalve, inequilateral, obliquely rotundato-ovate, only moderately convex. The margin continuously convex from ear to ear, more so in front, where the anterior border is produced. The hinge-line straight and short. The umbones small, triangular, pointed, flattened, slightly raised, placed about the centre of the hinge-line, but posterior to the median vertical diameter of the valve. The anterior and upper part of the valve much cut away for the byssal notch, and the border extending forwards considerably beyond the anterior ear. The anterior ears well marked, depressed, well defined from the valve, separated in the right by a slit for the byssus; the posterior ears very small, triangular, compressed, the posterior superior angle very obtuse. Shell very thin.

Interior.—The adductor muscle-scar large and normal in position. The lower part of the left valve obscurely ribbed internally.

Exterior.—The surface of both valves is quite smooth, with an occasional concentric sulcus, pointing to interference with growth. Several specimens show narrow, radiating, and concentric colour-bands. Both anterior ears are crossed by several moniliform radiating ribs.

Dimensions.—Pl. XXI, fig. 13, the type, measures—

Antero-posteriorly	14 mm.
Dorso-ventrally	16 mm.

Localities.—England: the Carboniferous Limestone of Thorpe Cloud, Park Hill, and Castleton, Derbyshire; Narrowdale, Staffordshire; Hill Bolton and Settle, Yorkshire; five feet above Underset Limestone, Goodham Gill, Swarth Fell, Westmoreland; White Limestone, Poolvash, Isle of Man. Scotland: shore east of Kinghorn; shore west of Kinning Point, Charlestown; Cockmuir Quarry, Hillhead Bridge, Denny. Ireland: Carboniferous Limestone of Little Island and Ballydaniel, co. Cork; Doohylebeg, co. Limerick.

Observations.—The type-specimen (Pl. XXI, fig. 13) is preserved in the Gilbertson Collection, Natural History Museum, South Kensington. It is a right valve and not very perfect. The species is easily recognised by the smooth surface of both valves, and it is very common in the shell beds on Thorpe Cloud, Dovedale, but it is difficult to obtain whole from the matrix. The valves vary a good deal in breadth, and there is a tendency for the shells to become less ovate and more orbicular with age, and I imagine that several of de Koninck's species represent different states of *P. anisotum*. De Koninck referred the species to *Aviculopecten* in the text, but with a (?) in the explanation of the plates; I am at a loss to understand why he retained the species in the genus *Aviculopecten*. *P. anisotum* is more oblique, less tumid, and broader than *P. ellipticum*.

P. sibericum, de Verneuil, is, I think, probably the same shell as Phillips's *P. anisotum*. The drawing of the Russian shell represents a right valve, showing an anterior ear, which has a reticulate character; this and the smooth, slightly sulcated, broad ovate valve, seem to me to leave little doubt as to the identity of the shell.

I consider that *Pecten consimilis*, M'Coy, is merely the young of Phillips's shell. M'Coy called attention to the striation of the anterior ears, which is a characteristic feature. I think that *P. variabilis*, M'Coy, represents a rather medium-sized specimen of Phillips's species, but the type-specimens are so obscure that their true nature is quite uncertain. *Lima obliqua*, M'Coy, also seems to me to be a fragment of *P. anisotum*.

PSEUDAMUSIUM GIBBOSUM, *M'Coy*, sp., 1844. Plate XXI, fig. 12.

PECTEN GIBBOSUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 93, pl. xviii, fig. 5.

Specific Characters.—Shell small, orbicular, very convex, the contour from ear to ear nearly circular. The hinge-line straight, fairly long. The umbo tumid, incurved, and pointed, raised above the hinge-line in the left valve. The ears narrow and elongate; the anterior ear deeply separated from the valve by a curved groove, the posterior ear with its posterior superior angle a right angle.

Interior.—Unknown.

Exterior.—The surface of the left valve is ornamented with fine, microscopic, radiating lines apparent only on the anterior third of the valve; there are also very fine, close, concentric lines visible with the microscope. The ears appear to be smooth. The right valve has a similar ornament.

Dimensions.—Pl. XXI, fig. 12, a left valve from Castleton, measures—

Antero-posteriorly	20 mm.
Dorso-ventrally	20 mm.
Gibbosity of the valve . . .	5 mm.

Localities.—England: the Carboniferous Limestone of Castleton, Derbyshire. Ireland: Ballyduff, Dungarvan, co. Waterford.

Observations.—I am doubtful if the type of M'Coy's *Pecten gibbosus* is preserved in the Griffith Collection, Science and Art Museum, Dublin. The specimen is a left valve, much larger and much flatter than the figure, which represents a right valve, and the ears are much longer than those in the figure. I have only met with one other specimen of this species, a left valve. M'Coy's description is very definite and accurate; his observations on the species are:—"This little species is almost globular. The small lengthened ear is perfectly flat, and distinctly separated from the body of the shell."

PSEUDAMUSIUM FIBRILLOSUM, *Salter*, sp., 1864. Plate XVI, figs. 16—22.

AVICULOPECTEN FIBRILLOSUS, *Salter*, 1864. Mem. Geol. Survey, Geol. of Country round Oldham, p. 65, pl. i, fig. 2.

PECTEN PRÆTENUIS, *von Koenen*, 1879. Neues Jahrb. f. Min., p. 329, taf. vi, figs. 3, 4.

AVICULOPECTEN CAIRNSII, *Bolton*, 1897. Mem. Manch. Lit. and Phil. Soc., vol. xli, No. 6, p. 3.

PECTEN (PLEURONECTITES) cf. PRÆTENUIS, *Wolterstorff*, 1899. Untercarbon. Magdeburg-Neustadt, p. 47, pl. iii, figs. 8—16.

Specific Characters.—Shell below medium size, ovate, slightly oblique, the left valve a little more convex than the right valve. The anterior margin cut away under the anterior ear, descending outwards and downwards with a slightly concave curvature till it meets the convexity which is continued round the lower margin, making a rounded obtuse angle; the posterior margin rapidly approaching the umbo, forming a well-marked ridge which limits the posterior ear. The ears depressed, small, triangular, the posterior smaller than the anterior. Byssal notch deep. Hinge-line short and straight. The umbones small, pointed, sub-central.

Interior.—Unknown.

Exterior.—The right valve is marked with irregular fine or coarse concentric lines and striæ of growth, radiating striæ obsolete. Ears apparently smooth. The left valve is ornamented with many fine, close, irregular, radiating, fibrillose striæ, crossed by concentric lines and rugæ of growth. Ears with fine radiating striæ. Periostracum thick, often wrinkled, probably from pressure.

Dimensions.—Pl. XVI, fig. 22, a right valve, measures—

Antero-posteriorly	25 mm.
Dorso-ventrally	25 mm.

Localities.—England: Coal Measures, 150 yards over Great Mine Coal, river at Ashton-under-Lyne; above the Gin Mine Coal, Nettlebank Sinking, Smallthorne, North Staffordshire; marine bed in Middle Coal Measures, River Tame, Dukinfield; Pendleside Series, Leek and Waterhouses Railway, Staffordshire; and at Holden and Pendle Hill, Lancashire. Ireland: (?) Coal Measures, Slieve Carna, co. Mayo.

Observations.—This species was established by Salter for some shells found in the banks of the river Tame, at Ashton-under-Lyne. The series of shells used for description and illustration are preserved in the collection of the Geological Survey, Jermyn Street, and I have been permitted to study them. The illustrations are somewhat hypothetical, as the right valve in well-preserved specimens is free from radiating striæ, and in full-grown specimens, where the periostracum is very thick, they are not always seen in the left valve. The narrow hinge-line and small ears, of which the anterior is larger than the posterior, are, however, correctly indicated. I have met with this species in a much finer condition in beds of the Pendleside Series at Holden, Bolland, and have referred the shell in lists of fossils to *Pecten prætenuis*, von Koenen. I have arrived at the conclusion that this species is identical with Salter's shell, and placed the name as a synonym of *Pseudamusium fibrillosum*. Wolterstorff has given some good figures of the species, referring it to von Koenen's *Pecten prætenuis*.

It is of interest to note that *P. fibrillosum* is found in the Pendleside Series and Coal Measures of England and Ireland, and in the Culm beds of Herborn and Magdeburg, one of several species common to these localities, and indicating a

faunal relationship between the Culm and Pendleside Series. I have not met with the species in the Lower Carboniferous Series.

PSEUDAMUSIUM AURICULATUM, *M'Coy*, sp., 1844. Plate XVI, figs. 23—27.

LIMA LÆVIGATA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 88, pl. xiv, fig. 3
INOCERAMUS AURICULATUS, *M'Coy*, 1844. Ibid., p. 77, pl. xix, fig. 5.
PECTEN CINGENDUS, *M'Coy*, 1844. Ibid., p. 90, pl. xvii, fig. 11.
cf. AVICULOPECTEN ? CONCENTRICO-COSTATUS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 237, pl. xxxi, figs. 6, 7; pl. xli, figs. 28—33.

Specific Characters.—Shell below medium size, inequivalve, the left valve gibbose, the right valve less so; ovate, orbicular, oblique. The anterior margin below the ear produced and rounded; the lower margin broadly round; the posterior margin almost straight, making a right angle with the hinge-line, which is straight and of medium length. The umbones gibbose, incurved, and pointed, the left the higher, more swollen, and arching over the right. The anterior ear well marked off from the valve, depressed and small, separated in the right valve by the byssal slit; the posterior ear large and ill-defined, its margin rectangular.

Interior.—Unknown.

Exterior.—The surface is smooth, but raised into several concentric ribs in both valves, which become obsolete towards the posterior superior angle of the valve. The ears seem to be smooth.

Dimensions.—Pl. XVI, fig. 25, a bivalved example in the collection of the Geological Survey of Ireland, measures—

Antero-posteriorly	16 mm.
Dorso-ventrally	18 mm.
From side to side	9 mm.

Localities.—Ireland: the Carboniferous Limestone of Middleton and Little Island, co. Cork; Abbeybay, Ballyshannon, co. Donegal; Croag and Knocksouna, co. Limerick; Millicent, Clane, co. Kildare.

Observations.—The type of *Inoceramus auriculatus*, M'Coy, is stated to have been in the collection of Dr. Haines, of Cork, but I have not been able to trace it. Kelly states that it came from co. Cork.[1] I have no hesitation in referring *Pecten cingendus*, M'Coy, the type of which is in the Griffith Collection, Royal College of Science Museum, Dublin, to this species. The latter is a right valve, evidently

[1] 'Journ. Geol. Soc. Dub.,' vol. vii, p. 12.

somewhat compressed, hence its flattened condition. An almost perfect bivalved example is in the collection of the Geological Survey of Ireland (Pl. XVI, fig. 25).

The name *P. auriculatum* has been adopted, as it occurs in M'Coy's work several pages in advance of *Pecten cingendus*, and therefore has the priority.

His species is easily distinguished from *A. Sedgwicki*, in which shell the concentric ribs are angular and acute. It seems to me that the species is most likely to be mistaken for small, incomplete specimens of *Posidoniella vetusta*, in which there is no anterior ear, and the whole shell is more oblique. *Aviculopecten? concentrico-costatus*, de Koninck, is probably a young form of M'Coy's species, which accounts for the number and closeness of the concentric ribs.

The type of *Lima lævigata*, M'Coy (Pl. XVI, fig. 24), is evidently only a full-grown example of the left valve of *P. auriculatum* distorted by shearing.

PSEUDAMUSIUM REDESDALENSE, sp. nov. Plate XX, figs. 1—6.

Specific Characters.—Shell below medium size, obliquely suborbicular, sub-equivalve, the left valve the more convex. The margin one single curve, most convex and produced in front; the hinge-line short and straight. The umbones small, pointed, very slightly raised, and situated about the centre of the hinge-line, and therefore posterior to the middle vertical diameter of the valves. The ears small, the anterior in the right valve well defined, divided from the valve by a deep, broad, scimitar-shaped groove for the byssus, that of the left valve triangular and sharply depressed. The posterior ears small and triangular in both valves, their posterior margin vertical.

Interior.—The adductor muscle-scar is large, oval, and placed posterior to the middle line above the centre of the valve from above downwards. The pallial line is remote from the margin. The inner surface of the left valve below the pallial line is marked by flat radiating ribs, the right valve being quite smooth. Flat radiating colour-bands of considerable thickness often present. The hinge shows an elongate groove for the ligament.

Exterior.—The surface of the right valve is smooth, but the anterior ear has imbricating concentric lines. The left valve has almost obsolete, flat, radiating ribs, covered with fine, close, linear, radiating striæ in its lower two-thirds. Apparently smooth in the upper third.

Dimensions.—Pl. XX, fig. 3, a bivalved example, measures—

Antero-posteriorly	25 mm.
Dorso-ventrally	25 mm.
From side to side	8 mm.

Localities.—England: the Redesdale Ironstone Beds, Redesdale, Northumberland. Scotland: Lower Carboniferous of Thornton Burn, Haddington.

Observations.—This species has the characteristically expanded anterior side of *Streblopteria*, but with a short hinge-plate. It differs from other described species of the genus in having the left valve ornamented with flattened ribs covered with fine radiating lines, while the right valve is smooth. The interior of the valve also shows the flat ribs. The majority of the species of the genus are smooth, but even in some of these there are well-marked radiating colour-bands.

De Koninck describes two of his species, *L. ellipsoidea* and *S. pleurophora*, as having radiating striæ. In the former these striæ arise some distance from the umbo, and in the latter it is stated that the striæ are more marked near the margin; but it is not noted that only the left valve is so ornamented, though it is the left valve which is figured in both cases.

P. Redesdalense resembles *P. propinquum*, de Koninck, in general shape, and it is possible that the species may be one; but no radiating ribs are figured or described as being present in the Belgian shell.

In Prof. Lebour's list of the shells from the Redesdale Ironstone beds ('Handbook Geol. and Nat. Hist. Northumberland and Durham,' p. 121) four species of *Aviculopecten* are enumerated, namely, *A. planoradiatus*, M'Coy; *A. papyraceus*, Sow.; *A. concavus*, M'Coy; *A. cœlatus*, M'Coy, and a new species. It is probable that *P. Redesdalense* was mistaken for *A. planoradiatus*, which I have not met with there; but the hinge, ears, and general shape of the shell are very different. Of course, *Pterinopecten papyraceus* does not occur at this locality.

