

XVIII.—The Lamellibranchs of the Silurian Rocks of Girvan. By Wheelton Hind, M.D., B.S., F.R.C.S., F.G.S. Communicated by Dr J. HORNE, F.R.S. (With Five Plates.)

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INTRODUCTION.

The task of examining and determining the fine series of lamellibranchs collected by Mrs R. GRAY in the Girvan district, from rocks of Llandeilo, Bala, and Llandovery age, has been no light one. In the first place, the literature of the subject is very scattered, and is chiefly to be found in the various reports of the Geological Surveys of the different States of North America and Canada. The work of British palæontologists is to be found in the publications of the Geological Survey and in various periodicals, but nothing systematic has been attempted before in this country, although SOWERBY described and figured, in an appendix to MURCHISON'S *Silurian System*, all the known species. Under these circumstances there has been the greatest difficulty in studying original types, many of which are Swedish or North American.

I have to acknowledge my obligations to Dr TEALL, the Director of H.M. Geological Survey, and the Palæontologists, Dr KITCHIN and Mr ALLEN, who have placed all their type specimens at my service; and to Mr H. WOODS, of the Sedgwick Museum, Cambridge, who has also lent me the species described by M'COY in his *British Palæozoic Rocks and Fossils*. But unfortunately these fossils were not of much assistance, for I found that few of them were represented in the suite of specimens from Girvan, and have therefore had to trust, in many cases, to the descriptions and figures of American authors for the identification of the species.

The number of specimens in Mrs GRAY'S collection which I could refer to no known species is comparatively large; hence I have been compelled to describe a number of new specific forms, often, unfortunately, on single specimens. Again, owing to the indifferent preservation, or to the fact that the hinge plates and internal structures were not exposed, difficulty has arisen in deciding as to which of the many genera erected by American authors it was advisable to refer certain species. Hence, in the future, fresh material may necessitate some revision in the names of genera now assigned.

The lamellibranch fauna as a whole has a very strong generic affinity with the fauna described by HALL from the Devonian rocks of North America.* A comparatively large number of genera extend from Ordovician to Devonian time, though, from our present knowledge, it would seem that the species of each genus were far

* *Geol. Survey New York, Pal.*, vol. v., pt. i., Lamellibranchiata, pt. i. and ii.

more numerous in the Devonian rocks. Several genera persist into Carboniferous times, but in them many genera are represented by fewer species than obtained in the Devonian period.

The most striking feature of the Ordovician lamellibranch fauna, when compared with those from the Devonian and Carboniferous rocks, is the absence of shells belonging to the *Pecten* family. Two species only seem to me to be in any way related to the Pectinidæ, and for them I have erected the new genus *Protopecten*. The Aviculidæ, on the other hand, are represented by the genera *Pterinea*, Goldfuss, and *Leptodesma*, Hall. The number of genera having modioliform or mytiloid characters is large, but these, though modioliform in shape, have, in most cases, well-developed cardinal and lateral teeth in the hinge plate. The Nuculidæ are represented by *Nucula*, *Nuculana*, *Ctenodonta*, and *Palæoneilo*, the last two apparently dying out in Carboniferous times. The nuculiform type of hinge is, therefore, very old and remarkably persistent. The type of hinge developed in *Cyrtodonta*, Billings, persisted with very slight change in detail to Cretaceous times, being represented in Mesozoic rocks by *Grammatodon*, Meek and Hayden. That curious genus *Conocardium* shows the same peculiar habits of growth in Ordovician times that it does in its last representative of the Carboniferous period. One cannot help being struck by the remarkable degree of stability shown by the class of lamellibranchs through all ages, and not only in the persistence of type, but also in the permanence of structural detail. I have not been able to assure myself that any of the Ordovician lamellibranch genera were sinupalliate, and surface ornamentation is, as a rule, much simpler than obtains in Devonian and Carboniferous species. Very few lamellibranchs have been described from rocks older than Ordovician. HICKS figured and described in 1873 twelve species referred to five genera, from the Tremadoc series of St Davids (*op. supra cit.*), the genera *Ctenodonta* and *Modiolopsis* and *Palæarca* (*Cyrtodonta*) being represented; and others have been described by WALCOTT from the *Olenellus* zone of North America. PEACH has recorded, in the Geological Survey Memoir on "The Geological Structure of the North-West Highlands of Scotland," the presence of one genus of lamellibranchs.

SALTER described a series of derived lamellibranchs found in the Triassic pebble beds of Budleigh Salterton, the exact age of which is doubtful. Certain genera, we thus learn, were in being in Cambrian times, and nothing whatever is known of their ancestors. In the examination of the fine series of lamellibranchs in Mrs GRAY'S collection, I have not been able to learn anything as to lines of descent of the various genera. The great lesson gained is the knowledge that many genera have been in existence for immense periods of time.

The general succession and subdivisions of the Girvan series, as worked out by Professor LAPWORTH, are given in the following table, from which it will be seen that there is a marked divergence in the lithological characters of the strata from those in the central Moffat region of the south of Scotland. In most of the subdivisions there

is a great development of coarse sediments, consisting of conglomerates, grits, greywackes, flagstones, mudstones, and shales, implying deposition near land and in comparatively shallow water. As might be expected from the foregoing conditions, the Girvan series yields organic remains in profusion, on certain horizons. Of special importance are the bands of graptolite shales, yielding many of the zonal forms of the Moffat region which enabled Professor LAPWORTH to correlate the Silurian divisions of the Girvan and Moffat areas.

TABLE OF SILURIAN STRATA, GIRVAN.

F. Wenlock.	1. Blair and Straiton Beds.—Grits, flags, and shales. <i>Beyrichia Klædeni</i>	Thickness. 500 feet.
E. Tarannon.	2. Drumyork Flags, Bargany Group.—Shales, etc. <i>Cyrtograptus Grayi</i> , <i>Monograptus priodon</i> 1. Penkhill Group.—Grits, purple shales. <i>Monograptus exiguus</i> , <i>Crossopodia</i>	1100 feet. 1000 feet.
D. Llandoverly.	3. Camregan Group.—Grits, limestones, shales. <i>Rastrites maximus</i> , <i>Pentamerus</i> 2. Saugh Hill Group.—Flagstones, shales. <i>Monograptus spinigerus</i> , <i>Rastrites peregrinus</i> 1. Mulloch Hill Group.—Conglomerate, sandstone, shales. <i>Diplograptus</i> <i>acuminatus</i> , <i>Meristella</i>	200 feet. 500 feet. 350 feet.
C. Caradoc.	<i>Ardmillan Series.</i> 5. Drummuck Group.—Mudstones, with Star-fish beds on top. <i>Dicellograptus anceps</i> , <i>Trinucleus</i> 4. Barren Flagstone Group.— <i>Diplograptus (Orthograptus) truncatus</i> , <i>Nematolites</i> 3. Whitehouse Group.— <i>Dicellograptus</i> , <i>Pleurograptus</i> , trilobites 2. Ardwell Group.—Flagstones, shales. <i>Climacograptus caudatus</i> , <i>Dicranograptus</i> 1. Balclatchie Group.—Mudstones, conglomerate. <i>Climacograptus bicornis</i> . Fossils abundant	400 feet. 800 feet. 300 feet. 1200 feet. 100 feet.
B. Llandeilo Area, N. of Stinchar.	<i>Barr Series.</i> 4. Benan Conglomerate 3. Graptolitic Mudstones.— <i>Didymograptus superstes</i> 2. Stinchar Limestone.—Trilobites, brachiopods, corals 1. Kirkland Group.—Sandstones, conglomerate. <i>Orthis confinis</i> . Local unconformability	500 feet. 30 feet. 60 feet. 240 feet.
A. Arenig.	3. Radiolarian Cherts, mudstones, volcanic tuffs, Arenig and Lower Llandeilo cherts 2. Bennane Head Black Shales.—Interleaved with volcanic agglomerate. <i>Tetraograptus bryonoides</i> 1. Volcanic rocks, lavas, tuffs, with fossiliferous intercalations Approximate thickness Base not seen.	70 feet. 3-4 feet. 1500 feet.

BIBLIOGRAPHY.

The earliest allusion to fossil lamellibranch shells from Silurian or Ordovician rocks appears to be WAHLENBERG, *Act. Soc. Upsal.*, 1821; DALMAN, *Act. Holm.*, 1827, p. 372, and HISINGER, 1826, *Petrefact. Suec.*, p. 63, both referred to by SOWERBY as figuring the shell now known as *Goniophora cymbæformis* under the name *Cardites carpomorphus*.