PSEUDAMUSIUM SUBLOBATUM, *Phillips*, sp., 1836. Plate XVII, figs. 11—14.

AVICULA SUBLOBATA, *Phillips*, 1836. Geol. Yorks., pt. ii, p. 211, pl. vi, fig. 25.
— — *Brown*, 1849. Illust. Foss. Conch., p. 162, pl. lxvi**, fig. 32.
AVICULOPECTEN SUBLOBATUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 166.
— — *R. Etheridge, jun.*, 1876. Geol. Mag., dec. ii, vol. iii, p. 151, pl. vi, figs. 2—6.

Specific Characters.—Shell below medium size, slightly obliquely oval, somewhat inequivalve, the left valve regularly and very convex, the right less so. The greater part of the margin of the valve regularly curved, but the curvature apparently terminating both in front and behind in a kind of shoulder, above which the edge of the valve slopes inward to the base of each ear. The hinge-line probably very short. The right anterior ear small, but deeply separated from

the valve by a wide, scimitar-shaped slit for the byssus; the right posterior ear almost obsolete. The left anterior ear ill-defined, rolled, and small; the posterior ear still smaller. The umbones gibbose, subcentral, and pointed.

Interior.—Unknown.

Exterior.—The surface of both valves is ornamented with radiating bands of colour, varying in width and number. The surface of the valves is almost smooth, but the microscope shows fine concentric lines and striæ. The anterior side of the right valve shows close radiating ribs, which extend to the border, but become gradually obsolete from before backwards.

Dimensions.—Pl. XVII, fig. 13, a left valve, measures—

Antero-posteriorly . . .	25 mm.
Dorso-ventrally . . .	21 mm.
Convexity of valve . . .	5 mm.

Localities.—England: the Carboniferous Limestone of Park Hill and Castleton, Derbyshire. Ireland: the Carboniferous Limestone of Little Island, co. Cork.

Observations.—Mr. R. Etheridge, jun., re-described and figured Phillips's species. He figured five specimens which are in the Museum of the Geological Survey, Jermyn Street, and I am kindly permitted to figure four of them (Pl. XVII, figs. 11—14). Unfortunately no single specimen is absolutely perfect, but at least two are right valves. The posterior ears are almost obsolete, but the anterior ears are well developed.

The type of *Avicula sublobata*, Phillips, has unfortunately disappeared; but, in spite of the poor figure and meagre description, I think there is no doubt that Mr. Etheridge, jun., was quite correct in referring his specimens to that species. He discusses at length the peculiar size and number of the colour-bands as indicated in the figures, and thinks that the shell shows some doubtful affinity to *Streblopteria*, M'Coy; but the absence of the large and expanded posterior ears at once necessitates its removal from that genus. I therefore have placed it under the genus *Pseudamusium*.

PSEUDAMUSIUM CONCENTRICO-LINEATUM, sp. nov. Plate XX, figs. 7—10.

Specific Characters.—Shell of medium size, equivalve, equilateral, almost circular, moderately gibbose. The anterior, lower, and posterior margin formed by a regular curve, almost circular in form. The hinge-line straight, of moderate length. The umbones small, pointed, not raised, subcentral. The right anterior ear well marked and separated from the valve by a deep byssal slit; that of the left valve depressed, deep, and somewhat rolled. The posterior ears smaller than

the anterior ears, triangular, the posterior superior angle being only very slightly obtuse. Shell thin.

Interior.—Smooth. Muscle-scar in normal situation. Hinge not known.

Exterior.—Both valves are adorned with regular, concentric, flattened ridges, separated by shallow, linear, concentric grooves, which are much closer together and more numerous on the left than on the right valve, and also are crowded and less regular near the lower margin. On the left valve the concentric ridges are crossed by fine radiating lines, most marked at the anterior border. The anterior ears have fine radiating and concentric ridges, while the posterior ears are almost smooth.

Dimensions.—Pl. XX, fig. 10, a left valve, measures—

Antero-posteriorly	50 mm.
Dorso-ventrally	48 mm.
Elevation of valve	7 mm.

Localities.—England: the Carboniferous Limestone of Wetton, Staffordshire; Castleton, Derbyshire. Ireland: the Carboniferous Limestone of Askeaton, co. Limerick.

Observations.—The marking of the right valve might be mistaken for that of *A. dissimilis* if the ears were not preserved, but the latter shell is much flatter and not so circular. The hinge-line and ears are totally different in character. The species is not common, but has a fairly wide distribution. The valves seem to be equally convex, but as I have not obtained a bivalved example, I cannot be certain on this point. The shell was very thin, and if the specimens are at all rolled the characteristic concentric lines and spaces are obliterated. The ears and the length of the hinge-line show the real generic affinity. The general form and ornament have some resemblance to the Cretaceous *Pecten cinctus*, Sow.

Genus Crenipecten, *Hall*, 1883.

Crenipecten, *Hall*, 1883. Pal. N. York, vol. v, pt. 1, plates and exp., p. 3.
— — 1885. Ibid., vol. v, pt. 1; Lamell., vol. i, p. 81.

Generic Characters.—Shell Pectiniform, ears well developed, smooth, the anterior ear the larger (Hall). Hinge with a number of small, close, subequal, parallel, vertical, ligamental pits or teeth throughout its entire length. Surface smooth or radiated.

Observations.—This genus was founded by Hall for shells possessing the peculiar hinge-characters described above. It differs from *Pernopecten*, Winchell, which

has the shape of *Syncyclonema* and *Amusium*, but has a central cartilage pit and a row of vertical, narrow pits, which are arranged, not in a straight line, but each series rises slightly from the centre outwards. It also differs from *Euchondria*, Meek, which has an excentric cartilage pit, and the lateral pits unequal on the two sides.

All the species figured by Hall, except one, *C. Winchelli*, are smooth, with a short hinge-line and small ears; but the species just mentioned has a long hinge-line, large ears, and well-marked, numerous, radiating ribs. The only British shell which shows the characteristic hinge-plate of *Crenipecten* resembles the latter species very closely. Prof. Hall says of it :—" This species differs from any known form of *Crenipecten*. It is like *Aviculopecten* in external form and surface characters, and resembles the recent genus *Pecten* . . . Except in the hinge crenulations, this form has no other relations with the genus *Crenipecten*, and it may be found to belong to some genus yet undescribed, which will include other species, now placed with the Carboniferous forms of *Aviculopecten*."

CRENIPECTEN SEMICIRCULARIS, *M'Coy*, sp., 1844. Plate XV, figs. 21—23.

PECTEN SEMICIRCULARIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 99, pl. xvii, fig. 10.

Specific Characters.—Shell of medium size, almost equivalve, the valves moderately convex, transversely semicircular. The margin regularly rounded, extending in front of the anterior ear, markedly falcate posteriorly where it joins the posterior ear. The hinge-line straight, long, projecting beyond the posterior margin. The umbones small and inconspicuous, not raised, central. The anterior ears depressed and well defined from the body of the valve, that of the right valve slit for the byssus; the posterior ears long, large, and well defined, the posterior border very falcate.

Interior.—Smooth.

Exterior.—The surface of the right valve is ornamented with very numerous, fine, somewhat irregular, rounded ribs on the body of the valve, totally absent on the posterior ear, and with only five on the anterior ear. These ribs are crossed by concentric lines and rugæ of growth, which are well marked on the posterior ear. The same ornament occurs on both valves.

Dimensions.—Pl. XV, fig. 21, a left valve, measures—

Antero-posteriorly	72 mm.
Dorso-ventrally	61 mm.

Localities.—England: the Carboniferous Limestone of Castleton, Derbyshire; Poolvash, Isle of Man; Underset Limestone of Farcote Gill, Wildboar Fell, Westmoreland. Scotland: the Lower Limestone series of Thornton. Ireland: the Carboniferous Limestone of Bruckless, Dunkineely, co. Donegal.

Observations.—M'Coy founded his species on a mere fragment, probably the impression of the exterior of a right valve, but not possessing sufficient details to warrant the drawing of the anterior ear. The peculiar character of the numerous fine radiating ribs is, however, well marked in the type-specimen.

The large and almost smooth posterior ears, quite free in their greater part from radiating ribs, is an important character, and prevents any confusion between this shell and *Pterinopecten concavus*, which has a somewhat similar marking, but differs totally in the characters of its ears. There seems to be little or no difference between the convexity and markings of both valves.

I am able to figure both valves. The left valve (Pl. XV, fig. 21) is from the cabinet of Mr. R. Law, who obtained the specimen from Castleton. The right valve is a specimen from Derbyshire in the Wood Collection, York Museum (Pl. XV, fig. 23). I obtained a fragment, showing the hinge-plate, from the Underset Limestone, high up in the Yoredale Series of Lunedale. It shows the peculiar ears and markings of M'Coy's shell, in addition to the characteristic hinge-plate of *Crenipecten*. The hinge-plate is a little imperfect at the centre, and evidently belongs to a right valve (Pl. XV, fig. 22).

C. semicircularis, M'Coy, closely resembles *C. Winchelli* from the Waverley Sandstone, Newark, Ohio, but has a rather longer hinge-plate, and is generally more transverse. It seems to me that Hall was mistaken in stating that the anterior ear is larger than the posterior ear. Pl. ix, figs. 27, 28, of his monograph, evidently represent left valves, as he states they show the posterior ear to be the larger; but, as I have quoted above, he regards *C. Winchelli* as an aberrant generic form. It is interesting, therefore, to see a shell with such similar characters present in the Carboniferous Strata of England.

Genus Obliquipecten, nov.

Generic Characters.—Shell compressed, with the anterior end much developed; the posterior end almost obsolete. The left valve flattened, with a large anterior ear; posterior ear almost obsolete. The right valve with a large anterior ear, the posterior part of the valve bent on itself obliquely downwards and forwards. Hinge-line small. Umbones pointed, curved forwards, and flattened.

Exterior.—The surface, almost smooth, is ornamented by fine concentric lines of growth.

Observations.—This is a very curiously shaped shell, with a strong Pectiniform character; but one cannot look at the left valve without the *Ostrea*-like form calling for comment. The right valve is the more common. A single specimen of the left valve from Settle is in the Woodwardian Museum, Cambridge, and I know no other.

OBLIQUIPECTEN LÆVIS, sp. nov. Plate XIX, figs. 1, 2.

Specific Characters.—Shell of moderate size, compressed, obliquely extended in front, truncate behind, very inequivalve, the right valve being the more convex; very inequilateral, the posterior portion being almost obsolete. Anterior border descending from the umbo, curved rapidly outwards so that the edge of the valve is deeply concave in the region of the anterior ear, the valve below this becoming very convex. The lower margin convex, the posterior margin more gently curved. The hinge-line short, especially behind the umbo, which is flattened, pointed, and curved forwards, placed at the junction of the posterior and middle thirds of the hinge-line. The anterior ears large, especially that of the right valve, which is expanded above the hinge-line and deeply notched for the byssus below. The posterior ears very small, but definite. The right valve bent suddenly on itself along a curved line which passes downwards and forwards from below the posterior ear, the angle of flexion gradually becoming less as it approaches the lower border.

Interior.—Unknown.

Exterior.—The surface is almost smooth, but the microscope shows it to be ornamented with fine concentric striæ and lines of growth. The right anterior ear has concentric lines, and the left ear shows fine radiating lines.

Dimensions.—Pl. XIX, fig. 2, a left valve from Settle, measures—

Antero-posteriorly	37 mm.
Dorso-ventrally	45 mm.

Localities.—England: the Carboniferous Limestone of Settle and Hill Bolton, Yorkshire; Castleton, Derbyshire; and Narrowdale, Staffordshire.

Observations.—This very peculiarly shaped species is not likely to be confounded with any other. The right valve is recognised by the marked flexure of the valve near its posterior border. The Woodwardian Museum, Cambridge, has a set of seven specimens from Settle, six of which are right valves. The peculiarly expanded anterior ear, with its deep slit for the byssus, is not met with in other Pectiniform shells. The species is not common, but I have found it myself in the localities named above, which are all on the same horizon.

Genus Syncyclonema, *Meek*, 1864.

Syncyclonema, *Meek*, 1864. Smithsonian Check-list N. Amer. Cret. Foss., p. 31.
Entolium, *Meek*, 1864. Geol. California, vol. i, p. 478.

Generic Characters.—Shell Pectiniform, ovate, compressed, equivalve; ears small, triangular. In the left valve the anterior larger, and both projecting upwards; umbones small and acute, depressed and central. The triangularly shaped body of the shell marked off by two broad diverging grooves from the expanded anterior and posterior margins. No byssal orifices beneath the anterior ear.

Interior.—Hinge with a small cartilage pit at the centre, and a linear, horizontal groove on either side. Two deep, oblique, strong ridges diverge from the umbo, triangular in shape, terminating abruptly, seen as grooves in casts, probably hinge-teeth. Starting below these teeth, and internal to them, broad, oblique, shallow ridges pass downwards and towards the margins, separating the body of the valve from the curiously expanded borders. The adductor muscle-scar is large, shallow, central, and close below the umbonal region.

Exterior.—The surface is almost smooth, or covered with concentric striæ and lines of growth. In decorticated specimens fine radiating striæ and zigzag markings are seen, especially near the lower border of the valve.

Observations.—When describing the peculiar characters of *P. Sowerbyi* in 1844, M'Coy stated that it agreed with certain Oolitic forms, but mentioned no species. Later on ('Brit. Pal. Foss.,' 1855, p. 478) he referred his species to the genus *Amusium*, Megerle, from which it seems to differ solely in the absence of internal radiating ribs, and possibly in the gaping lateral margins. To *Amusium* M'Coy referred *Pecten Sowerbyi*, M'Coy, and *P. deornatus*, Phillips, but I cannot accept the latter shell as belonging to the same genus as the former. *P. deornatus* has not the peculiar shape of *S. Sowerbyi*, and Phillips describes it as follows:—"This has scarcely distinguishable characters, yet contrasts with the others by its smooth concentric furrows." Had this type, which, indeed, has unfortunately disappeared, possessed the peculiar characteristics of *Syncyclonema*, Phillips could not have described it in these terms.