1839. SOWERBY, in Pt. II. of MURCHISON'S *Silurian System*, describes *Cypricardia? amygdalina*, *C.? impressa*, *C.? undata*, *C.? retusa*, *C. cymbæformis*, *Pullastra complanata*, *Cucullæa antiqua*, *Nucula? ovalis*, *Avicula retroflexa?* and *A. lineata* from the Upper Ludlow rocks; *Mya rotundata*, *Cardium striatum*, *Avicula reticulata?* from the Aymestry limestone; *Cypricardia solenoides*, *Psammodia rigida*, *Cardiola fibrosa*, *C. interrupta*, *Modiola semisulcata* from the Lower Ludlow rocks. From the Caradoc limestone and Llandeilo flags, *Arca Eastnori*, *Nucula lævis*, *Avicula orbicularis*, *A. obliqua*.
- 1836-1840. GOLDFUSS, *Petrefacta Germanica*. Various species are included in this work.
1841. CONRAD, *Annual Geological Report of the State of New York*.
1843. PORTLOCK, *Geol. Report on Londonderry and Parts of Tyrone and Fermanagh*, in which are described *Mytilus cinctus*, *M. semirugatus*, *Modiola Brycei*, *M. expansa*, *M. Nerei*, *M. securiformis*, *Avicula orbicularis*, *Inoceramus contortus*, *I. priscus*, *I. transversus*, *I. trigonus*, *Posidonomya venusta*, *Cypricardia simplex*, *Arca cylindrica*, *A. dissimilis*, *A. Eastnori*, *A. obliqua*, *A. regularis*, *A. subtruncata*, *A. transversa*, *Pectunculus ambiguus*, *P. Apjohni*, *P. semitruncatus*, *Nucula acuta*, *N. radiata*.
1845. MURCHISON, DE VERNEUIL, and DE KEYSERLING, *Géol. de la Russie de l'Europe*, vol. ii., pt. iii., "Paléontologie," in which is figured and described, from the Silurian beds of Russia, *Cypricardia Deshayesiana*.
1846. M'COY, *Synopsis Silurian Fossils Ireland*. In this the following new species are described:—*Lucina bulla*, *Pullastra speciosa*, *Nucula subcutata*, *N. subcylindrica*, *Arca quadrata*, *A. scitula*, *Pterinea fimbriata*, *P. orbicularis*, *P.? panopæiformis*, *P.? posidoniaformis*, *P. squamosa*, *P. sublævis*, *Avicula bullata*, *Pleurorhynchus pristis*.
1847. HALL, *Palæontology of New York*, vol. i. A large number of genera and species were described from the Silurian rocks of this State by HALL.
1848. PHILLIPS, JNO., *Mem. Geol. Surv. Gt. Britain*, vol. ii., pt. i. Palæontological Appendix by JNO. PHILLIPS and J. W. SALTER. In the work the following species were named by each author:—*Pleurorhynchus æquicostatus*, Phillips; *Orthonota angulata*, Hising., sp.; *O. triangulata*, Salter; *O. extrasulcata*, Salter; *O. inornata*, Phillips; *Mytilus gradatus*, Salter; *M. perovalis*, Salter; *M. quadratus*, Salter; *M. platyphyllus*, Salter; *M. exasperatus*, Phillips; *M.? mytilimeris*, Conrad, sp.; *M. chemungensis*, Conrad, sp.; *M.? unguiculatus*, Salter; *Actinodonta cuneata*, Phillips; *Arca? primitiva*, Phillips; *Nucula coarctata*, Phillips; *N. deltoidea*, Phillips; *N. lingualis*, Phillips; *N. rhomboidea*, Phillips; *Avicula ampliata*, Phillips; *A. triton*, Salter; *Pterinea? planulata*, Conrad.
1851. MURCHISON, "Silurian Rocks of Scotland," *Q.J.G.S.*, vol. vii., with description of *Pleurorhynchus dipterus*, Salter, var. *rhomboideus*; but no reference is given to any previous publication, so probably the specific description is by SALTER; but if so the necessity for a varietal name is not apparent.
1853. RIBEIRO and SHARPE, "On the Carboniferous and Silurian Formations of the Neighbourhood of Busaco in Portugal," *Q.J.G.S.*, vol. ix. p. 135. The following lamellibranchs are listed from Silurian localities:—*Redonia Deshayesiana*, Rouault; *R. Duvalina*, Rouault; *Nucula costæ*, *N. Ciæ*, *N. rebiero*, *N. Ezquerra*, *N. Eschwegii*, *N. mastri*, *N. Beirensis*, *N. Bussacensis*, *Leda Escosuræ*, *Dolabra Lusitanica*, *Cypricardia? Beirensis*, *Modiolopsis elegantulus*. The descriptions are by Sharpe.

1854. MURCHISON, *Siluria*, 1st ed., on pp. 191, 225, and 226, woodcuts of lamellibranchs from Lower Silurian and two from Upper Silurian beds are given, with names. In the 3rd ed., 1859, and 4th ed., 1867, the numbers of the pages and woodcuts are altered, and a new cut is introduced at p. 50, and p. 48 of the 4th ed. of *Fossils from the West Side of the Stiper Stones*. All forms had been previously described and figured. At the end of the 3rd and 4th eds. are plates copied from those in the *Silurian System*, but rearranged and reduced in size to suit the style of the book.
1855. M'COY, *British Palæozoic Fossils*, figured the following:—*Pterinea pleuroptera*, Conrad, sp.; *P. subfalcata*, Conrad, sp.; *P. tenera*, M'Coy; *P. asperula*, M'Coy; *P. hians*, M'Coy; *P. retroflexa*, Wahl, sp.; do. var. *B. naviformis*, Conrad; *P. megaloba*, M'Coy; *Avicula Danbyi*, M'Coy; *Modiolopsis inflata*, M'Coy; *M. modiolaris*, Conrad, sp.; *M. Nilsoni*, Hisinger, sp.; *M. post-lineata*, M'Coy; *Orthonotus nasutus*, Conrad; *Sanguinolites decipiens*, M'Coy; *S. anguliferus*, M'Coy; *Arca subæqualis*, A. Edmondiiformis, *Nucula levata*, Hall; *Nuculites poststriatus*, Emmons; *Clidophorus ovalis*, M'Coy; *C. planulatus*, Courad; *Anodontopsis quadratus*, M'Coy; *A. bulla*, M'Coy; *A. angustifrons*, M'Coy; *Ambonychia acuticostata*, M'Coy; *Lyrodesma plana*, Conrad; *Tellinomya lingulicomes*, M'Coy; *Leptodomus truncatus*, M'Coy; *Grammysia rotundata*, Sow., sp.; *G. cingulata*, var. *triangulata*, Salter; *G. extrasulcata*, Salter; *Dolabra obtusa*, M'Coy; *Tellinites affinis*, M'Coy; *Anodontopsis securiformis*, *Dolabra elliptica*, *Leptodomus globulosus*.
1858. BILLINGS, amongst others, proposed the genera *Maltheria* and *Cyrtodonta* for groups of Lower Silurian shells with a well-marked hinge plate (*Canadian Naturalist and Geologist*, vol. iii.).
1860. EICHWALD, *Lethæa Rossica*, describes and figures a number of species; but as I am not able to state correctly which are Silurian species, I do not attempt to give a list.
1861. BARRANDE, *Acephales*, vol. vi. This volume contains lists and enumerates many new genera erected for Silurian lamellibranchs, and has several plates of figures.
1861. SALTER (*Mem. Geol. Surv. Scotland*, No. 32, "The Geology of the Neighbourhood of Edinburgh") describes and figures *Lunulacardium elegans*, *Orthonota amygdalina*, var. *gentilis*, *O. bulla*, *Anodontopsis? lucina*, *Ctenodonta obesa*, *C. thracioides*, from the Silurian rocks of the Pentland Hills.
1866. SALTER, *Mem. Geol. Surv. Gt. Britain*, "The Geology of North Wales," in which are described *Palæarca Billingsiana*, *P. obscura*, *P. modiolaris*, *P. (Maltheria) quadrata*, *P. bulla*, *P. socialis*, *P. amygdalus*, *Ctenodonta varicosa*, *Redonia anglica*, *Ribiera? complanata*, *Modiolopsis pyrus*.
1873. HICKS, *Q.J.G.S.*, vol. xxix. p. 39, "On the Tremadoc Rocks in the Neighbourhood of St David's, South Wales, and their Fossil Contents," in which he figures twelve species belonging to five genera, of which *Glyptarca* and *Davidia* are new.
1875. MEEK, *Geological Survey of Ohio*, vol. ii., pt. ii., "Palæontology," in which are described *Tellinomya levata*, *T. pectunculoides*, *Lyrodesma cincinnatiensis*, *Pterinea demissa*, *Ambonychia radiata*, *Sedywickia? divaricata*, *Orthodesma contracta*, *O. curvata*, *O. recta*, *Cuneameya miamiensis*, *C. scapta*, *Grammysia neglecta*, *Modiolopsis truncata*, *M. cincinnaticensis*, *M. pholadiformis*, *M. modiolaris*, *M. concentrica*, from Lower Silurian, and *Cypricardites ferrugineum* and *Amphicoelia costata* from Upper Silurian rocks.
1876. RÖEMER, FERD., *Lethæa Palæozoica*, in which figures of the following fossils are given from Lower Silurian rocks:—*Ctenodonta nasuta*, Salter; *Megalomus? Deshayesianus*, Murchison, de Vern., and Keys.; *Ambonychia radiata*, Hall; *A. incrassata*, Eichwald, sp.; *Modiolopsis modiolaris*.
1881. BARRANDE, *Système Silurien de la Bohême*, vol. vi. This work contains a large number of new genera, which are described and figured. He recognises fifty-eight genera of lamellibranchs, of which twenty-nine are new.
1886. WALCOTT, *Bull. U.S. Geol. Surv.*, No. 30, p. 123, describes *Fordilla troyensis*, from the Upper Taconic of North America.
1889. MILLER, *North American Geology and Palæontology*. This work gives a list of all North American genera and species of fossils, amongst which are a few new genera for Silurian lamellibranchs, and references to the earliest publication of each.
1890. WALCOTT, *10th Ann. Rept. U.S. Geol. Surv.*, "The Fauna of the Cambrian or Olenellus Zone." Two new genera, *Fordilla* and *Modioloides*, are described.

1893. ULRICH, *Geological Survey of Ohio*, vol. vii. In the volume the following new genera are described, with many species:—*Byssonychia*, *Anomalodonta*, Miller; *Eridonychia*, *Allonychia*, *Opisthoptera*, Meek; *Psilonychia*, *Anoptera*, *Clionychia*, *Modiolodon*, *Actinomya*, *Colpomya*, *Cymatonota*, *Psiloconcha*, *Ortonella*, *Ischyrodonta*, *Whitella*, *Pyrenomæus*, Hall; *Technophorus*, Miller; *Cycloconcha*, Miller; *Rhytimya*, *Physetomya*.
- The dates of those genera must be carefully examined, for the volume quoted above often refers to the *Final Report*, vol. iii., *Geological and Natural History Survey of Minnesota*, which is referred to as 1893; but the completed volume itself only bears the date 1897. In the Ohio volume ULRICH speaks of the Minnesota paper as being in the press.
1897. To the volume on Minnesota just mentioned ULRICH contributed "The Lower Silurian Lamellibranchiata of Minnesota." The generic description of *Modiolodon* and *Byssonychia* and others, for example, referred to in vol. vii. of the Ohio report, dated 1893, only appears in the Minnesota volume dated 1897, but on the title-page the date 1892-96 is printed. The following generic descriptions also occur in the latter volume:—*Clionychia*, *Eurymya*, *Actinomya*, *Aristerella*, *Endodesma*, *Plethocardia*, *Saffordia*.
1900. *Handbook on the Natural History of Glasgow and the West of Scotland*, Brit. Assoc. A description of the Silurian rocks in the South of Scotland is given by Messrs PEACH, HORNE, and MACCONOCHIE, with a description and table of strata, and a list of fossils.
1902. COWPER REED, *Geol. Mag.*, dec. 4, vol. ix., describes and figures SALTER'S undescribed species, among which are the following lamellibranchs:—*Pterinea exasperata*, *P. condor*, *Goniophora grandis*, *Modiolopsis minus*, *Orthonota Hughesi*.
1905. COWPER REED, *Geol. Mag.*, dec. 5, vol. ii. p. 492, gives a list of seventeen species of lamellibranchs from the Redhill and Slade beds of Haverford West, nine of which are new.

Protopecten, genus nov.

Generic Characters.—Shell erect, ovate, moderately convex. Antero-superior and postero-superior angles compressed and slightly subalate. Hinge plate straight, flattened, edentulous. Umbones subcentral, small, very slightly elevated. Pallial line entire. Surface ornamented with retiform or crenulate markings.

Observations.—There are two shells in the Gray Collection which seem to me to show a tendency to a Pecten-like form, especially in the ornament; one, *Protopecten vimineus*, has a very delicate basket-like appearance; the other, *P. crenulatus*, shows distinct crenulate lines of growth in its older stages. The ear-like condition of the anterior and posterior superior angles and the generic shape and ornament suggest an approach to the Pectinidæ, a family very poorly represented in the older rocks. Unfortunately, the material on which I have erected this genus is small and the specimens not quite complete, but I know of no other genus in which to place them.

Protopecten vimineus, sp. nov. (Pl. I., figs. 2, 3.)

Specific Characters.—Shell small, almost equilateral, erect, narrow transversally, ovate, regularly moderately gibbose. The margin is formed by a continuous curve, which is broad in front and behind and more acute below. The hinge line is straight, nearly equal to the transversal diameter of the valve. The umbo is small, tumid, very slightly elevated, central.

The antero- and postero-superior angles are compressed and flattened, well defined from the umbonal gibbosity.

Interior.—The hinge plate is flattened and edentulous. No trace of anterior adductor muscles. Pallial line entire.

Exterior.—The surface is ornamented by a fine, delicate retiform marking, the meshes being diamond-shaped and transverse, and arranged concentrically. In the centre of the valve are one or two very obscure but broad radiating ribs. The retiform marking is continued to the angles of the valve.

Dimensions.—Fig. 2, Pl. I., measures: antero-posteriorly, 11 mm.; dorso-ventrally, 18 mm.; elevation of valve, 3 mm.

Locality.—Lower Llandovery of Mulloch Hill.

Observations.—The ornament of this shell is so striking that it is not likely to be confounded with any other species. The specimen consists of a cast of the exterior and a mould of the interior. Unfortunately, the former is incomplete at one angle and near the umbo, and I am not able to say which valve it is. It is to be hoped that more specimens of this interesting shell may be found.

Protopecten crenulatus, sp. nov. (Pl. I., fig. 1.)

Specific Characters.—Shell of moderate size, equilateral, subcircular, moderately gibbose. The margin forms a single curve of varying intensity, and was probably crenate in the adult. The antero- and postero-superior angles well marked, compressed, and subalate. The hinge line of moderate length, straight. The umbones subcentral, small, pointed, slightly elevated.

Interior.—Not exposed.

Exterior.—The surface is ornamented with concentric lines of growth, somewhat rugose and irregular, and towards the margin markedly crenate, fine and close.

Dimensions.—Fig. 1, Pl. I., measures: antero-posteriorly, 25 mm.; dorso-ventrally, 28 mm.

Locality.—Upper Llandovery of Penkhill.

Observations.—The specimen on which I have erected this species is somewhat obscure and incomplete. The crenulate markings of the anterior and lower margins, and the approach of the two upper angles to ears, have induced me to regard the shell as related to the *Pectinidæ*.

Genus *Byssonychia*, Ulrich, 1894.

Byssonychia, Ulrich, 1894, *Pal. Minnesota, Fin. Rep.*, vol. iii. p. 498.

„ „ 1893, *Rep. Geol. Surv. Ohio*, vol. vii. p. 629.

Generic Characters.—Shell oblique, subovate and quadrate, very inequilateral, gibbose, subalate, and compressed posteriorly. Umbones anterior, terminal, twisted

forwards, acute. Anterior surface depressed and hollowed, pierced below the beaks by a circular aperture for the byssus. Hinge line straight, of moderate length.

Interior.—Three short, diverging lateral teeth at the posterior end of the hinge plate. Anterior adductor scar small, just within the umbones. Posterior adductor scar large and shallow, placed low down and remote from the margin.

Exterior.—The surface is ornamented with radiating ribs which increase in size and strength as they pass across the valve. They are crossed occasionally by deep concentric lines of growth.

Observations.—The presence of a large byssal aperture below the umbones separates this genus from *Ambonychia*, with which it has, however, very close affinities. ULRICH has described several species from the Trenton and Cincinnati groups of Minnesota and Ohio. He states that he has found that, "within reasonable limits, the number of the radiating costæ is constant for each species, and the same in specimens of all ages." On this point I am able to say nothing, as my material, though consisting of numerous examples, is very imperfect. A large number of specimens show the byssal aperture, and one the posterior part of the hinge plate.

Byssopteria, Hall (*Pal. N. York*, vol. v., pt. i., p. 252), is probably either identical or closely allied to *Byssonychia*, but as the anterior part of the shell was not described it is impossible to make any definite statement at present.

It is questionable whether the genus *Byssonychia* is really necessary. HALL describes his genus *Ambonychia* as sinuate on the anterior side for the passage of the byssus.

Byssonychia sublævis. (Pl. I., figs. 25, 25a.)

Specific Characters.—Shell small, triangular, oblique, moderately convex. The anterior end obsolete, adpressed to form an anterior surface above with an acute border below. The inferior border is narrow, rounded. The posterior border elongate, truncate, gently curved. The hinge line short, straight. The umbones small, pointed, incurved, terminal.

Interior.—Unobserved.

Exterior.—The surface is ornamented with numerous simple, radiating, fine striæ obsolete in the region of the umbones.

Dimensions.—Fig. 25, Pl. I., measures: dorso-ventrally, 18 mm.; antero-posteriorly, 10 mm.

Localities.—Mulloch Hall, Lower Llandovery; Woodland Point, Middle Llandovery.

Observations.—Two examples of this species are in the collection. One is a cast of the interior, which unfortunately does not give any trustworthy details; the other shows the external ornament. Both specimens are crushed. The species is very much smaller, and the radiating linear ornament much less pronounced than the strong ribs which characterise *B. radiata*, for which it could not be mistaken.

Byssonychia radiata, Hall, 1847. (Pl. I., figs. 19–22.)*Ambonychia radiata*, Hall, 1847, *Pal. N. York*, pt. i. p. 292, pl. lxxx. figs. 4a–b.

Specific Characters.—Shell obliquely abovate, obliquely gibbose, anterior end obsolete. The anterior surface is adpressed and much hollowed near the anterior border, which is rounded. The anterior border appears to be straight and almost vertical. Inferior border broadly rounded. Posterior margin truncate, oblique, making an obtuse angle with the hinge line, which is straight. Umbones raised, produced forwards, incurved, prosogyrous, contiguous. Dorsal slope compressed, flattened, subalate.

Interior.—Normal; between the byssal orifice and the umbonal cavity is a thick boss of shell, indicated in casts by a deep hollow.

Exterior.—The surface is ornamented by many close, rounded, radiating ribs, finer and closer on the dorsal slope. These radiating ribs are crossed by from 3 to 4 distant deep concentric sulci, giving rise to a crenulation on each rib as it crosses them, more frequent near the lower margin.

Dimensions.—Fig. 22, Pl. I., a bivalve example, measures: antero-posteriorly, 28 mm.; dorso-ventrally, 38 mm.; from side to side, 19 mm.

Locality.—Scotland: Upper Bala, Star-fish bed; Drummuck.

Observations.—This species is represented in the Gray Collection by several examples. HALL separated his species from the *Pterinea carinata* of GOLDFUSS on account of the much larger number of radiating ribs. He says that for shells of equal size GOLDFUSS' specimen has 24, while his has 35 to 40. Only one of HALL'S figured specimens shows concentric interruptions to the ribs.

Many of the specimens show the large circular byssal opening below the umbones.

Byssonychia angusta, sp. nov. (Pl. I., figs. 23, 24.)

Specific Characters.—Shell acutely triangular, narrow, transversely oblique, moderately convex. The anterior edge acute, compressed, its border depressed beneath the overhanging umbones, and pierced by semicircular foramina in each valve, for the byssus. The inferior border bluntly rounded. The posterior rounded below, obliquely truncate, and almost straight above, where it joins the short, straight hinge line at an obtuse angle. The umbones are produced, compressed, pointed, twisted forwards and terminal.

Interior.—An oblique cardinal tooth immediately below the umbo, with flattened hinge plate, narrow, elongate; posterior end not seen.

Exterior.—Surface ornamented with numerous radiating thick ribs, separated by grooves of equal size. Rarely concentric lines of growth towards the lower border.

Dimensions.—Fig. 24, Pl. I., a right valve, measures: antero-posteriorly, 20 mm.; dorso-ventrally, 36 mm.

Localities.—Middle Bala, Shalloch Mill ; Upper Bala, Star-fish bed.

Observations.—A much narrower, less transverse variety, with a more elongate narrow umbo, than *B. radiata*, and the radiating ribs are fewer and larger. Unfortunately, the material is not in a good state of preservation, and the specimen is anything but perfect. A single example of what I take to be the same species occurs in the Star-fish bed.

Genus *Ambonychia*, Hall, 1847.

Ambonychia, Hall, 1847, *Geol. Survey New York*, Pal., vol. i. p. 163.

,, Miller, 1889, *North American Geology and Palæontology*, p. 460.

Generic Characters.—Shell equivalve, inequilateral, compressed and subalate posteriorly. Anterior side inflated and adpressed. Umbones raised, incurved, projecting forwards. Cardinal line straight. Sinuate anteriorly for the byssus.

Interior.—The hinge has a cardinal tooth below the umbo, and posteriorly two or three narrow, elongate, slightly diverging teeth.

Exterior.—The surface is almost smooth, or with concentric lines.

Observations.—I have followed ULRICH in placing the well-known form *A. radiata* of authors in his new genus *Byssonychia*. He states that an examination of the type *Ambonychia bellistriata* shows that it has no byssal opening or lateral teeth. MILLER, however, figured a specimen of this shell in his *North American Geology and Palæontology*, p. 460, with lateral teeth, and so at present the question must remain over as to whether ULRICH'S statement is correct. I find no large byssal opening in the shells which I refer now to *Ambonychia*, and unfortunately I can say little or nothing about the hinge teeth of most of them. *A. triton* probably should be placed in a different genus when more is known about its internal characters. Its broad subquadrate character resembles *Gosslettia* to some extent.