In 1864 Meek proposed the name *Entolium* for a Jurassic species which has all the important characters distinguishing the Carboniferous shell. He reviews this new genus at length ('Min. Rep. Nebraska' [U. S. Geol. Surv., 1872], p. 190) when describing a shell from the Carboniferous beds of Nebraska, which is probably identical with the British species. He writes:—"At the time of proposing this name I was under the impression that the valves of these shells were closed on

each side, but the species here under consideration (*E. aviculatum*, Swallow, sp.) seems to have been gaping on the sides above the middle. This being the case, I am not sure the group is more than sub-generically distinct from *Pseudamusium*, Brug., 1789. It differs from *Amusium* mainly in having no internal costæ, and in having the valves more nearly equal, with sometimes minute radiating striæ, and no traces of a sinus under the anterior ear in either valve." There is, therefore, a very close relationship between *Entolium* and *Amusium*.

The genus *Pernopecten*, Winchell, is closely allied to *Entolium*, and differs only in having a crenulated hinge-line formed by a row of pits placed on either side of the cartilage pit. I doubt if the genera could be distinguished if the hinge were not exposed, as the external characters are so very similar. The two genera stand to each other in the same relation that *Aviculopecten* stands to *Euchondria*, Meek, and *Crenipecten*, Hall, probably synonyms. This tendency of different genera to develop along parallel lines is of great phylogenetic interest. Hall in 1885 ('Pal. New York,' vol. v, part 1; 'Lamell.,' part ii, p. 57) gives a long and comprehensive note on the synonymy of *Entolium*, and Mr. R. Etheridge, jun. ('Geol. Mag.' dec. ii, vol. iv, 1877, p. 241), has also discussed the peculiar characters of the genus at length, giving good and accurate drawings of the hinge-plate and showing the generic identity of the Carboniferous and Jurassic species. Unfortunately no one recognised that the genus occurred also in the Cretaceous beds, and had been described by Meek in 1864 (*loc. cit.*) as *Syncyclonema*, and therefore this generic term has the priority to *Entolium*. Nor was it recognised that shells with a ribbed internal surface, and other characters common to *Amusium*, existed in Carboniferous beds side by side with those having a smooth internal surface.

It is interesting, therefore, to note the persistence of *Syncyclonema* from Carboniferous to Cretaceous times, and *Amusium* from Carboniferous to Recent. It is most difficult to separate species of the two genera unless the interior is exposed, and they are most closely related.

At present only two species of *Syncyclonema* are known from Carboniferous rocks, one of these occurring in the Coal Measures; but three species of *Amusium* have been found. De Koninck referred five species from the Carboniferous rocks of Belgium to *Entolium*, and at least two of these must be now removed to *Amusium*.

I have not been able to satisfy myself as to the condition of the ears in both valves, *i. e.* whether both valves have the ears raised above the hinge-line so as to prevent opening. The left valve always seems to have one or both ears so raised, but the right valve has the hinge-line straight in the majority of cases. This may be due to fracture, for there seems no necessity for the valves to open if the sides are not closed, and there may be compensation in the flange-like expansions of the sides of the valve.

It is also very difficult to ascertain the side to which the valve belongs. I think, however, that the anterior ear is narrower and longer, and is a little better defined from the rest of the valve than the posterior ear.

SYNCYCLONEMA SOWERBYI, *M'Coy*, sp., 1844. Plate XVIII, figs. 21—26.

PECTEN SOWERBII, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 100, pl. xiv, fig. 1.
— VALDAICUS, *de Verneuil*, 1845. Murchison's Geol. Russia, vol. ii, p. 328, pl. xxvii, fig. 9.
— SOWERBII, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 175.
AMUSIUM SOWERBII, *M'Coy*, 1855. Brit. Pal. Foss., p. 478.
AVICULOPECTEN SOWERBII, *Armstrong and Young*, 1871. Trans. Geol. Soc. Glasg., vol. iii, App., p. 47.
ENTOLIUM AVICULATUM, *Hayden*, 1872. Rep. U. S. Geol. Surv., p. 189, pl. ix, figs. 11 *a*—11 *g*.
PECTEN (PSEUDAMUSIUM) BATHUS, *de Koninck*, 1873. Rech. Anim. Foss. Carb. Bleiberg, p. 94, pl. iii, fig. 19.
— SOWERBII, *R. Etheridge, jun.*, 1874. Geol. Mag., dec. ii, vol. i, p. 300, pl. xiii, figs. 1, 2.
— — *Baily*, 1875. Figs. Char. Brit. Foss., p. 113, pl. xxxix, fig. 3.
— (AMUSIUM ?) SOWERBII, *R. Etheridge, jun.*, 1877. Geol. Mag., dec. ii, vol. iv, p. 241, pl. xii, figs. 1—3.
ENTOLIUM SOWERBII, *R. Etheridge, jun.*, 1878. Ann. Mag. Nat. Hist., ser. 5, vol. ii, p. 30, pl. i, figs. 4, 5.
Non — — *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 241, pl. xxxiii, figs. 5, 6.

Specific Characters.—Shell below medium size, ovato-elliptical or suborbicular, almost equivalve, and equilateral. The valve formed of a central, pear-shaped, convex portion, bounded in front and behind by an oblique groove, which separates broad, flange-like, flattened lobes. The margin of the valve convexly curved for the greater part of its extent, but near the upper part of the valve both in front and behind, becoming suddenly bent towards the middle line of the valve at a bluntly obtuse angle, then passing upwards and inwards till it meets the ear. The ears are small, triangular, the anterior somewhat better demarcated from the body of the valve than the posterior ear. Ears continuous with the hinge-line, with a straight upper margin in the right valve, but the anterior ear raised in the left valve so that its antero-superior angle is elevated, and the upper border of the valve is formed by two lines, which are inclined at an angle. The umbones small, flattened, triangular, and pointed, central.

Interior.—The internal surface is smooth. The adductor muscle-scar is shallow and round, placed high up in the valve and posterior to the middle line. The

hinge-plate consists of a horizontal cavity on each side of a central, small cartilage pit. Extending obliquely on either side of this cartilage pit are two ridges which end abruptly, having in the left valve a hollow internal to them, and probably corresponding to hinge-teeth. Still lower an oblique ridge separates, both in front and behind, the slightly hollow flange from the concave body of the valve.

Exterior.—The surface is almost smooth, but the microscope shows close, fine, concentric lines of growth. When the upper layer of shell is removed the valve appears to be covered by closely set, parallel, zigzag markings.

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

Antero-posteriorly	41 mm.
Dorso-ventrally	34 mm.

Localities.—England: the Carboniferous Limestone of Castleton, Park Hill, and Thorpe Cloud, Derbyshire; Hill Bolton, Yorkshire; Poolvash, Isle of Man. Underset Limestone of Lunds Fell and Goodham Gill; below Hardraw Scar Limestone, Mill Gill, and in Swaledale, Yorkshire. Scotland: common in the Upper Limestone and the Lower Limestone series of the East and West of Scotland; Ferniehill, Gilmerton, near Edinburgh. Ireland: Yellow Sandstone of Bruckless; the Carboniferous Limestone of Little Island and Ballyrichards, co. Cork; Howth, co. Dublin; Rathkeale, co. Limerick.

Observations.—*Syncyclonema Sowerbyi* has been well studied by R. Etheridge, jun., who has made out all the important features of the valve. He at once recognised the importance of removing the shell from the genus *Pecten*, and at first referred it provisionally to *Amusium*, afterwards to *Entolium*. I am not certain whether both ears of the left valve are always raised, the posterior appearing often straight, but it may have broken off at the transverse cartilage groove, a weak spot. On the other hand, the ears of the right valve are never raised, a necessary condition to permit of the opening of the valves. I am inclined to think that the valves gaped at the sides, and that the curious flange-like processes in front and behind had some connection with this arrangement.

The shells of *S. Sowerbyi* show considerable variation, both in size and contour, some being much more orbicular than the type, which is preserved in the Griffith Collection in the Museum of Science and Art, Dublin (Pl. XVIII, fig. 26). This specimen shows faint, irregular, oblique colour-bands not indicated in the figure, and is imperfect.

The specimen figured as *Entolium Sowerbyi* by de Koninck in 1885 is evidently wrongly referred to this species. The figure shows none of the peculiar characters of the genus.

There is no doubt that the Russian shell, *P. Valdaicus*, is identical with

S. Sowerbyi, and its name must be placed as a synonym. I am not persuaded of the specific value of *S. Witryi*, de Koninck.

S. Sowerbyi seems to have a very wide horizontal and vertical distribution.

A specimen in the Leckenby Collection, Woodwardian Museum, No. 123 (Pl. XVIII, fig. 21), locality unfortunately unknown, shows a curious system of colour-bands arranged in slightly undulating, concentric lines, which start from the anterior margin, pass obliquely upwards to the centre of the valve, and then descend again to the posterior margin, the angle formed by the two limbs being very wide. De Koninck has described a somewhat similar form of marking, forming a species, *Entolium coloratum*, on this single character. The arrangement of the colour-bands differs in his specimen, being less regular. I doubt if the shape of his figure is correct; probably it is incomplete, there being no lateral flanges, and I think it probable that this character is a generic one.

SYNCYCLONEMA CARBONIFERUM, sp. nov. Plate XIX, figs. 3—6.

Specific Characters.—Shell small, obovate, expanded, very slightly convex; more so near the umbo. Margins of valve small, the anterior the larger. Hinge-line narrow. Ears triangular and raised so that their upper margins meet at the umbo at an obtuse angle, the anterior a little larger and deeper than the left. Umbones small, pointed, swollen, not elevated. Shell very thin.

Interior.—As in *S. Sowerbyi.*

Exterior.—The surface is ornamented with very fine, close, concentric ribs, only visible under the microscope. Ears smooth.

Dimensions.—Pl. XIX, fig. 5, a right valve, measures—

Antero-posteriorly	11 mm.
Dorso-ventrally	15 mm.

Locality.—England: the Marine Band above the Gin Mine Coal, Nettlebank Sinking, Smallthorne, North Staffordshire Coalfield.

Observations.—This little shell occurs plentifully in a bed of grey shale with calcareous bullions at the horizon and locality mentioned above. The Gin Mine Coal is high up in the Coal Measures, and occurs about 430 yards below the Bassy Mine Ironstone, which is taken as the base of the Upper Coal Measures. This bed was recognised by Mr. Ward so long ago as 1865, while a sinking was going on at the Speedwell Colliery, Longton, and it was not until March, 1903, when Mr. Stobbs, mining lecturer under the Staffordshire County Council, noticed marine shells in the spoil-heap from a sinking at Nettlebank, that this marine bed was noticed again. The bed is of great importance, evidently, as a guide to the coal immediately below it, and the value of fossil evidence in mining is demonstrated.

The following list of the fossils found with *S. carboniferum* will be of interest:

BRACHIOPODA:
- *Athyris ambigua.*
- *Chonetes Laguessiania.*
- *Discina nitida.*
- *Lingula mytiloides.*
- *Orthis resupinata?*
- *Productus semireticulatus.*

LAMELLIBRANCHIATA:
- *Pseudamusium fibrillosum.*
- *Pterinopecten papyraceus.*
- *Posidoniella*, sp. nov.
- *P. lævis.*
- *Syncyclonema carboniferum.*
- *Ctenodonta lævirostris.*
- *Nucula gibbosa.*
- *Nuculana Sharmani.*
- *N. acuta.*
- *Schizodus antiquus.*
- *Solenomya primæva.*

CEPHALOPODA:
- *Gastrioceras carbonarium.*
- *Glyphioceras diadema.*
- *Dimorphoceras Gilbertsoni.*
- *Ephippioceras bilobatum.*
- *Pleuronautilus armatus.*
- *Stroboceras sulcatum?*
- *Orthoceras*, sp.
- *O. sulcatum?*

GASTEROPODA:
- *Loxonema*, sp.
- *Macrocheilina*, sp.
- *Raphistoma junior.*
- cf. *Turbonellina formosa.*
- cf. *Bellerophon* (*Euphemus*) *Urei.*

ECHINODERMATA:
- *Archæocidaris* (spines and plates).
- Crinoid ossicles.

PISCES:
- *Listracanthus, Edestus*, etc.

Many of these species are dwarfed.

S. carboniferum is much narrower than *S. Sowerbyi*, and I think quite a distinct species, and not merely dwarfed. I have been able to see the interior, which in every detail is similar to that of *S. Sowerbyi*, but the valve is markedly ornamented with fine, close, concentric lines.

Genus AMUSIUM, *Bolten* (ex *Klein*).

AMUSIUM, *Bolten*, 1798. Mus. Bolten, pt. 2, p. 165.

Generic Characters.—Shell ovato-triangular, with broad anterior and posterior flanges, flattened. Umbones small. Ears small, triangular, elevated.

Interior.—Marked with broad radiating sulci.

Exterior.—The shell is ornamented with narrow, regular, concentric lines, so fine in some shells as to be almost smooth; occasionally broad, radiating, almost obsolete ribs are seen.

Distribution.—Carboniferous to Recent.

Observations.—Hitherto Carboniferous shells, which had been referred to *Amusium* by M'Coy, with a query by R. Etheridge, jun., have been those which possess smooth, non-ribbed, internal surfaces; and, until the present, no species with this character have been recognised from Carboniferous rocks. It is

now known that at least three species have well-marked internal ribs, and therefore they are referred to *Amusium*. It is unnecessary to discuss the question of the relation of this genus to *Syncyclonema*, to which it is so closely allied in shape and structure, as this has been fully done in my observations on that genus, p. 116.

AMUSIUM CONCENTRICUM, sp. nov. Plate XXI, figs. 7—11.

ENTOLIUM SOWERBYI, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 241, pl. xxxiii, figs. 5, 6.

AVICULOPECTEN ? PROTEUS, *de Koninck*, 1885. Ibid., p. 239, pl. xxxiii, figs. 3, 4; pl. xxxix, fig. 12; and pl. xl, figs. 10—13, 16—20.

Specific Characters.—Shell small, ovate from above downwards. The central part of the valve narrow, triangular, and only moderately convex, separated by broad oblique grooves from an anterior and posterior broad flange-like process. The margin regularly rounded in the greater part of its extent, when it becomes deflected both in front and behind towards the middle line, forming an obtuse angle. The hinge-line short and straight, or angular, the ears very small, the posterior the longer and larger. The umbones small, pointed, and central.