Mytilarca of HALL cannot be very far removed from *Ambonychia*, as is evidenced by general shape and the posterior hinge teeth. Both genera, though mytiliform in shape, have a relationship with the arciform *Grammatodon* and *Palæarca* in the character of the posterior hinge teeth.

The genus *Ambonychia* appears to be confined to Silurian rocks.

Ambonychia triton, Salter, sp., 1848. (Pl. I., figs. 26, 27.)

Avicula triton, Salter, 1848, *Mem. Geol. Surv. Gt. Brit.*, vol. ii., pt. i., p. 367, pl. xxiii. fig. 5.

Avicula (Ambonychia), Murchison, 1859, *Siluria*, 3rd ed., p. 213, fig. 8.

Specific Characters.—Shell sub-rectangular, obliquely gibbose. The anterior end obsolete, compressed, and subalate posteriorly. The anterior margin descends somewhat obliquely backwards ; lower margin short, slightly rounded, passing with a broadly rounded curve into the posterior border, which is oblique and truncate, and makes

a slightly obtuse angle with the hinge line. The latter long and straight. Umbones pointed terminal and excavated internally. The anterior part of the valve is adpressed and folded inwards, and presents a broad anterior surface.

Interior.—The posterior part of the hinge plate has a fine elongate lateral tooth.

Exterior.—The surface is ornamented with fine concentric lines of growth, crossed by almost obsolete radiating ribs, best marked in front.

Dimensions.—Fig. 27, Pl. I., a right valve, measures: antero-posteriorly, 27 mm.; dorso-ventrally, 23 mm.; gibbosity of valve, 7 mm.

Locality.—Scotland: Llandeilo beds, Craighead; Lower Llandovery, Mulloch Hill; Middle Llandovery, Woodland Point.

Observations.—This is an easily recognised form which reaches a size about three times as large as the figured specimen. The species was originally described by SALTER from Bird's Hill. If the shell is described with the hinge line horizontal, it is seen that SALTER'S remarks that the "beak of the present species falls considerably within the anterior margin," and "the great gibbosity, too, is beneath the beak, not in a diagonal line from this to the siphonal end," are not correct, but depend entirely upon the orientation of the specimen. Nearly all the shells that I have diagnosed as belonging to this species show more or less clearly defined radial ribbing, even in the young. The Llandeilo specimens are very large, Lower Llandovery small, and Middle Llandovery nearly equal to the largest specimen. *P. triton* is much flatter than *P. quadratus*.

Ambonychia amygdalina, Hall, 1847. (Pl. I., figs. 28, 29.)

Ambonychia amygdalina, Hall, 1847, *Pal. New York*, vol. i. p. 165, pl. xxxvi. fig. 6a, b, c.

Specific Characters.—Shell narrow, obliquely ovate, and gibbose. Anterior end obsolete, the margin adpressed to form a broad surface. The inferior margin elliptical, the posterior elongate, oblique, nearly straight. The hinge line short, straight, making an obtuse angle with the posterior border. Umbones acute, pointed, curved forwards, contiguous, terminal. Near the upper angle the umbonal gibbosity is almost angular on the anterior slope. Dorsal slope rapidly compressed.

Interior.—No details have been obtained.

Exterior.—Apparently covered by fine concentric lines of growth.

Dimensions.—Fig. 24, Pl. I., a right valve, measures: antero-posteriorly, 41 mm.; dorso-ventrally, 23 mm.

Locality.—Scotland: Llandeilo beds, Balclatchie, Craighead, Ardmillan, Dowhill, Minuntion

Observations.—This species is evidently not uncommon, but the specimens are very poor, in the form of casts, which unfortunately give no details of the hinge plate or muscle scars.

Ambonychia undata, Emmons, sp., 1842. (Pl. I., fig. 30.)*Pterinea undata*, Emmons, 1842, *Geol. Rept. New York*, p. 395, fig. 1.*Inoceramus vetustus*, Sow., var. *priscus*, Portlock, 1848, *Rept. Geol. Londonderry*, p. 423, pl. xxxiii. figs. 1, 2, 3.*Ambonychia undata*, Hall, 1847, *Pal. New York*, vol. i. p. 165, pl. xxxvi. figs. 7a, b.

Specific Characters.—Shell oblique, triangularly ovate, obliquely gibbose in front, compressed, and subalate posteriorly. Anterior end obsolete, adpressed to form a broad anterior surface. The anterior margin slopes downwards and backwards; the inferior margin rounded, posterior truncate, straight, oblique, making an obtuse angle with the hinge line, which is straight and as long as the transverse diameter of the shell. The umbones are terminal, bluntly pointed, very little elevated above the hinge line.

Interior.—Unknown.

Exterior.—The surface has an ornament of several broad concentric bands, separated by shallow sulci of about the same breadth as the bands.

Dimensions.—Fig. 30, Pl. I., a left valve, measures: antero-posteriorly, 10 mm.; dorso-ventrally, 9 mm.

Locality.—Scotland: Llandeilo beds, Ardmillan.

Observations.—PORTLOCK, though he referred his species to the Carboniferous shell described by SOWERBY as *Inoceramus vetustus*, recognised that his species did not agree exactly with that shell, and gave it the varietal name of *priscus*. It is interesting to note the homomorphy of the Llandeilo *A. undata*, the Carboniferous *Posidoniella vetusta*, and Cretaceous *Inocerami*. All these genera, absolutely distinct in their hinge characters, have a similar external ornament. *A. undata* is rare in the Gray Collection, and the specimen is much smaller than that figured by PORTLOCK or HALL.

Ambonychia quadratus, sp. nov. (Pl. II., figs. 1–3.)

Specific Characters.—Shell subquadrate, gibbose, oblique. The anterior end obsolete; the border, raised, thickened, rounded and incurved, descends with a gentle convexity and gradually becomes flattened to join the broadly convex lower margin. The posterior border is somewhat truncate, rounded below where it joins the inferior margin, and making a well-marked, somewhat obtuse angle with the hinge line above. The latter is straight and produced. The umbones are large, incurved, and somewhat prosogyrous, not contiguous, anterior. The dorsal slope is much compressed, the posterior superior angle subalate. The greatest convexity of the valve is anterior and subumbonal.

Anterior.—The hinge plate seems to be plain except at the posterior end, where there are three small oblique lateral teeth separated by fine grooves.

Exterior.—The surface is ornamented with fine concentric striæ and lines of growth.

Dimensions.—Fig. 2, Pl. II., measures: antero-posteriorly, 55 mm.; dorso-ventrally, 46 mm.; elevation of valve, 10 mm.

Localities.—Penkhill, Upper Llandoverly; Woodland Point, Middle Llandoverly; Mulloch Hill, Lower Llandoverly; Balclatchie, Ardmillan, Llandeilo series.

Observations.—This species is represented in the collection by numerous examples from Penkhill and Mulloch Hill, but only two specimens were found at Woodland Point. Although there are two casts of the interior, I have not been able to make out the muscle scars, and only a part of the hinge plate is exposed.

Several specimens show the radiating lines on the anterior part of the shell.

The largest specimen found measures 47 mm. antero-posteriorly; in full-grown shells the radiating ornament is much better marked than in those belonging to immature examples.

Ambonychia cuneata, sp. nov. (Pl. II., figs. 4–6, 6a, 6b.)

Specific Characters.—Shell of moderate size, obliquely subquadrate, gibbose anteriorly, compressed posteriorly, very inequilateral. The anterior end is adpressed, with a broad anterior surface, hollowed above on each side of the narrow projecting border. The inferior border is blunt and slightly convex; the posterior oblique, almost straight. The hinge line is short and straight. The umbones are gibbose, pointed, twisted forwards and raised. The dorsal slope is much compressed and hollowed.

Interior.—Not seen.

Exterior.—The surface appears to have been almost smooth, with obscure concentric striæ of growth.

Dimensions.—Fig. 5, Pl. II., measures: antero-posteriorly, 18 mm.; dorso-ventrally, 17 mm.; from side to side, 12 mm.

Localities.—? Star-fish bed, Upper Bala; Mulloch Hill, Lower Llandovery; Woodland Point, Middle Llandovery; Penkhill, Upper Llandovery.

Observations.—*Ambonychia acutirostris*, Hall, from the Niagara beds of North America, has a certain resemblance to this species, but it is too oblique, and its dorso-ventral measurements are comparatively much longer. I have not been able to see any trace of the striated hinge plate of *Ambonychia*, and have referred the shell to that genus provisionally.

Ambonychia simplex, sp. nov. (Pl. II., figs. 7, 7a-c, 8, 9.)

Specific Characters.—Shell small, narrow oblique, ovate acute, moderately gibbose in front, compressed posteriorly, very inequilateral. The anterior end adpressed so that the line of junction of the valves is posterior to the anterior border, which descends obliquely downwards and backwards, and is slightly sinuate. Inferior border bluntly rounded; posterior border obliquely truncate, gently convex. Hinge line short and straight; postero-superior angle well marked, slightly obtuse. The umbones are large, prominent, pointed, prosogyrous, and terminal.

Interior.—Normal.

Exterior.—The surface seems to have been smooth.

Dimensions.—Fig. 7, Pl. II., a right valve, measures: antero-posteriorly, 13 mm.; dorso-ventrally, 17 mm.

Localities.—Mulloch Hill, Lower Llandoverly ; Woodland Point, Middle Llandoverly ; and Penkill, Upper Llandoverly.

Observations.—This species is much smaller and less gibbose than *A. amygdalina*, from which it is probably descended. A single specimen only occurs in the Lower and Middle Llandoverly, but many examples were obtained from Penkill. Fortunately, one of these, fig. 6, Pl. II., shows the posterior part of the hinge plate, and its generic affinity is therefore certain.

Genus *Posidonomya*, Bronn, 1837.

For synonymy, see *Posidonomya*, Hind, 1901, *Brit. Carb. Lamell.* (Pal. Soc.), pt. ii. p. 26.

Generic Characters.—Shell of moderate size, ovate, oblique, compressed, with an anterior rounded ear and a compressed-expanded posterior ear. Hinge line straight ; umbones small, pointed, placed anterior to the centre of the hinge line. Shell obliquely but very moderately convex.

Surface ornamented with numerous concentric grooves and ridges, occasionally decussated by radiating lines. Periostracum well developed.

Observations.—This genus is represented by five species in Carboniferous times, and I have now referred to it a well-marked shell from the Middle Bala series. It may be that, when details of the hinge plate turn up, a reconsideration of its generic position may be necessary.

Posidonomya antiqua, sp. nov. (Pl. I., fig. 12.)

Specific Characters.—Shell of medium size, moderately compressed, obliquely U-shaped, inequilateral. The anterior border prolonged, very slightly convex. The inferior margin strongly convex. The posterior border nearly straight and long. The hinge line straight, making a well-marked, slightly obtuse angle with the posterior border. The umbones are small, slightly raised, and placed far forwards. The valves are obliquely gibbose, the postero-superior angle much compressed.

Interior.—Unknown.

Exterior.—The surface is ornamented by regular, raised, angular concentric ridges, close in front, but becoming widely separated as they pass over the body of the valve. The concave sulci which separate the ridges are finely striate concentrically.

Dimensions.—Difficult to estimate, on account of the imperfect state of the specimen on which the species is founded, but the antero-posterior diameter was probably 25–30 mm. The dorso-ventral diameter is at least 40 mm.

Locality.—Middle Bala beds of Shalloch Mill.

Observations.—M'Cox has described a somewhat similar shell from Ferriter's Cove, Dingle, Co. Kerry (*Silurian Fossils of Ireland*, p. 22, pl. ii. fig. 10), as *Pterinea* (?) *posidoniaformis*, but this species is figured as having its umbones subcentral, and the anterior end is dissimilar to the species under description. The present specimen

is very incomplete, much of the posterior side having been broken off, but the contour of the valve can be recognised in the younger portion of the valve. The shell is a striking one, its ornament so well marked that even fragments could be easily distinguished. I have referred the species to *Posidonomya* on external characters only.

Pterinea, Goldfuss, 1836–40.

Pterinea, Goldfuss, 1836–40, *Petrefact. German.*, p. 134.

„ M'Coy, 1855, *Brit. Pal. Foss.*, p. 258.

„ Hall, 1884, *Geol. Survey New York, Pal.*, vol. v. pt. i., Lamell., i., p. xii.

Generic Characters.—Shell unequivalve, inequilateral, posterior side alate, anterior end nasute or auriculate. Ligament internal. Ligamental area longitudinally striated. Cardinal teeth two or more. Lateral teeth linear, oblique. Posterior muscular impression large, situated on the post-umbonal slope. Anterior muscular impression small, situated within the rostral cavity. Test ornamented with rays.

Observations.—I have adopted HALL'S definition of the genus. M'Coy has described several species from Silurian and Ordovician rocks (*op. supra cit.*). The genus is represented in the Devonian rocks of North America by numerous examples, but does not seem to have survived into Carboniferous time. All the Carboniferous forms referred to the genus should be more correctly placed in *Leiopteria* and *Limatulina*.

Pterinea subfalcata, Conrad, sp., 1842. (Pl. I., figs. 4, 5.)

Avicula subfalcata, Conrad, 1842, *Journ. Acad. Philadelphia*, vol. viii., pl. xiii. fig. 4.

Pterinea subfalcata, M'Coy, 1855, *Brit. Pal. Foss.*, p. 263, pl. i. fig. 3.

Specific Characters.—Shell small, oblique, subquadrate. The body of the shell is swollen and ovate. The anterior border is sinuous, the inferior broadly convex, the posterior convex below, subfalcate above. The hinge line is straight, the longest diameter of the valve. The umbo is small but tumid, subcentral. The anterior superior angle compressed into a small lobe; the posterior superior angle compressed and subalate.

The interior appears to be normal.

Exterior.—The surface is ornamented with fine thread-like radiating lines crossed by close concentric ridges.

Dimensions.—Fig. 1, Pl. I., measures: antero-posteriorly, 12 mm.; dorso-ventrally, 11 mm.

Locality.—Craigens Quarry, Lower Llandovery; Camregan Wood, Upper Llandovery.

Observations.—There are six examples of this little shell which I refer to *P. subfalcata*, Conrad, on account of its oblique character and the short posterior ear.

M'Coy figures a specimen from the schists of Howgill Fells, and states that the species occurs at Benson Knot, Kendal, and near Pont-ar-y-llechan, Llandeilo. The ornament is well seen on two specimens. I have only seen the left valve, the smooth or right valve not occurring in the collection.

Pterinea elegans, sp. nov. (Pl. I. fig. 6.)

Specific Characters.—Shell subquadrate, U-shaped, moderately gibbose. The anterior end is compressed and short, its border sinuous, the inferior border expanded and bluntly rounded, the posterior almost straight, only very slightly concave above. The hinge line is straight, slightly produced, making a small acute angle with the posterior border. The umbo is small, placed in front of the middle joint of the hinge line, slightly elevated and incurved. The anterior lobe is small, the posterior superior angle compressed and subalate.

Interior.—Not seen.

Exterior.—The surface is very beautifully marked with regular, well-marked and sharp concentric lines, which follow the contour of the valve. Towards the lower and posterior part a few broad, very shallow radiating flexuous ribs are to be seen.

Dimensions.—Fig. 6, Pl. I., measures: antero-posteriorly, 15 mm.; dorso-ventrally, 20 mm.; elevation of valve, 3 mm.

Locality.—Craicens Quarry, Lower Llandovery.

Observations.—I have erected this species on a single specimen, consisting of two portions, the cast and its mould. The beautiful external ornament is preserved in the latter, and can be studied by moulds of modelling wax. The specimen is a left valve. It is more quadrate and has a shorter hinge line, and the posterior border is not so falcate as in the other Silurian species, none of which possess the characteristic ornament which I have described.

Pterinea reticulata, sp. nov. (Pl. I. figs. 7, 8.)

Specific Characters.—Shell small. Body of the valve ovate acute, swollen; anterior end comparatively large, auriculate, rolled. The posterior subalate, compressed. The anterior margin sinuous, the inferior rounded, the posterior rounded below, falcate above. The hinge line straight, produced. The umbone small, pointed, incurved, subcentral. The convex body of the valve is marked off from the anterior end by an oblique shallow sinus.

Interior.—Hinge plate and muscle scars normal.

Exterior.—The body of the valve is ornamented by radiating ribs somewhat sharp and flexuous, crossed by fine raised concentric lines, so that the surface is markedly reticulate. The anterior radiating ribs are absent, and the lines of growth are so strong as to be subimbricate. Apparently the radiating ribs are also obsolete on the posterior wing.

Measurements.—Fig. 1, Pl. I., a left valve, incomplete posteriorly, measures: antero-posteriorly, 15 mm. (circ.); dorso-ventrally, 12 mm.

Locality.—The Star-fish bed, Upper Bala.

Observations.—This shell has well-marked characters and can be easily recognised.

The absence of radial ribs on the large posterior end will separate it at once from *P. asperula*, M'Coy. The latter shell has a fine reticulate ornament.

The specimen on which I have erected this species consists of a cast of the interior showing the characteristic hinge plate of *Pterinea*, and a mould of the exterior from which the surface ornament can be studied by a wax impression. Unfortunately the posterior end is absent.

Genus *Opisthoptera*, Meek, 1872.

Opisthoptera, Meek, 1872, *Proc. Acad. Nat. Sci. Phil.*, p. 319.

„ Meek, 1873, *Ohio Pal.*, vol. i. p. 131, note.

„ Ulrich, 1893, *Rep. Geol. Surv. Ohio*, vol. vii., Pal., p. 642.

Generic Characters.—“Shell equivalve, usually triangular in outline, with the beaks of moderate size, incurved and terminal, and the hinge line straight and very long, in most cases forming a great posterior wing, length greater than the height. Anterior side more or less abrupt. In the typical section, the greatest height is in the anterior half, and the surface marked with numerous and frequently bifurcating costæ. In another group of species, provisionally regarded as congeneric, the posterior part of the shell is the highest, and the radiating costæ few and mostly simple. Byssal opening, muscle scars, and pallial line as in *Anomolodonta* and *Byssonychia*. Hinge with two small cardinal teeth in each valve, but so far as is known, no posterior lateral tooth. External ligamental area usually narrow; no internal ligament.”

Observations.—The above is ULRICH'S description of the genus (*op. supra cit.*). It is to the second group of species that I consider the Scotch specimen belongs which I refer to the genus. The greatest dorso-ventral diameter is posterior; the radiating ribs are single and almost obsolete. The byssal orifice is much too small for *Byssonychia*, and the shell is too transverse.

Opisthoptera transversa, sp. nov. (Pl. III., fig. 4.)

Specific Characters.—Shell of medium size, very inequilateral. Anterior side obsolete, moderately swollen, transversely subquadrate. The anterior margin abrupt, adpressed, and excavated below the level of the edge of the umbonal fold. The inferior margin prolonged, gently convex; the posterior obliquely truncate and straight above, rounded below. The hinge line straight, of moderate length, meeting the posterior border at an obtuse angle. The umbones are compressed anteriorly, pointed, and twisted forwards, raised and terminal. The dorsal slope is compressed and becomes concave as it approaches the posterior margin.

Interior.—Not exposed.

Exterior.—The surface is covered with numerous subobsolete simple radiating raised lines, more apparent towards the lower margin, and crossed here and there by more or less well-marked concentric lines of growth.

Dimensions.—Fig. 4, Pl. III., a left valve, measures: antero-posteriorly, 25 mm.; dorso-ventrally, 18 mm.

Locality.—Lower Llandovery of Mulloch Hill.

Observations.—Only one specimen of this shell is in the collection; but it is a well-marked form, and unlike any described species to which I have had access. A reference to *O. notabilis* from the Middle Cincinnati group, Ohio (ULRICH, *op. supra cit.*, pl. xlix. fig. 16), will show that the Scotch shell has similar generic characters.

Genus *Pteronites*, M'Coy, pars, 1884.

Pteronites, pars, M'Coy, 1844, *Synopsis Carb. Foss. Ireland*, p. 81.

„ Hind, 1901, *Mono. Brit. Carb. Lamell.*, vol. ii. p. 5.

Generic Characters.—“Shell compressed, oblique, subtriangularly transverse, very inequilateral; anterior end small, sharp, and pointed. Inferior border convex and posterior border sinuous. Hinge line forms the most transverse diameter of the valve; umbones small, placed anteriorly, not terminal. Valves obliquely swollen from the umbo towards the postero-inferior angle. Posterior slope compressed, expanded, and subalate. External surface ornamented with concentric lines and folds, more apparent posteriorly and over the swollen part of the valve.”