Interior.—The internal surface is ribbed.

Exterior.—The surface is ornamented with regular, fine, concentric lines of growth, through which are seen obscure, almost obsolete, broad, widely separated, radiating ribs.

Localities.—England: the Carboniferous Limestone of Thorpe Cloud, Park Hill, and Castleton, Derbyshire; Hill Bolton, Yorkshire; above the Main Limestone, Nine Standards Rigg, Westmoreland. Ireland: the Carboniferous Limestone of Little Island, co. Cork; Lisbellaw, co. Fermanagh; Croag, co. Limerick; St. Doulaghs, co. Dublin.

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

Antero-posteriorly	28 mm.
Dorso-ventrally	34 mm.

Observations.—This little shell is not at all rare in the upper beds of the Carboniferous Limestone of Derbyshire. It has probably always been regarded as the young of *S. Sowerbyi;* indeed, I have no doubt that de Koninck figured and described a specimen under this name. A reference to his figure (*loc. cit.*) will show that his shell had radiating ribs and sulci, a character which at once separates *A. concentricum* from that shell. *A. concentricum* is much narrower than *S. Sowerbyi*, and has the concentric markings well developed, the latter shell being almost smooth and also much larger and suborbicular.

AMUSIUM TENUE, *de Koninck*, sp., 1885. Plate XXI, figs. 4—6.

ENTOLIUM TENUE, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belg., tom. xi, p. 242, pl. xxxii, fig. 18.

Specific Characters.—Shell below medium size, transversely oval, equilateral, feebly convex, the contour of the valve regularly curved. The hinge-line short and straight. The umbones central, small, pointed. The right valve with the ears not raised above the hinge-line, the anterior narrower and slightly longer than the posterior ear, and more definitely marked off from the valve by an oblique linear groove than the posterior ear. The left valve with the ears raised above the hinge-line. The central triangular portion of the body of the valve not well defined from the flange-like, expanded anterior and posterior borders.

Interior.—The internal surface is marked by distant, radiating, shallow grooves.

Exterior.—The surface of the valves is almost smooth, but in the left valve concentric striæ and lines of growth are seen under the microscope. The decorticated shell shows zigzag markings.

Dimensions.—Pl. XXI, fig. 6, a left valve, measures—

Antero-posteriorly	35 mm.
Dorso-ventrally	31 mm.

Localities.—England: a specimen in the York Museum is labelled Northumberland. Scotland: Lower Limestone series at Kirktonholm, East Kilbride.

Observations.—I have referred four specimens from the above locality, in the collection of Mr. J. Neilson, to de Koninck's species, on account of their characteristic shape.

Amusium tenue is much more transverse and regularly oval than *Syncyclonema Sowerbyi*, to which species the specimens in question have been hitherto referred. The valves are more regularly convex, especially that of the right side. The right valve (Pl. XXI, fig. 5) shows well-marked radiating ridges through the thin shell, and therefore the species belongs to the genus *Amusium*.

AMUSIUM PLANICOSTATUM, *M'Coy*, sp., 1844. Plate XXI, figs. 1—3.

PECTEN PLANICOSTATUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 98, pl. xiv, fig. 6.

Specific Characters.—Shell of medium size, transversely broadly oval, the left valve only very moderately convex, the right still less so, with the anterior and

posterior margins flattened. The hinge-line short and straight. The inferior margin broad and convex, meeting the slightly convex anterior and posterior margins at a rounded, obtuse angle. The ears very small and not raised; the umbones small, pointed, central, that of the left valve the more convex.

Interior.—The internal surface is crossed by well-marked, broad, radiating grooves and ribs. Pallial line remote from the margin.

Exterior.—The surface is marked by broad radiating ribs and sulci, the ribs being about twice the breadth of the grooves. The ribs often appear subdivided. They are absent for a small space near the posterior border, and are almost obsolete in front. The ribs and sulci are crossed by very close, fine, concentric lines of growth.

Dimensions.—Pl. XXI, fig. 3, a left valve, measures—

Antero-posteriorly	57 mm.
Dorso-ventrally	45 mm.
Depth of left valve about . . .	6 mm.

Locality.—Ireland: Carboniferous Limestone, Cork and Little Island, co. Cork.

Observations.—This species was founded on specimens from Little Island, co. Cork, two large examples being in the collection of Mr. Joseph Wright, of Belfast (Pl. XXI, figs. 1 and 3). Fig. 1 represents a right valve with a portion of the test preserved, showing the general contour of the valve and its anterior ear. Fig. 3 represents a cast of the left valve, a little incomplete at the hinge-line. In this species the broad radiating ribs are present on the surface, and by this character the species is easily identified.

M'Coy's type-specimen is preserved in the Griffith Collection of the Museum of Science and Art, Dublin. It is a left valve (Pl. XXI, fig. 2), not quite complete, and was very badly represented by the inaccurate figure in M'Coy's work. The hinge-line and general obliquity of the shell are inventions of the artist, and unfortunately the description seems to have been drawn up from the figure rather than from the specimen. M'Coy doubted whether he was correct in referring this shell to *Pecten*, I think on good grounds, though I do not consider that the shell has any close relation to *Lima*. He says, "I have much doubt whether this shell really belongs to the genus *Pecten*; it is at least an aberrant type, and if placed in this genus it leads to *Lima*, and if placed in *Lima* it leads back to the present genus."

PLATE VII.

Fig. 1.—*Eumicrotis hemisphæricus.* The left valve of a bivalved example. Fig. 1 *a.* The right valve of the same shell with the anterior ear broken away. Fig. 1 *b.* The same specimen viewed from above, showing that the valves have slipped on each other. From the Carboniferous Limestone of Hill Bolton, Craven. My Collection. (Page 45.)

Fig. 2.—*Eumicrotis hemisphæricus.* A left valve, the type of Phillips's *Pecten hemisphæricus.* In the Gilbertson Collection, Natural History Museum, South Kensington. (Page 46.)

Fig. 3.—*Eumicrotis hemisphæricus.* A left valve. From the Carboniferous Limestone of Park Hill. My Collection. (Page 45.)

Fig. 4.—*Eumicrotis hemisphæricus.* A right valve. From the Carboniferous Limestone of Poolvash, Isle of Man. My Collection. (Page 45.)

Fig. 5.—*Eumicrotis hemisphæricus.* A left valve to show the sulcus in the cast, between the umbo and the anterior ear. From the Carboniferous Limestone of Castleton. My Collection. (Page 45.)

Fig. 6.—*Eumicrotis hemisphæricus.* A left valve. Same locality and Collection. (Page 45.)

Fig. 7.—*Pterinopecten papyraceus.* A left valve. Roof of the Hard Coal, Halifax. My Collection. (Page 51.)

Fig. 8.—*Pterinopecten papyraceus.* A right valve, uncrushed. From a bullion in the Pendleside series of Horsebridge Clough. My Collection. (Page 51.)

Fig. 9.—*Pterinopecten papyraceus.* A right valve, with well-preserved anterior ear. From the roof of the Hard Coal, Halifax. My Collection. (Page 51.)

Fig. 10.—*Pterinopecten papyraceus.* An uncrushed left valve. Same locality and Collection. (Page 51.)

Fig. 11.—*Pterinopecten papyraceus.* A left valve, flattened by pressure. Above the Hard Coal, Halifax. My Collection. (Page 51.)

Fig. 12.—*Pterinopecten papyraceus.* Right and left valves. From shales below the Third Grit, Wadsworth Moor. My Collection. (Page 51.)

Fig. 13.—*P terinopecten papyraceus.* A left valve. From the Lower Coal Measures of Southowram. My Collection. (Page 51.)

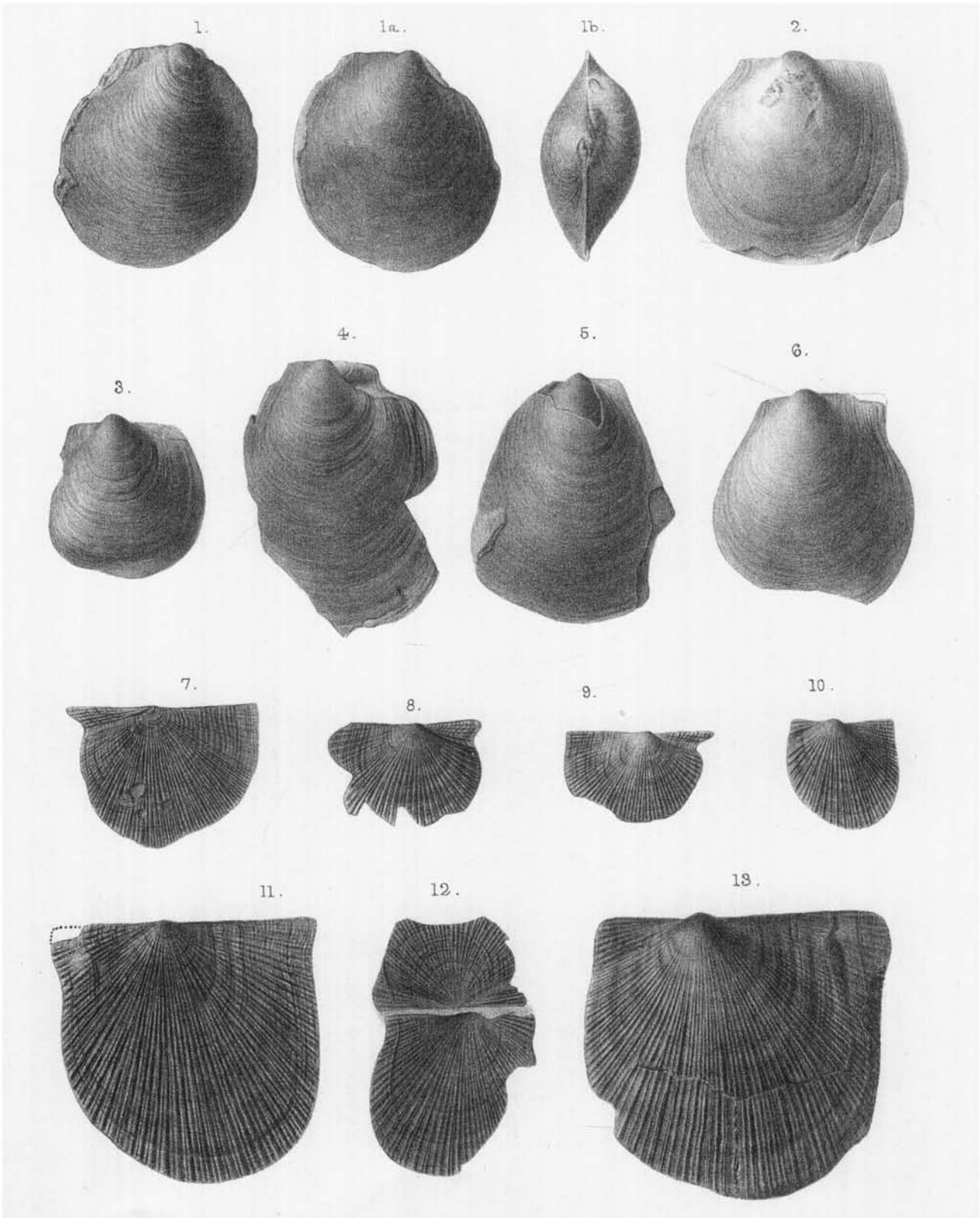
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PLATE VIII.

Fig. 1.—*Pterinopecten rigidus.* A left valve. From the Carboniferous Limestone, Drumkeeran, co. Fermanagh. In the Collection of the Geological Survey of Ireland. (Page 61.)

Fig. 2.—*Pterinopecten rigidus.* A left valve. From Millicent, Clane. In the Collection of the Woodwardian Museum (No. 146), Cambridge. (Page 60.)

Fig. 3.—*Pterinopecten rigidus.* The shell figured by Portlock as *Orthis umbraculum.* A left valve. From co. Fermanagh. In the Museum of the Geological Survey, Jermyn Street. (Page 61.)

Fig. 3 *a.*—*Pterinopecten rigidus.* The hinge-plate of Fig. 3.

Fig. 4.—*Pterinopecten Dumontianus.* A left valve. From the Carboniferous Limestone of Castleton, Derbyshire. My Collection. (Page 65.)

Fig. 5.—*Pterinopecten Dumontianus.* A left valve. From Poolvash, Isle of Man. My Collection. (Page 66.)

Fig. 5*a.*—*Pterinopecten Dumontianus.* The right valve of Fig. 5.

Fig. 6.—*Pterinopecten Dumontianus.* A well-preserved left valve. From the Carboniferous Limestone of Craven. In the York Museum. (Page 65.)

Fig. 7.—*Pterinopecten Dumontianus.* A left valve, showing rather coarser ribs. From the Carboniferous Limestone of Castleton. My Collection. (Page 65.)

Fig. 8.—*Pterinopecten Dumontianus.* A full-grown left valve. From the Carboniferous Limestone of Settle. In the Collection of the Woodwardian Museum (No. 152). (Page 66.)