Remarks.—I consider that the *Pterinea retroflexa*, Dalm., figured in the *Sil. Syst.*, pl. v. fig. 9, should be referred more correctly to *Pteronites*. Another species is represented in the Middle Llandovery of Woodland Point which I consider to be new.

Pteronites ellipticus, sp. nov. (Pl. I., fig. 9.)

Specific Characters.—Shell below medium size, almost elliptical, generally compressed, with a hollow dorsal slope. The anterior end well developed, narrow; the antero-superior angle acute. The anterior margin descends rapidly and is gently convex. Lower margin strongly convex; the posterior somewhat narrowed, truncate, almost straight.

The umbones are small, compressed, and elongate, placed about quarter of the length of the hinge line from the anterior end. Proceeding from the umbo towards the posterior border is a small oblique ridge which separates the compressed dorsal slope from the rest of the valve. The narrow anterior end is also separated from the convex portion of the valve by a broad shallow sinus.

Interior.—The hinge plate is linear posteriorly.

Exterior.—The surface is almost smooth. The striæ of growth are somewhat irregular at the anterior end.

Dimensions.—Fig. 9, Pl. I., measures: antero-posteriorly, 23 mm.; dorso-ventrally, 13 mm.

Locality.—Middle Llandovery of Woodland Point.

Observations.—This shell has the umbones much less anterior than *P. retroflexa*, and the anterior end is much less sinuous. Only one specimen, a right valve, is in the Gray Collection.

Genus *Leptodesma*, Hall, 1883.

Leptodesma, Hall, 1883, *Pal. New York*, vol. v., pt. i., Lamell., i. p. 13.

Generic Characters.—Shell aviculoid, oblique transverse, very inequilateral. Anterior end nasute and acute, posterior expanded and compressed, alate, upper border often produced into a linear spine. Hinge line with a slender lateral tooth, posterior to the beak and parallel to the hinge line. Surface with concentric lines of growth and smooth.

Observations.—*Leiopteria* and *Leptodesma* are very closely related. Indeed, I question the need for both genera. I have referred these species of Ordovician shells to the genus, but the Carboniferous forms I placed in *Leiopteria* on account of the shape of the anterior extremity. The genus is represented by a very large number of species in North American Devonian rocks.

Leptodesma ardmillanensis, sp. nov. (Pl. I., fig. 16.)

Specific Characters.—Shell below medium size, somewhat rhomboidal, obliquely gibbose, subalate. The anterior margin long, slightly sinuous; inferior margin is bluntly rounded, the posterior truncate, almost straight. The postero-superior angle a rounded right angle. The hinge line straight, the longest antero-posterior diameter of the shell. The umbo is gibbose, obliquely pointed, and placed about the junction of the anterior and middle thirds of the hinge line. The greatest gibbosity of the valve is subumbonal, the convexity gradually becoming less as the border of the shell is approached. The postero-inferior angle is much compressed and slightly expanded, but not produced.

Interior.—There appears to be a single linear oblique tooth below the posterior part of the hinge line.

Exterior.—The surface is ornamented by few distant, linear, but well-impressed concentric grooves.

Dimensions.—Fig. 16, Pl. I., measures: antero-posteriorly, 18 mm.; dorso-ventrally, 17 mm.; elevation of valve, 5 mm.

Locality.—The Llandeilo series, Ardmillan.

Observations.—The specimen on which this species is founded consists of two portions, the shell and its impression. It agrees with a subsection of the genus found in Devonian rocks of New York State, which have no posterior wing and no projecting rostrum. *L. umbonatum*, Hall (*Pal. N. York*, Lamell., i. p. 198, pl. xc. fig. 9), from the Chemung group, has a strong resemblance to the Scotch shell, but the hinge line is comparatively longer.

? *Leptodesma modiolaris*, sp. nov. (Pl. I., figs. 13–15, 15a.)

Specific Characters.—Shell of medium size, roughly trigonal, modioliform. Anterior end nasute, small, separated from the rest of the valve by a deep, broad byssal sinus, which notches deeply the anterior part of the lower border; posteriorly the lower border is broadly convex. Posterior border truncate, almost straight. Hinge line long, straight. Postero-superior angle almost a right angle. Umbones small, directed forwards, but not terminal. Posterior to the byssal sinus, the valve is obliquely swollen, the swelling becoming broader and flatter as it approaches the margin. Postero-superior angle compressed.

Interior.—Unknown.

Exterior.—The surface is almost smooth, but here and there concentric wrinkles and lines of growth are seen. These are much more pronounced in the neighbourhood of the byssal sinus.

Dimensions.—Fig. 13, Pl. I., measures: antero-posteriorly, 22 mm.; dorso-ventrally, 15 mm.; gibbosity of valve, 3 mm.

Locality.—Scotland: the Star-fish bed, Upper Bala.

Observations.—This species is founded on the cast of a right valve, from which I have taken a wax impression. It is a well-marked form, but whether I am right in referring it to *Leptodesma* rather than to *Leiopteria* I cannot say without further material which would enable me to ascertain the character of the hinge plate.

Leptodesma transversa, sp. nov. (Pl. I., figs. 17, 18.)

Specific Characters.—Shell below medium size, transversely ovate. Anterior end narrow and short, its margin rounded, the posterior expanded and subulate, obliquely gibbose. The anterior margin elliptical, the inferior gently convex, the posterior rounded below, falcate above. The hinge line straight, produced posteriorly in a long thin process.

The umbones are small, swollen, scarcely raised above the hinge line, placed far forwards.

Interior.—Not exposed.

Exterior.—The surface is almost smooth, but the microscope reveals fine concentric lines of growth.

Dimensions.—Fig. 18, Pl. I., measures: antero-posteriorly, 12 mm.; dorso-ventrally, 8 mm.

Locality.—Lower Llandovery of Mulloch Hill.

Observations.—Only a single example, a right valve, has been obtained. It is more transverse and less triangular than *L. modiolaris*, and has a very elongate process at the posterior end of the hinge line of which the latter has no trace.

Genus *Myalina*, de Koninck, 1842.

Myalina, de Koninck, 1842, *Animaux Foss. Carb. Belge*, p. 25.

Psilonychia, Ulrich, 1893, *Rep. Geol. Surv. Ohio*, vol. vii. p. 648.

Myalina, Hind, 1897, *Mono. Brit. Carb. Lamell.* (Pal. Soc.), p. 103.

Generic Characters.—Shell triangular, oblique, mytiliform, expanded at the anterior border, compressed and subulate posteriorly. Umbones terminal. Hinge plate thickened, longitudinally striate.

Exterior.—Concentric lines of growth well marked, often subimbricate or lamellar.

Observations.—For a fuller synonymy and description I would refer to my monograph (*op. supra cit.*). I cannot but think that *Psilonychia* of Ulrich is unnecessary, as, according to his definition, there is not one single character mentioned which does not obtain in *Myalina*. He describes a single species, *P. perangulata*, which differs in shape from *M. prisca*, but the figures fully demonstrate the characteristic structure of *Myalina*.

A single specimen, which I now refer to *M. prisca*, is in the Gray Collection.

Myalina prisca, sp. nov. (Pl. II., fig. 10.)

Specific Characters.—Shell of moderate size, compressed, very inequilateral, triangular; the anterior end is adpressed and hollowed, and the thickest part of the valve is at the anterior border, but the anterior junction of the valves is so depressed that it lies some way posterior to the border. The anterior border is straight and sloping downwards and backwards, the inferior margin curved; the posterior obliquely truncate, straight above, but rounded below. The hinge line straight, and the longest transverse diameter of the valve. The postero-superior angle well marked and obtuse. The umbones are pointed and prosogyrous, terminal.

Interior.—The hinge plate is elongate, broad at the umbonal end, and becoming gradually narrower as it passes backwards, hollowed and finely striate longitudinally.

Exterior.—The surface is ornamented with concentric, somewhat irregular striæ and rugæ of growth, at times almost subimbricate.

Dimensions.—Fig. 10, Pl. II., measures: antero-posteriorly, 25 mm.; dorso-ventrally, about 25 mm.

Locality.—Middle Bala of Shalloch Mill.

Observations.—A very typical *Myalina*, with a strong resemblance to *M. redesdalensis*, Hind, a Carboniferous species, but the latter is much more massive and robust. Fortunately, the specimen, a right valve, shows the hinge plate very well. The longitudinal striæ on the hinge plate are not so strongly marked as in Carboniferous species of the genus. More transverse and with a longer hinge plate than *M. perangulata*, Ulrich, sp.

Genus *Gosseletia*, Barrois, 1881.

Gosseletia, Barrois, 1881, *Ann. Soc. Géol. du Nord*, vol. viii. p. 176.

„ Hall, 1884, *Geol. Surv. N. York, Pal.*, vol. v. pt. i., Lamellibr., p. xiv.

„ Miller, 1889, *N. Amer. Geol. and Pal.*, p. 482.

Generic Characters.—Shell subtriangular, truncate on anterior side, subalate posteriorly. Ligamental area wide, longitudinally striate; cardinal teeth below the beak strong; lateral teeth elongate; surface with concentric striæ.

Observations.—This genus was erected for a modioliform shell with cardinal and lateral teeth and a striate ligament, from the Devonian of Spain. HALL referred two specimens to the genus from the Hamilton group of New York, a member of the Devonian series of that State. The shells that I now refer to the genus are from the Upper Bala and Llandovery beds of Scotland, in which I consider it is represented by two species. Unfortunately, specimens are not numerous.

Gosseletia ponderosa, sp. nov. (Pl. III., figs. 1, 1a, 1b.)

Specific Characters.—Shell of medium size, obliquely subquadrate; extremely gibbose in front, subalate posteriorly. The anterior end obsolete. The anterior margins adpressed to form an oblique broad anterior surface, so impressed below the beaks as to be concave. The inferior margin is rounded; the posterior obliquely truncate, almost straight. The postero-superior angle well marked, obtuse. The hinge line of only moderate length, straight. The umbones are swollen, pointed, elevated, directed forwards terminally, widely separated by a broad striate ligamental area.

Interior.—No details exposed.

Exterior.—The surface is ornamented with fine concentric lines of growth, with an occasional deep, narrow, concentric sulcus.

Dimensions.—Fig. 1, Pl. III., measures: antero-posteriorly, 34 mm.; dorso-ventrally, 51 mm.; from side to side, 38 mm.

Locality.—The Star-fish bed, Upper Bala.