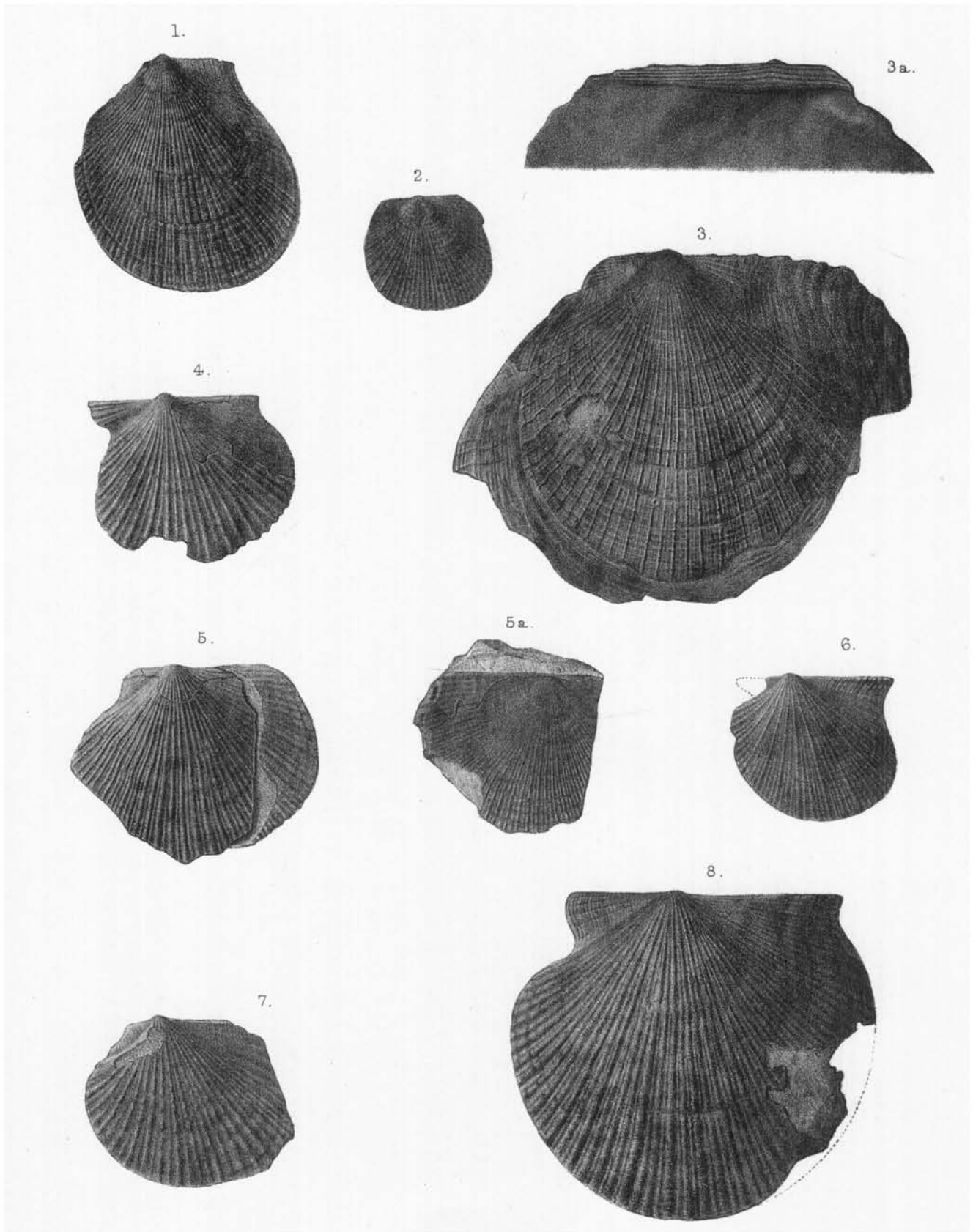
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PLATE IX.

Fig. 1.—*Limatulina scotica.* Portion of a left valve, showing the posterior ear. Muirfoot Burn, New Cumnock, Ayrshire. My Collection. (Page 36.)

Fig. 2.—*Limatulina scotica.* The left valve. Same locality. In the Collection of Mr. J. Smith, of Kilwinning. (Page 36.)

Fig. 3.—*Limatulina scotica.* The right valve of the last figure, showing the overlapping of the left valve and the flat right valve. Same locality and Collection. (Page 36.)

Figs. 4, 5.—*Limatulina scotica.* A fairly perfect specimen, Fig. 4 showing the right and Fig. 5 the left valve. Same locality. My Collection. (Page 36.)

Fig. 6.—*Pterinopecten concavus.* A left valve, the re-described type of M'Coy's species. From Lowick, Northumberland. In the Collection of the Woodwardian Museum, Cambridge. (Page 54.)

Fig. 7.—*Pterinopecten concavus.* Portion of a right valve. From the Carboniferous Limestone of Lowick, Northumberland. Same Collection. (Page 55.)

Fig. 8.—*Pterinopecten tessellatus.* A left valve. From the Carboniferous Limestone of Little Island, co. Cork. In the Collection of Mr. J. Wright. (Page 63.)

Fig. 9.—*Pterinopecten tessellatus.* A right valve. Same locality and Collection. (Page 64.)

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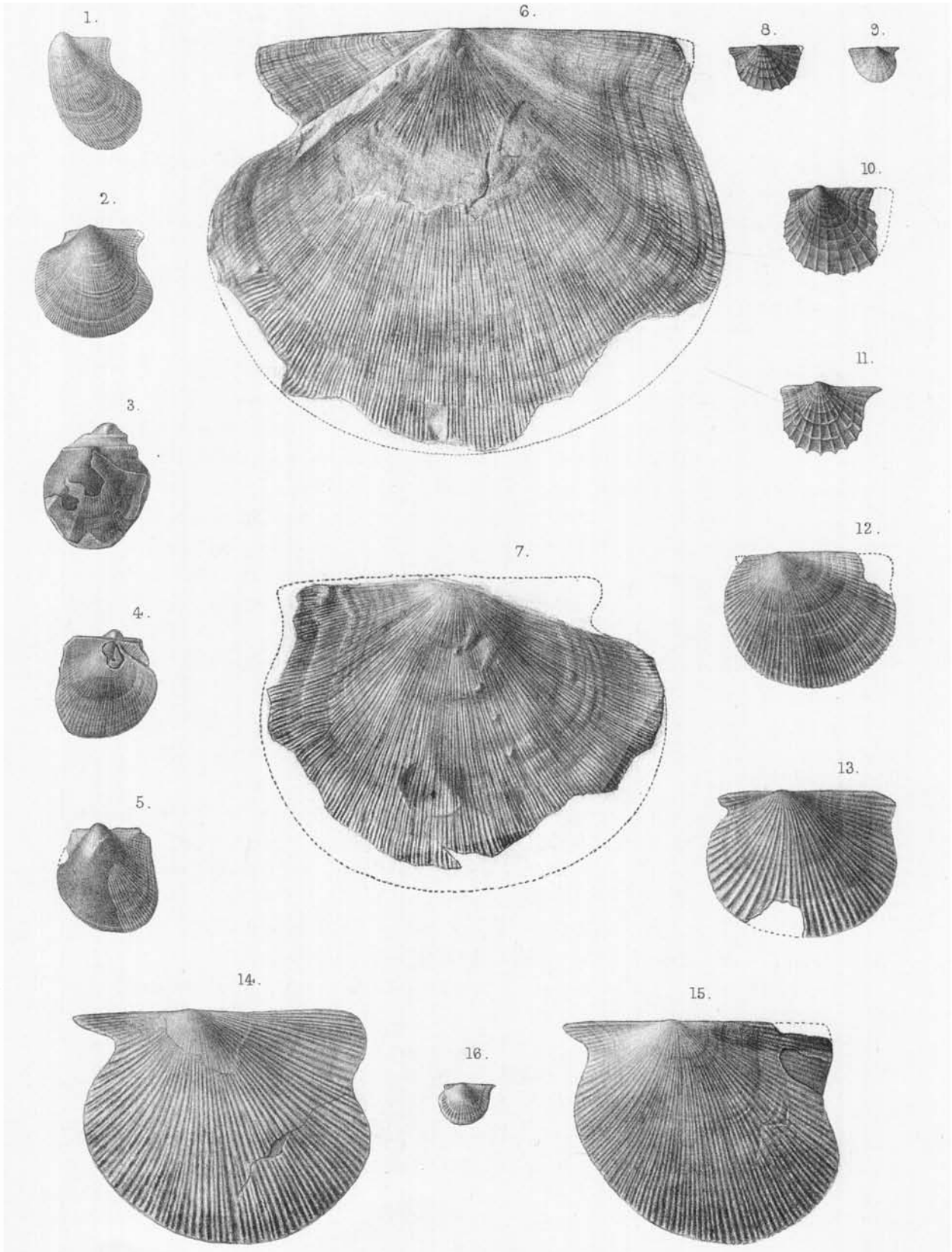
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PLATE X.

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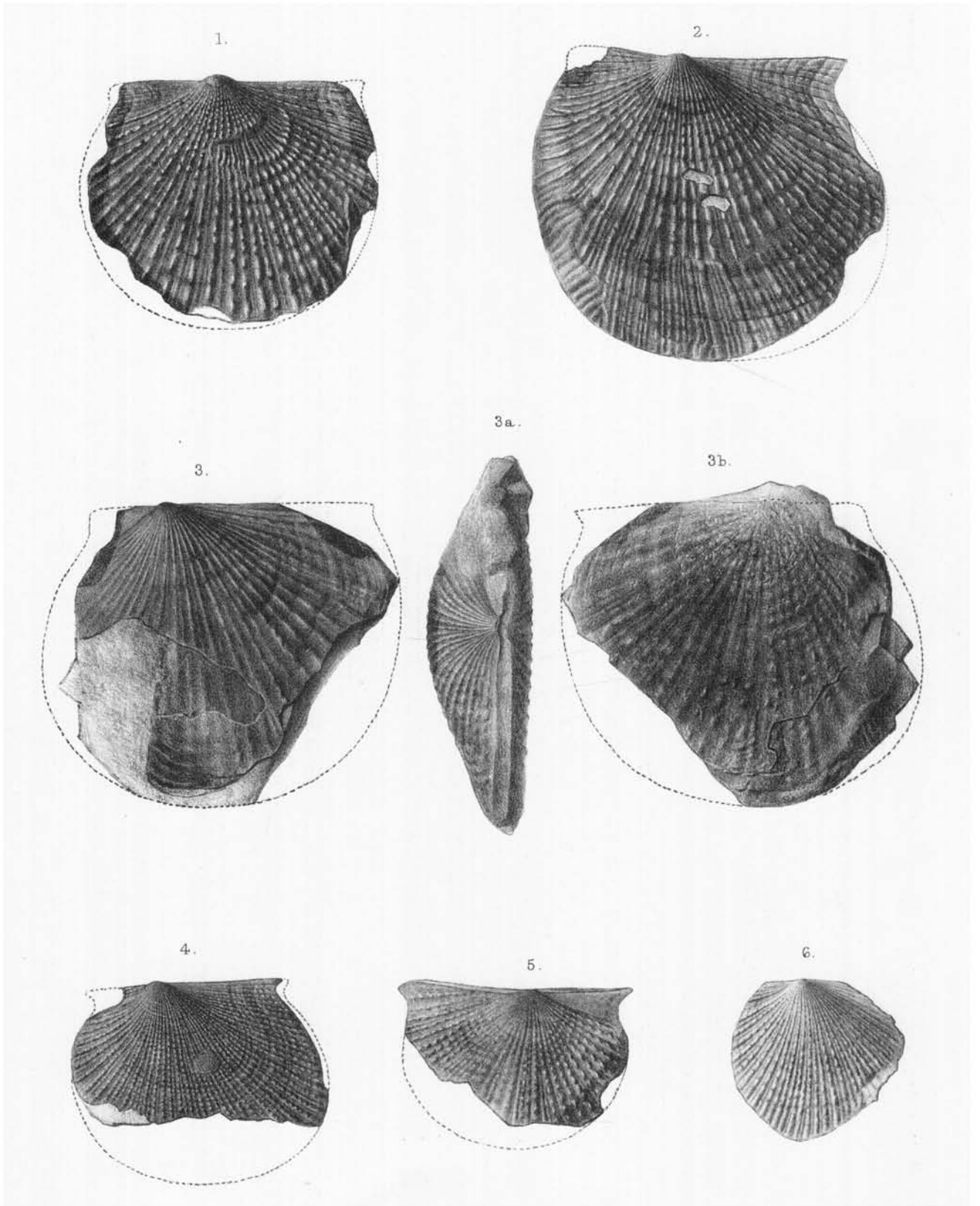
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PLATE XI.

Fig. 1.—*Streblopteria lævigata.* A left valve from Caherass, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 48.)

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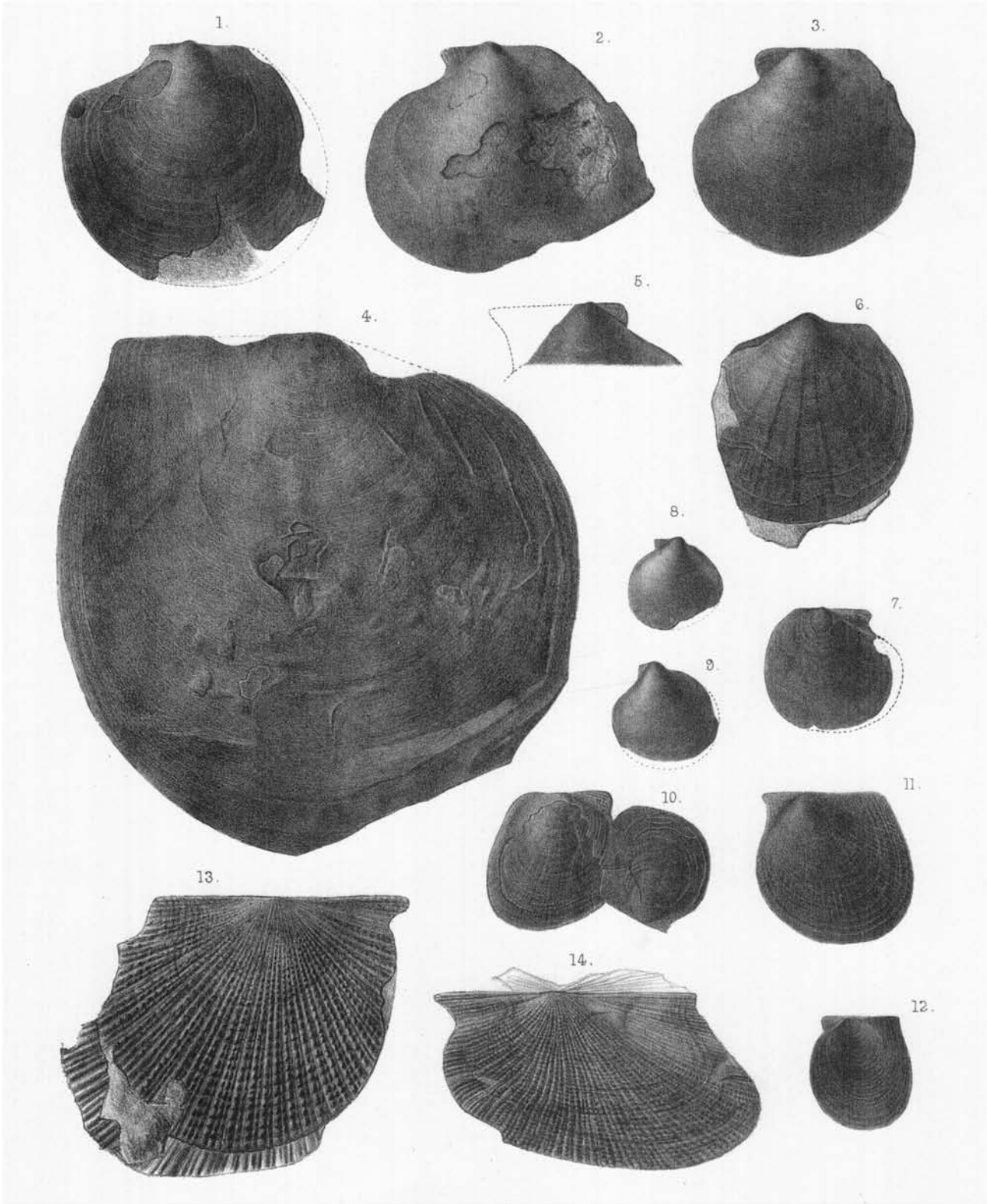
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PLATE XII.

Fig. 1.—*Aviculopecten tabulatus.* A left valve, presumably M'Coy's type of the species. From Derbyshire. In the Woodwardian Collection, Cambridge. (Page 68.)

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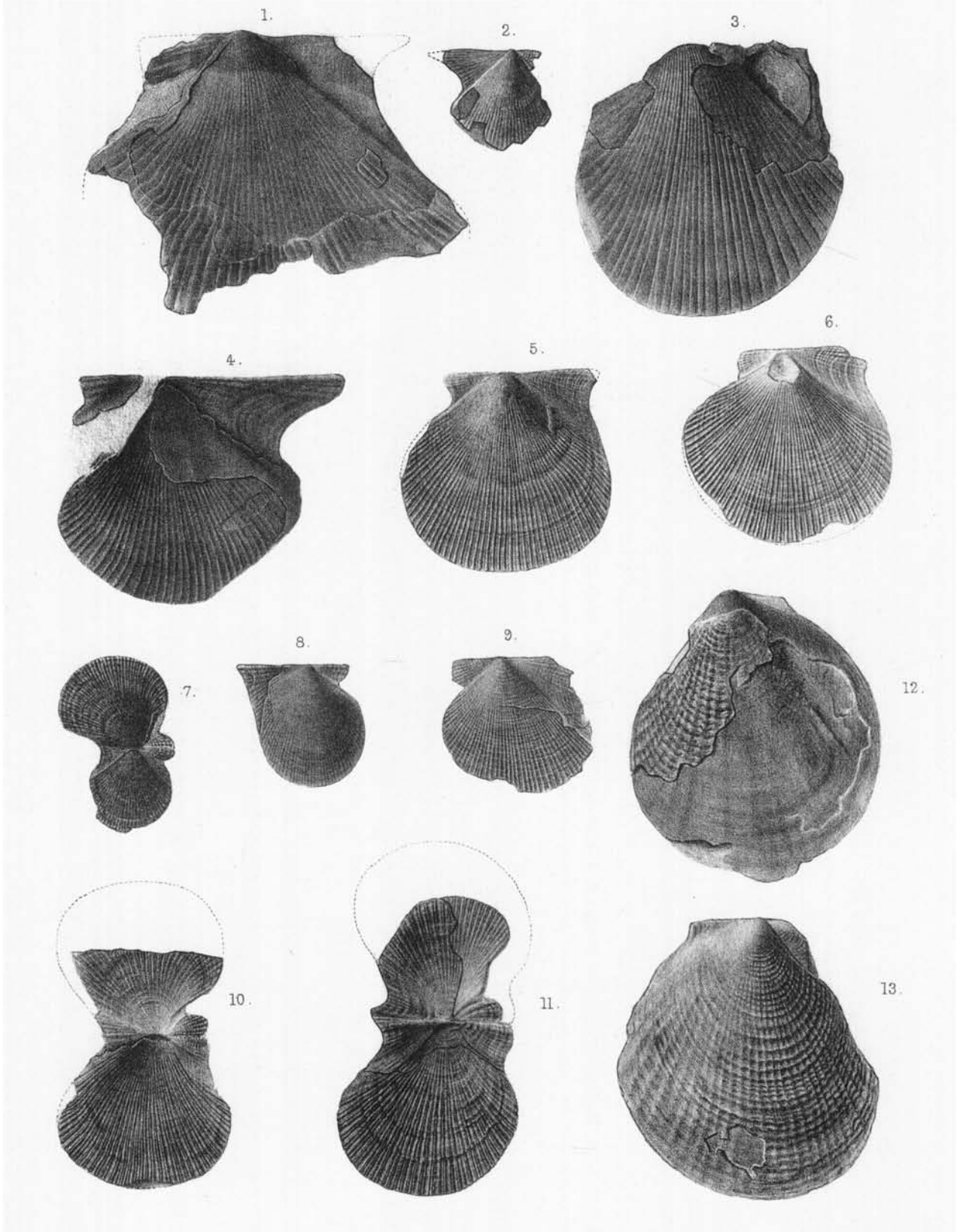
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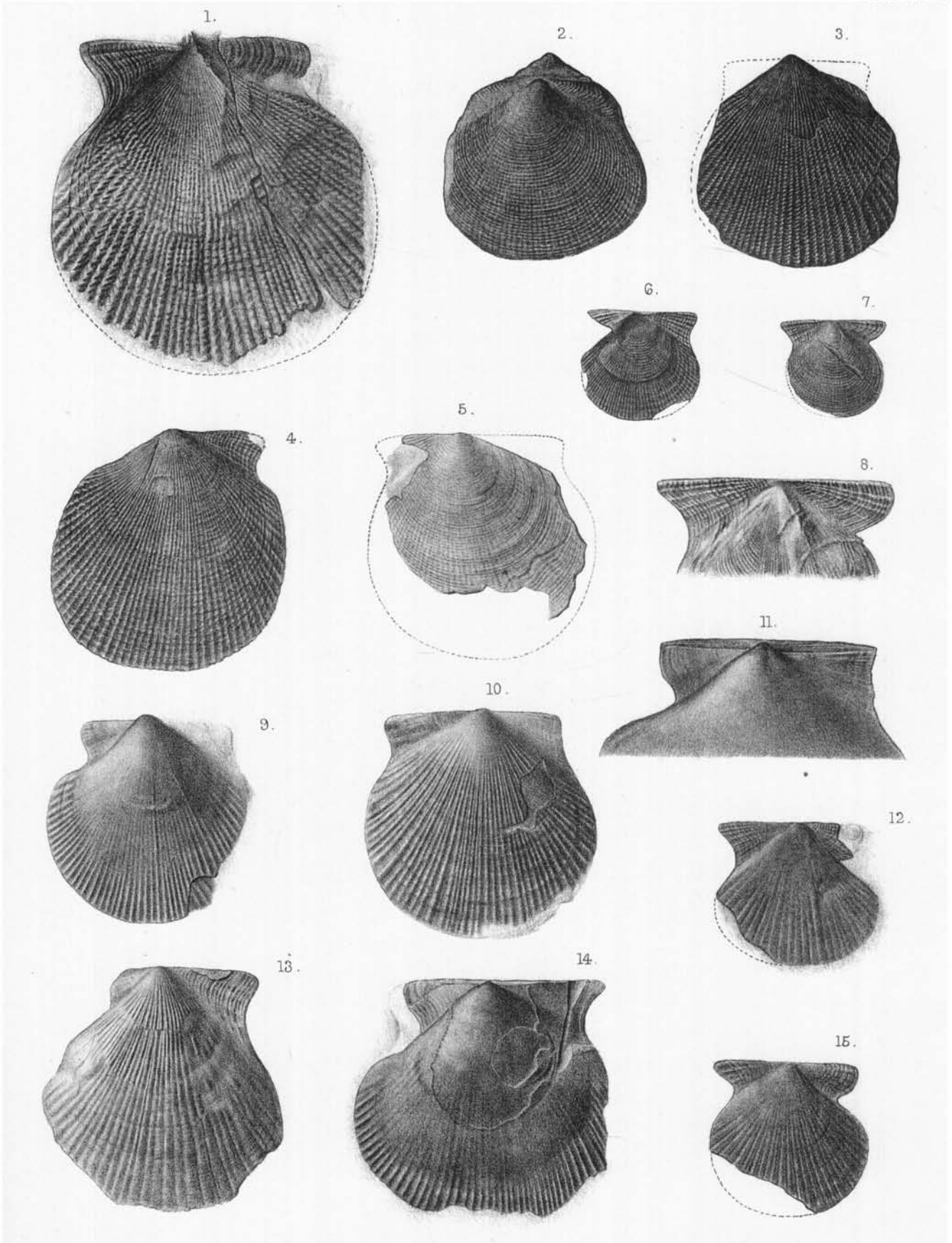
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PLATE XIV.

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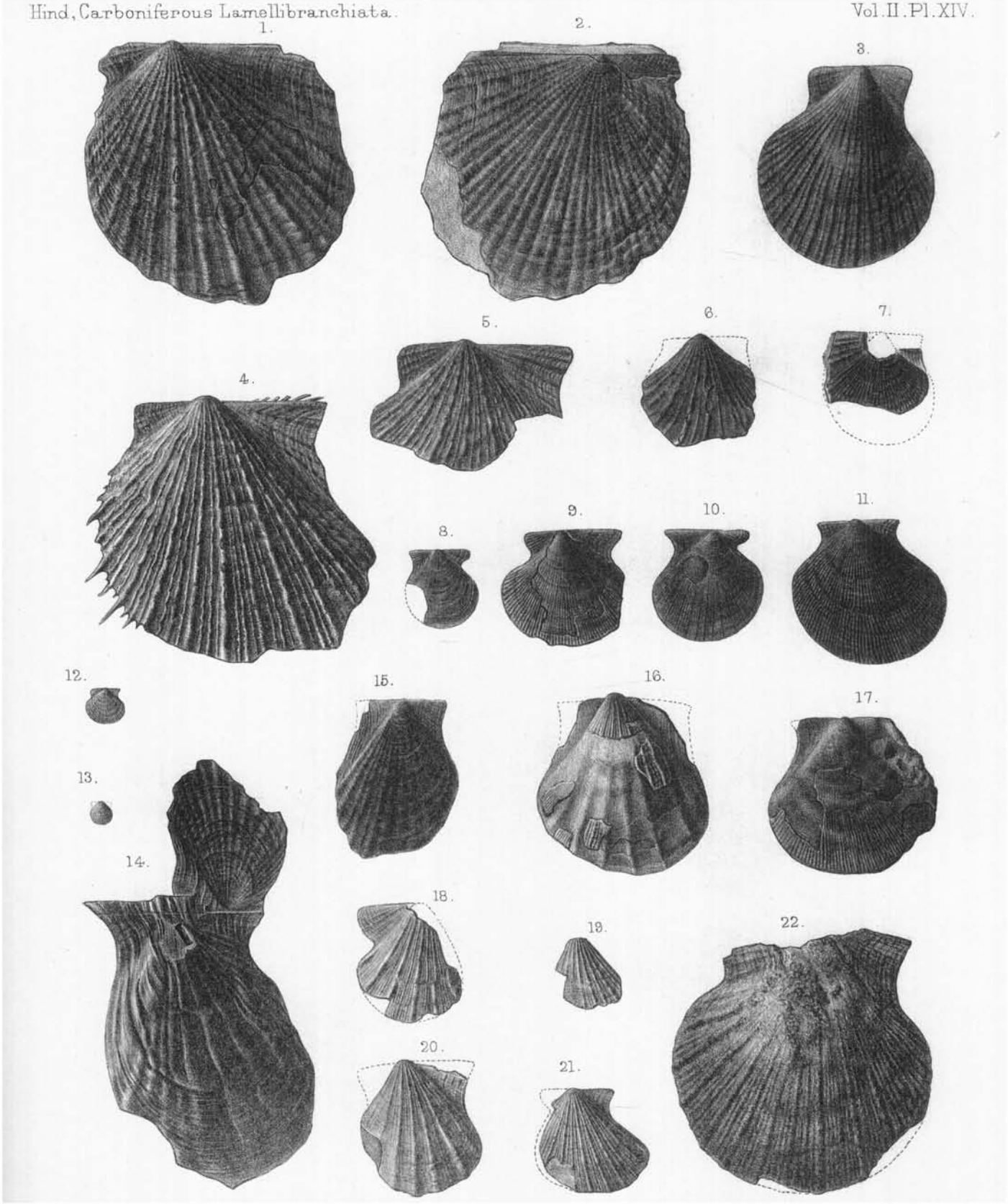

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PLATE XV.