Observations.—A single fairly perfect specimen, on which I have founded the species, occurs in the Star-fish bed. The specimen consists of a complete cast of the interior and a mould of the external surface. The hinge plate is not well enough preserved to show any of the hinge teeth. It could hardly be mistaken for the species which is found higher up in the Llandovery beds, the latter being much more compressed, with a totally different anterior end.

Gosseletia antiqua, sp. nov. (Pl. III., figs. 2, 3.)

Specific Characters.—Shell of medium size, obliquely ovate, triangular and gibbose. The anterior end almost obsolete, narrow, its margin rounded. The inferior border almost straight, descends downwards and backwards. Postero-inferior angle bluntly rounded. The posterior border is elongate, gently convex. Hinge line straight.

Postero-superior angle obtuse. The umbones are not well marked off from the valve, blunt, and all but terminal. Passing from the umbo to the lower margin is a blunt, subangular oblique ridge separating the narrow compressed triangular anterior from the more gradually compressed and expanded subalate posterior end.

Interior.—Hinge not exposed. Anterior adductor muscle scar small, subumbonal, and immediately within the anterior end.

Exterior.—Surface almost smooth; but under the microscope fine concentric lines of growth are to be seen, with here and there one more strongly impressed.

Dimensions.—Fig. 3, Pl. III., a bivalve example, measures: antero-posteriorly, 33 mm.; dorso-ventrally, 24 mm.; from side to side, 16 mm.

Localities.—Mulloch Hill, Lower Llandoverly; Woodland Point, Middle Llandoverly.

Observations.—Three specimens in the collection I refer to *Gosseletia* on account of the general shape; but I have not been able to see the hinge plate. *Gosseletia antiqua* is much more transverse and oblique than *G. triquetra* of the Hamilton group of New York, and the anterior end is not so adpressed.

Euthydesma, Hall, 1885.

Euthydesma, Hall, 1885, *Pal. New York*, vol. v. p. 32.

,, Miller, 1889, *North American Geol. and Pal.*, p. 480.

,, Beushau-en, 1895, *Abh. Königl. Geol.*, p. 316.

Specific Characters.—Shell inequilateral, equivalve, broadly subovate, with a subalate cardinal expansion. Cardinal line straight, anterior end short, surface concentrically lined; hinge line marked by a continuous ligamental groove.

Observations.—I have adopted MILLER's description of the genus (*op. cit.*). One species only, it appears, has been described from North America. BEUSHAUSEN has also described one species from the Upper Devonian of Oberscheld and Martenberge, near Adorf. I have referred these specimens in the Gray Collection to this genus under the following name:—

Euthydesma alata, sp. nov. (Pl. I., figs. 11, 12.)

Specific Characters.—Shell below medium size, broadly ovate, moderately compressed, the posterior superior angle flattened and expanded. The anterior margin starts close to the umbo, descending for a short distance; it then curves suddenly outwards, and then becomes strongly convex and passes with a regular, almost semi-circular curve into the broad, convex lower margin. The posterior border is almost straight and erect. The hinge line very short in front of the umbo, straight and of moderate length posteriorly. The umbones are raised, pointed and gibbose, twisted forwards.

Interior.—Unknown.

Exterior is almost smooth, but here and there moderately strong concentric lines denoting interruptions of growth are to be seen.

Dimensions.—Fig. 12, Pl. I., measures: antero-posteriorly, 26 mm.; dorso-ventrally, 20 mm.

Locality.—Middle Llandovery of Woodland Point.

Observations.—There are three fairly well preserved specimens which I refer to this species. They seem to me to indicate an approach to a Pecten-like form, more especially to the genus *Streblopteria*; but the Pecten-like anterior ear, present in the latter shell, is absent.

BEUSHAUSEN (*op. supra cit.*) suggests that the genus is allied to *Cardiola*, but I do not see the grounds for this view. All the specimens in the Gray Collection are left valves.

Genus *Sphenolium*, Miller, 1889.

Sphenolium, Miller, 1889, *N. Amer. Geol. and Pal.*, p. 513.

Generic Characters.—“Shell large, equivalve, inequilateral, elongate, cuneiform, ventricose. Umbones prominent, beaks incurved at the anterior end. Cardinal line at an angle of 50° or 60° from the basal line, and appearing wing-like towards the posterior end. Lunule present; no escutcheon; ligament external; muscular scars and hinge-line unknown.”

Observations.—MILLER erected this genus for three species of shells from the Hudson River group of North America which had a very ventricose cuneiform shape. Little or nothing is known of the real affinity of the genus, as no details of the interior have been observed. I have quoted the diagnosis of the genus as given by MILLER, and I regret that the Scotch examples afford no fresh details.

Sphenolium richmondense, Miller, 1889. (Pl. IV., figs. 30, 31, 31a.)

Sphenolium richmondense, Miller, 1889, *N. Amer. Geol. and Pal.*, p. 513, figs. 925, 926.

Specific Characters.—Shell of moderate size, truncate, cuneiform, ventricose, oblique. The anterior end almost obsolete and depressed. The inferior margin bluntly convex; the posterior rounded below, nearly straight above, oblique, making an obtuse angle with the hinge line, which is arched in front and straight behind. The shell has a very broad oblique gibbosity with a compressed lower and dorsal slope. The umbones are high, incurved, and directed forwards, not contiguous, placed very far forwards.

Interior.—Unknown.

Exterior.—Almost smooth, but there appears to have been a thick and wrinkled periostracum.

Dimensions.—Fig. 30, Pl. IV., measures: antero-posteriorly, 31 mm.; dorso-ventrally, 19 mm.; gibbosity of valve, 7 mm.

Localities.—Craighead, Lower Llandeilo; Woodland Point, Middle Llandovery.

Observations.—This is a shell that could not easily be mistaken, except perhaps for a Gasteropod with an affinity to *Capulus*. *Modiola radiata* of the Carboniferous limestone has something of the same habit and may belong to the same genus.

The Craighead specimen consists of the left valve, probably an internal cast. It is imperfect at the anterior end. The Woodland fossil specimen is crushed, but both valves are present. The periostracum is preserved.

I see no reason for separating the two specimens, nor do I see sufficient reason to erect a new species, and therefore have referred both examples to MILLER'S *S. richmondense*.

Genus *Modiolopsis*, Hall, 1847.

Modiolopsis, Hall, 1847, *Pal. New York*, vol. i. p. 157.

„ Miller, 1889, *N. Amer. Geol. and Pal.*, p. 489.

Generic Characters.—Modioliform, inequivalve, inequilateral, transverse, with an expanded and compressed posterior end. Umbones small, anterior. Cardinal teeth short, oblique (MILLER). Anterior adductor muscle scar deep circular, almost marginal. Ligament external. No escutcheon or lunule. Surface with concentric lines.

Observations.—There are a number of closely related families of modioliform shells in Ordovician rocks, *Modiolopsis*, *Modiolodon*, *Modiomorpha*, which differ from each other in small details of hinge structure. It is difficult, in the absence of any details of the hinge plate, to assign any species accurately to its genus. American specimens seem to have been much better preserved than those found in Great Britain, and to have had the essential details of structure better exposed.

Modiolopsis expansa, Portlock, sp., 1843. (Pl. II., fig. 21.)

Modiola expansa, Portlock, 1843, *Geol. Rep. Londonderry*, p. 425, pl. xxxiii. fig. 6.

Specific Characters.—Shell transverse, narrowed in front, expanded and compressed posteriorly, carinate. The anterior end is narrow and produced, its border elliptical. The inferior border curved, the posterior inferior angle bluntly rounded. The posterior border straight and oblique, the postero-superior angle obtuse. The hinge line straight, shorter than the inferior border. The umbones are carinate, small, incurved, placed about the junction of the anterior and middle thirds of the valve. Passing down obliquely from the umbo to the posterior inferior angle is a well-marked subangular keel, dividing the shell into two triangles, both of which are flattened and compressed, the posterior more rapidly than the anterior. No lunule or escutcheon.

Interior.—Unknown.

Exterior.—Surface covered with concentric lines and striæ of growth.

Dimensions.—Fig. 21, Pl. II., a right valve, measures: antero-posteriorly, 44 mm.; dorso-ventrally, 26 mm.

Locality.—Scotland: Llandeilo, Craighead. Ireland: Desertcreat, Co. Tyrone.

Observations.—PORTLOCK states that he found two varieties of this species, one
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being less transverse than the other. He figured the more transverse form. The specimen fig. 21, Pl. II., in the Gray Collection is, I take it, an example of the less transverse form.

Modiolopsis exasperatus, Phillips, sp., 1848. (Pl. II., figs. 13–15.)

Mytilus exasperatus, Phillips, 1848, *Mem. Geol. Surv. Gt. Brit.*, vol. ii., pt. i., p. 364, pl. xx. fig. 12.

Specific Characters.—Shell triangularly ovate oblique. The anterior end small, compressed, its margin elliptical. The inferior margin sinuous in front, broadly rounded posteriorly. Posterior margin arched and extended, making an obtuse angle with the hinge line. The latter straight, short. Umbones prominent, incurved and twisted forwards, slightly raised, placed in the anterior third of the hinge line. The valve is obliquely swollen from the umbo downwards and backwards, the gibbosity becoming broader and more rounded as it approaches the postero-inferior angle. In front of the oblique ridge the anterior slope is rapid, and marked by the byssal sinus. The posterior slope is more gradually compressed.

Interior.—Unknown.

Exterior.—The surface is ornamented with numerous distinct, sharp, concentric, raised, narrow ridges, separated by narrow sulci. These ridges are finer and crowded on the anterior portion of the valve.

Dimensions.—Fig. 15, Pl. II., a left valve, measures: antero-posteriorly, 52 mm.; dorso-ventrally, 23 mm.; gibbosity of valves, 15 mm.

Locality.—Scotland: Llandeilo beds, Balclatchie, Star-fish bed of Upper Bala. Wales: Myddleton series, Llandeilo.

Observations.—A single specimen occurs in the Gray Collection from the Llandeilo series. I cannot accept the reference of this species to *Mytilus*, on account of the marked anterior extremity and non-terminal umbones. It has a typical modioliform shape. The concentric ornament easily distinguishes the species from all others of the genus of Ordovician age.

Modiolopsis subquadratus, sp. nov. (Pl. II., figs. 16, 17.)

Specific Characters.—Shell small, oblique, subquadrate, valve gently convex. The anterior border oblique, almost straight. The inferior almost semicircular, the posterior more gently convex. The hinge line straight. The umbones are small, tumid, incurved, subcentral. The shell is obliquely swollen from the umbo towards the postero-inferior angle, the dorsal slope much compressed. The anterior end compressed.