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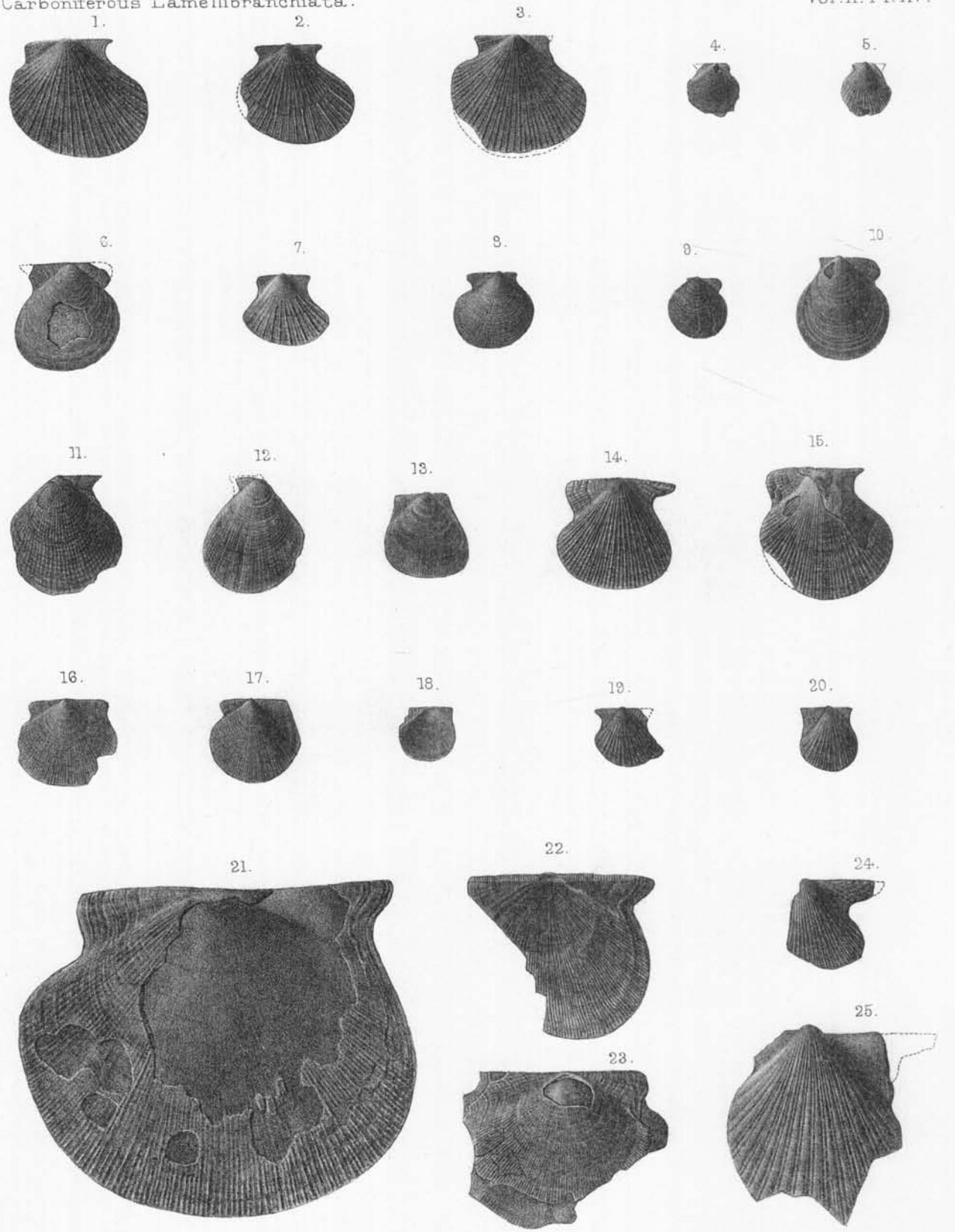

PLATE XVI.

Fig. 1.—*Aviculopecten nobilis.* A left valve. From the Carboniferous Limestone of Settle. Woodwardian Museum, Cambridge. (Page 90.)

Fig. 2.—*Aviculopecten nobilis.* A right valve. Same locality and Collection. (Page 90.)

Fig. 3.—*Aviculopecten nobilis.* A left valve. Same locality and Collection. (Page 90.)

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Figs. 21, 22.—*Pseudamusium fibrillosum.* Two right valves. From River Ribble, near Little Dinckly Hall. Pendleside Series. My Collection. (Page 106.)

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Figs. 30—32.—*Aviculopecten Sedgwicki.* Three views of a bivalved example showing the flattening of the right valve. From Little Island, co. Cork. Mr. J. Wright's Collection. (Page 101.)

Fig. 33.—*Aviculopecten Sedgwicki.* A left valve. Same locality and Collection. (Page 101.)

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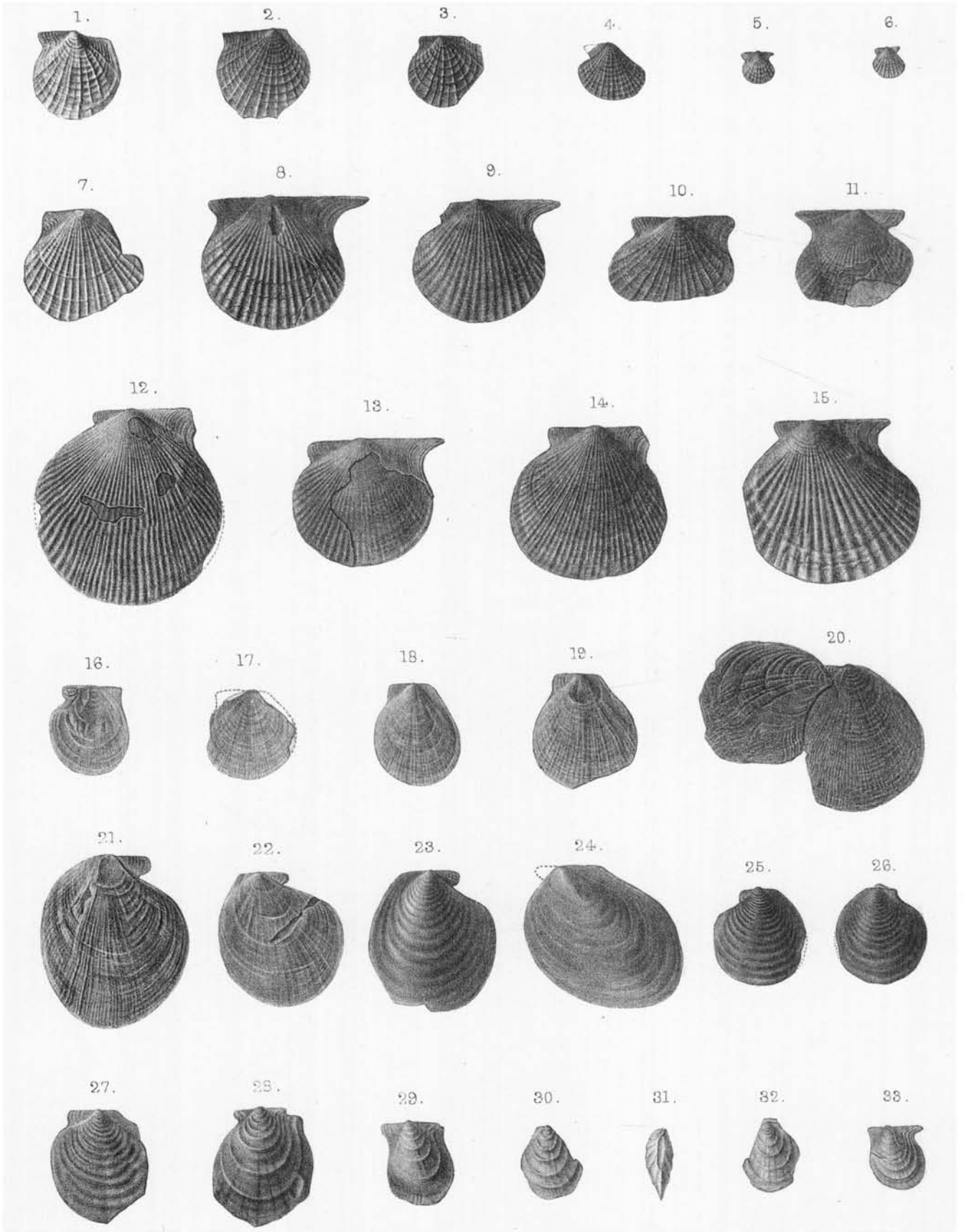

PLATE XVII.

Fig. 1.—*Aviculopecten subconoideus.* A right valve. From Knockhill, Fife. Marked as one of R. Etheridge's types. In the Collection of the Geological Survey of Scotland. (Page 77.)

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Fig. 6.—*Aviculopecten gentilis.* A left valve. ? The type of Sowerby's *Pecten gentilis.* From the Pennystone Ironstone, Coalbrookdale. Preserved in the Natural History Museum, South Kensington. (Page 86.)

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Figs. 11, 12.—*Pseudamusium sublobatum.* Two right valves, showing colour-bands. From Park Hill, Derbyshire. Figured by R. Etheridge, jun. In the Museum of the Geological Survey, Jermyn Street. (Page 110.)

Figs. 13, 14.—*Pseudamusium sublobatum.* Two left valves, showing colour-bands. Figured by R. Etheridge, jun. Same locality and Collection. (Page 110.)

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Fig. 27.—*Aviculopecten Carrolli.* A right valve; a cast. From Caherass, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 97.)

Fig. 28.—*Aviculopecten fallax.* The cast of a right valve. From Doohylebeg, co. Limerick. Same Collection. (Page 76.)

Fig. 29.—*Aviculopecten fallax.* A right valve. From Millicent, Kildare. In the Woodwardian Museum, Cambridge. (Page 76.)

Fig. 30.—*Aviculopecten fallax.* A left valve. From Gortnagrour, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 76.)

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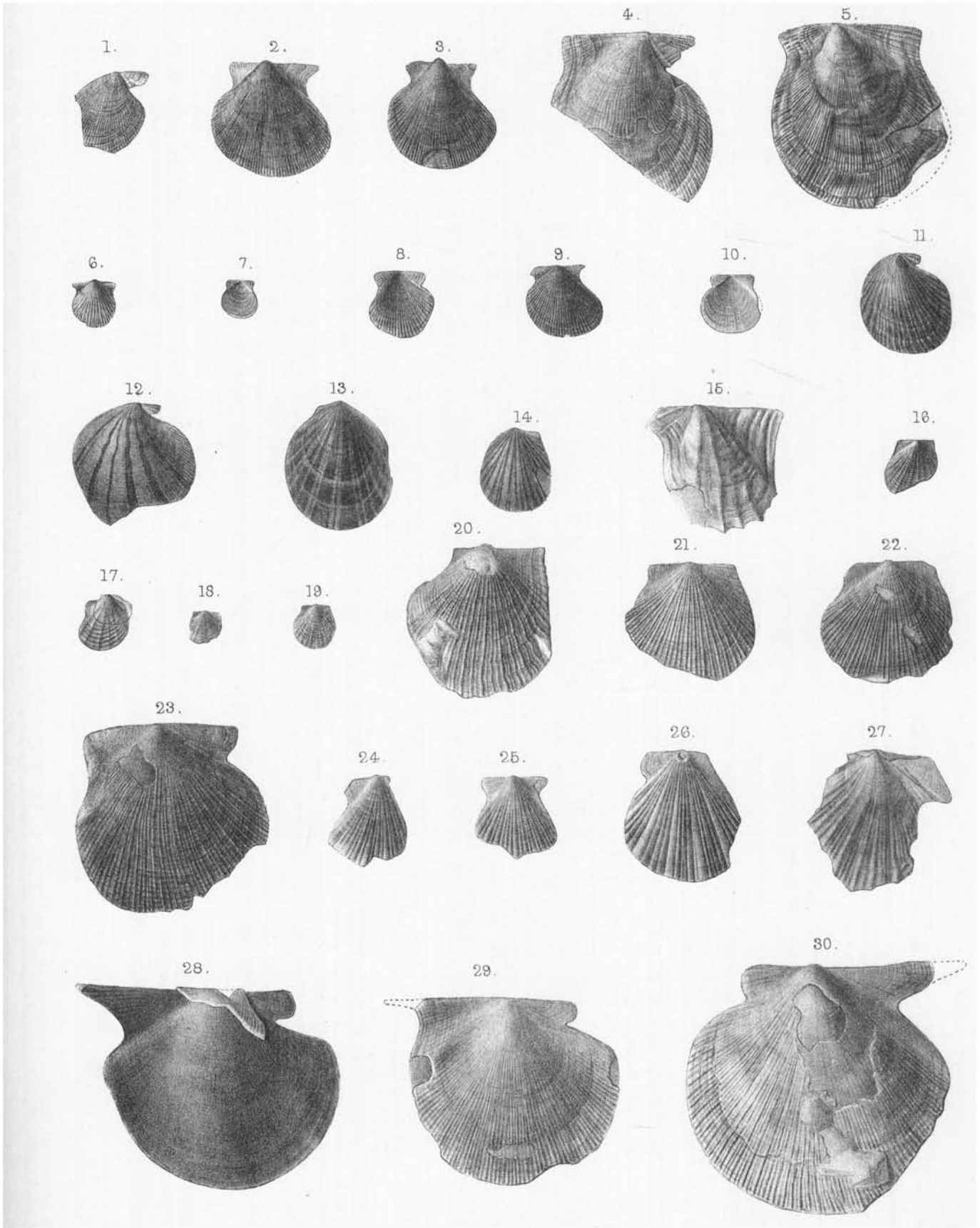

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PLATE XVIII.

Fig. 1.—*Aviculopecten Losseni.* A left valve. From Angram Brook, Pendle Hill. My Collection. (Page 80.)

Fig. 2.—*Aviculopecten Losseni.* A left valve. Same horizon. My Collection. (Page 80.)

Fig. 3.—*Aviculopecten Forbesii.* A right valve, somewhat sheared. From Little Island, co. Cork. Mr. J. Wright's Collection. (Page 83.)

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Fig. 7.—*Aviculopecten Forbesii.* M'Coy's type. From Millicent, Kildare. In the Griffith Collection, Science and Art Museum, Dublin. (Page 83.)

Figs. 8, 9.—*Eumicrotis ovalis.* The right and left valves, which have slipped past each other, of a specimen. From Settle. In the Woodwardian Museum, Cambridge. (Page 46.)

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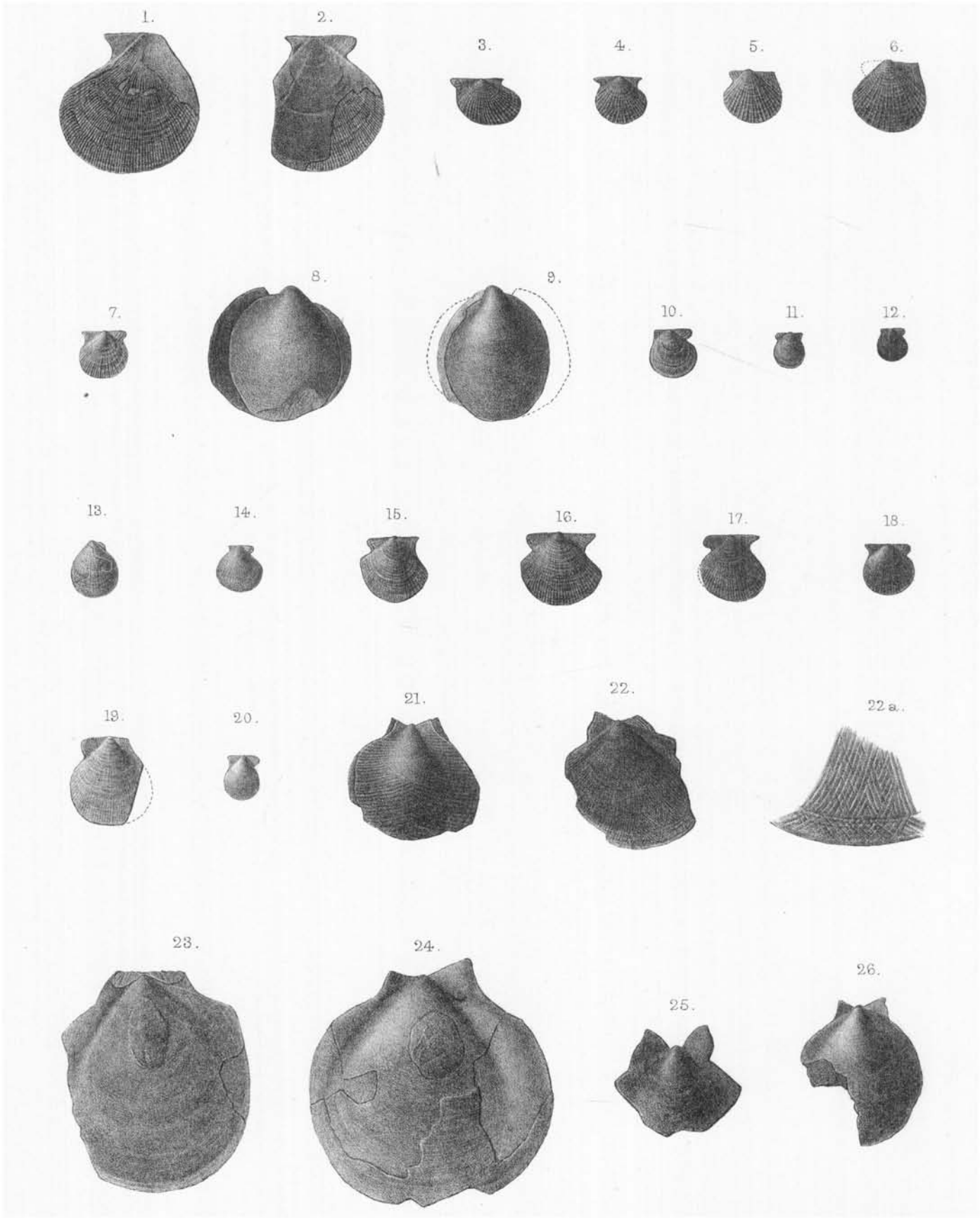
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Fig. 26.—*Palæolima simplex.* A right valve. From Little Island, co. Cork. Mr. J. Wright's Collection. (Page 39.)

Fig. 27.—*Palæolima simplex.* A left valve. Same locality and Collection. (Page 39.)

Hind, Carboniferous Lamellibranchiata.

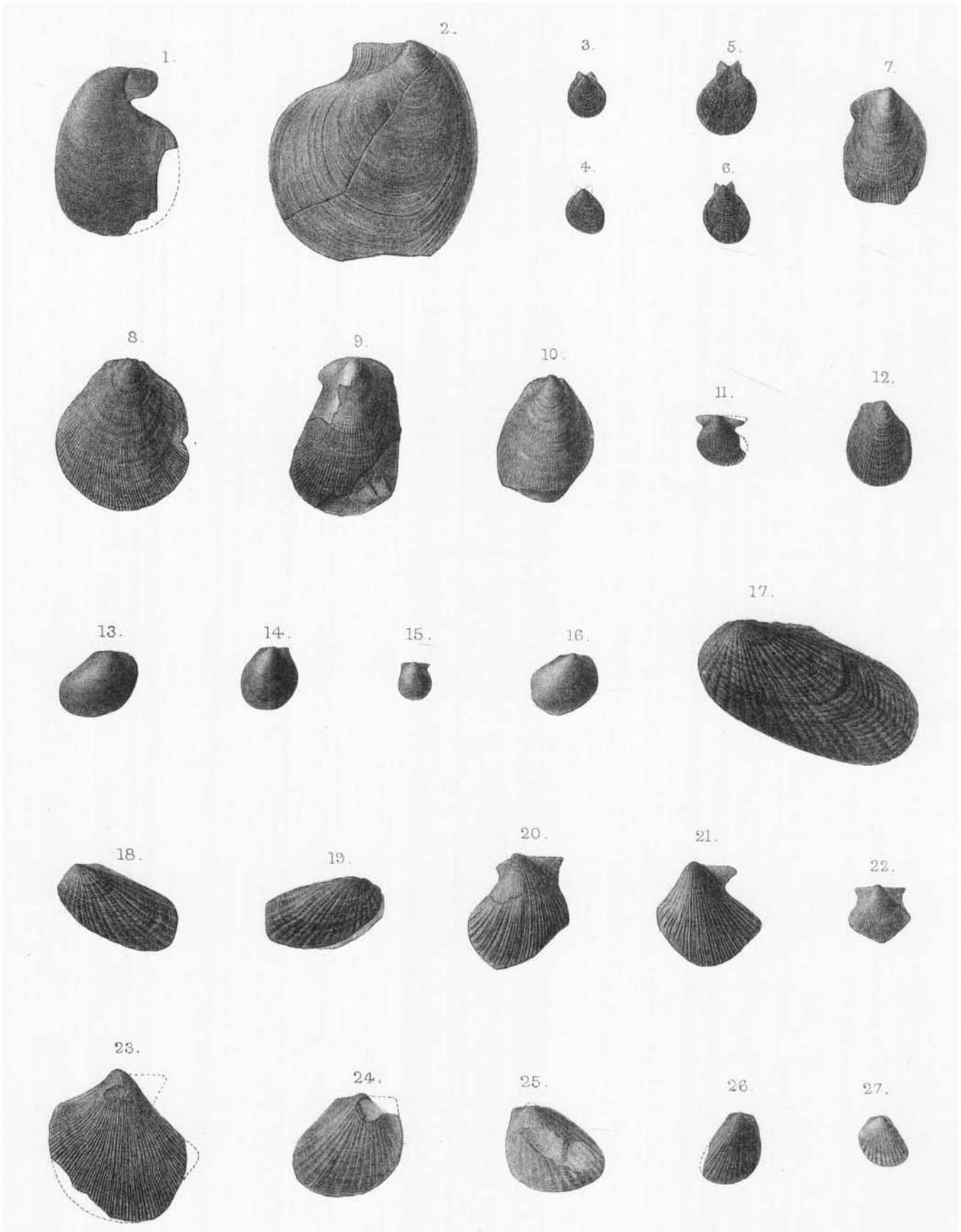

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PLATE XX.

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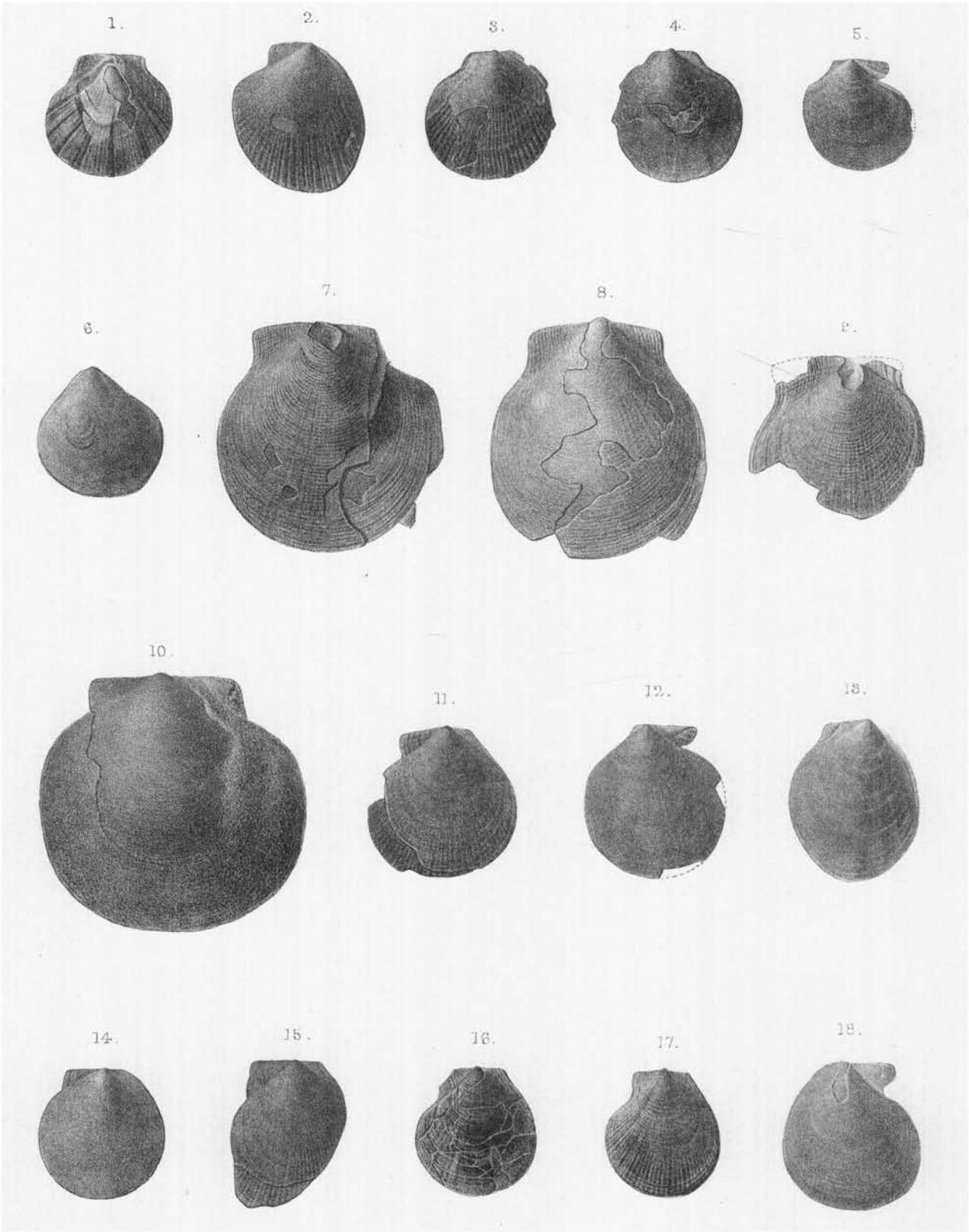

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PLATE XXI.

Fig. 1.—*Amusium planicostatum.* A right valve. From Little Island, co. Cork. In the Collection of Mr. J. Wright. (Page 124.)

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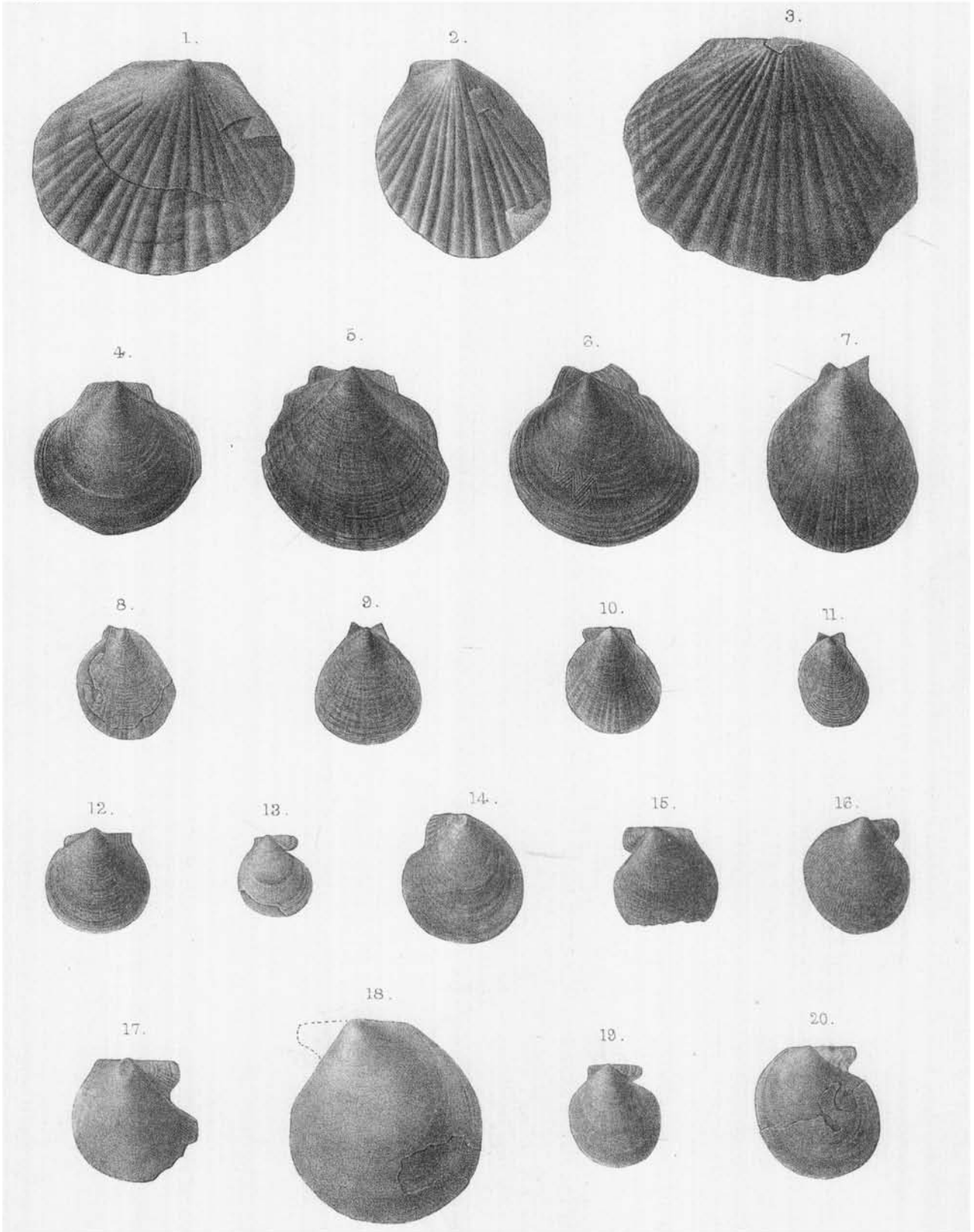
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