Interior.—Not exposed.

Exterior.—The surface is ornamented with microscopically fine regular lines of growth, the whole surface having somewhat irregular rugæ and sulci of growth.

Dimensions.—Fig. 16, Pl. II., a right valve, measures: antero-posteriorly, 14 mm.; dorso-ventrally, 12 mm.

Locality.—Upper Llandovery of Penkhill and Bargany Pond Burn.

Observations.—The figure of a shell named *Modiolopsis expansa*, Portl., is given on

p. 213 of the 3rd edition of the *Silurian System: Fossils*, Table 36, fig. 2, which from its shape, I should suggest, agrees much more closely with the species under description than PORTLOCK'S shell. The latter is transverse, and not nearly so deep in the dorso-ventral measurements.

The species does not appear to be common, and all the specimens in the collection are about the same size.

Modiolopsis scotica, sp. nov. (Pl. II., fig. 18.)

Specific Characters.—Shell of medium size, oblique, triangularly ovate, moderately oblique. Anterior end small, narrow, but distinct, subacute. The anterior margin descends downwards and backwards sinuously. The inferior margin is broadly rounded; the posterior obliquely truncate, almost straight, making a well-marked obtuse angle with the hinge line, which is straight and of moderate length. The umbones are narrow, slightly raised, and small, placed far forwards, but not terminal.

Proceeding obliquely downwards and backwards towards the middle of the inferior border, but soon becoming obsolete, is a subangular ridge, in front of which the shell is much compressed by a well-marked byssal groove. The valves are compressed into the postero-superior angle.

Interior.—The anterior adductor muscle scar is comparatively large and deep, and rounded; between it and the umbonal hollow are two small accessory pedal scars. Posterior adductor scar shallow and oval, normal in position.

Exterior.—The surface is ornamented with few distinct concentric deep lines of growth, more numerous and closer together near the lower margin. Elsewhere the surface is nearly smooth.

Dimensions.—Fig. 18, Pl. II., measures: obliquely, from anterior surface to postero-inferior angle, 50 mm.; transversely, 19 mm.

Locality.—The Star-fish bed, Upper Bala.

Observations.—A shell with the external appearance of *Modiola*, but having the muscle system of *Modiolopsis*, I have referred it to the latter genus. It differs from *M. pyrus*, Salter, in being more oblique and apparently not so gibbose, or regularly rotund. Several specimens occur in the Star-fish bed, but many of them are crushed flat. The two uncrushed examples are right valves, but these are imperfect posteriorly.

This species is accompanied by a peculiar variety which is much less triangular and has a short hinge plate, just as in the genus *Naiadites* a triangular form, *N. modiolaris*, is accompanied by a *N. quadratus*, which is less oblique and has a shorter hinge. I propose to call the variety as follows:—

Modiolopsis scotica, var. *brevis*. (Pl. II., figs. 19, 20.)

Varietal Characters.—Shell subquadrate, U-shaped, very slightly oblique; hinge-line equals the average transverse diameter of the shell.

External Characters.—As in *M. scotica*.

Modiolopsis minor, sp. nov. (Pl. II., figs. 22, 23.)

Specific Characters.—Shell small, oblique, triangularly ovate, moderately and obliquely gibbose. The anterior end is narrow and short, its border almost elliptical. The inferior margin descends downwards and backwards and is almost straight. The posterior border is almost straight, obliquely truncate. The hinge line is straight, of moderate length, making a well-marked obtuse angle with the posterior border. The umbones are small, elongate, and twisted forwards, placed far forwards.

Interior.—Apparently normal.

Exterior.—The surface is ornamented with regular, close, fine concentric lines.

Dimensions.—Fig. 23, Pl. II., a left valve, measures: antero-posteriorly, 13 mm.; dorso-ventrally, 7 mm.

Locality.—Penkhill, Upper Llandovery.

Observations.—A small species typical of the genus and possessing the characteristic ornament.

Genus *Mytilops*, Hall, 1884.

Mytilops, Hall, 1884, *Geol. Surv. New York, Pal.*, vol. v., pt. i., Lamell., i., p. xiv.

„ Miller, 1889, *N. Amer. Geol. and Pal.*, p. 494.

Generic Characters.—Modioliform. Hinge line straight, umbones blunt, terminal.

Observations.—Hall established this genus for certain shells as a sub-genus of *Modiola*. Little or nothing was known of the interior, for in neither of the two species, to include which the genus was erected, were any details of the hinge plate observed. In one of the shells which I now refer to this genus, the posterior part of the hinge plate shows short, narrow, sub-parallel teeth, which occur in *Grammatodon*, *Mytilarca*, *Plethomytilus*, and other palæozoic genera. This character is enough to separate the shells from *Modiola*.

Mytilops subovalis, sp. nov. (Pl. II., figs. 24, 25.)

Specific Characters.—Shell below medium size, triangularly ovate, oblique, moderately swollen, modioliform, compressed at the postero-superior angle and subalate. The anterior end is obsolete. The anterior border, oblique and almost straight. The inferior border well rounded; the posterior oblique and straight, almost parallel with the anterior. Hinge line straight, postero-superior angle obtuse. The umbones are inconspicuous, merged in the obtusely pointed anterior end.

Interior.—The hinge line has short lateral teeth posteriorly.

Exterior.—The surface is ornamented with fine concentric lines of growth, with here and there deeper concentric lines of grooves.

Dimensions.—Fig. 24, Pl. II., measures: antero-posteriorly, 25 mm.; dorso-ventrally, 15 mm.

Locality.—Middle Llandovery of Woodland Point.

Observations.—Two specimens moderately well preserved are found in the collection. One seems to show two small posterior lateral teeth; the other, which is a cast of the interior, is not so definite on this point. The blunt anterior and the obsolete umbones are well marked. The ornament is markedly modioliform in character.

Genus *Modiolodon*, Ulrich, 1893.

Modiolopsis, 1890, *Amer. Geol.*, vol. v. p. 276.

Modiolodon, Ulrich, 1897, *Fin. Rep. Geol. and Nat. Hist. Surv. Minnesota*, vol. iii. p. 521.

„ Ulrich, 1893, *Rep. Geol. Surv. Ohio*, vol. vii. p. 652.

Generic Characters.—Ovate shells of the same general type as *Modiolopsis* and *Modiomorpha*, but having from one to three oblique cardinal teeth in each valve.

Observations.—The genus was established by ULRICH, who gave the brief generic description noted above (*op. supra cit.*). I have referred several species to the genus on external characters only, for in no case have I been fortunate enough to examine the hinge. ULRICH points out that the hinge of *Modiolodon* is much like his other genus *Ischyrodonta*, but he thinks the latter approaches the hingeless *Modiolopsis* in general characters.

Modiolodon subovalis, Ulrich, 1893. (Pl. II., figs. 30, 31.)

Modiolodon subovalis, Ulrich, 1893, *Rep. Geol. Surv. Ohio*, vol. vii. p. 635, pl. li. figs. 11, 13.

Specific Characters.—Shell of moderate size, compressed, inequilateral, expanded posteriorly, subovate, slightly oblique. The anterior end is short, the narrowest part of the valve, its margin rounded. The inferior border gently convex. The posterior obliquely subtruncate. The hinge line arcuate. The umbones are small, compressed, and placed far forwards but not terminal. There is a tendency to angulation along a line from the umbone to the postero-inferior angle, posterior to which the dorsal slope is rapidly compressed.

Interior.—The hinge has not been observed in the Scotch examples. The anterior adductor scar is well marked and is deep, circular, and close to the antero-superior angle; the posterior, large and conspicuous, is seen in the hollow of the dorsal slope not far from the postero-superior angle. Pallial line entire.

Exterior.—The surface is adorned with close, fine concentric lines of growth, separated into groups by distant linear grooves.

Dimensions.—Fig. 30, Pl. II., a medium-size example, measures: antero-posteriorly, 30 mm.; dorso-ventrally, 20 mm.

Localities.—Middle Llandoverly of Woodland Point and Newlands.

Observations.—I have referred five specimens to this species rather than to *Mytilus gradatus*, Salter, which should, I think, more correctly be referred to *Modiolodon*. ULRICH describes several species which are closely related, but differ in contour and

conditions of growth. The peculiar external character is well marked in fig. 30, Pl. II., and one example, fig. 31, Pl. II., gives all the details of the interior except the hinge plate.

Modiolodon quadratus, sp. nov. (Pl. II., figs. 28, 29.)

Specific Characters.—Shell below medium size, transversely quadrate, compressed, anterior end almost obsolete, depressed. The inferior border is almost straight, parallel with the upper border. The posterior border very bluntly rounded. The hinge line depressed anteriorly, straight posteriorly. The umbones are anterior and immediately above the anterior end, so that they point directly forwards and are apparently placed half-way up the anterior margin, but which really is the junction of the small anterior end and the depressed anterior part of the hinge plate.

Interior.—The anterior adductor scar is large and is placed low down at the antero-inferior angle just within the margin. Hinge plate not seen.

Exterior.—The surface is almost smooth but concentric, fairly regular, but distant plicæ are seen towards the lower margin and over the posterior part of the valve.

Dimensions.—Fig. 28, Pl. II., a left valve, measures: antero-posteriorly, 10 mm.; dorso-ventrally, 15 mm.

Locality.—Woodland Point, Middle Llandoverly.

Observations.—A very quaintly shaped shell which should not be mistaken. It is allied to the *M. obtusus*, Ulrich, but the latter is much more transverse and not so broad in front. The *Megalomus*, *Cypricardites Deshayesiana* of de Verneuil, is much too gibbose and has a well-marked umbonal ridge. Three specimens are in the collection, one of which, a left valve, shows the anterior adductor muscle scar.

Modiolodon subcircularis, sp. nov. (Pl. II., figs. 26, 27.)

Specific Characters.—Shell below medium size, subcircular, slightly oblique, compressed, inequilateral. The anterior end has its margin rounded and continued in an interrupted subcircular sweep to the postero-superior angle. Hinge line arcuate. Umbone small, compressed, pointed, placed a little in front of the centre of the valve, raised. The valve is moderately convex, with a gently compressed dorsal slope.

Interior.—The adductor muscle scars are large, deep, and normal in position. Pallial lines entire. Hinge plate has no lateral teeth. Cardinal teeth not exposed.

Exterior.—The surface is covered with very fine concentric lines of growth, which, towards the lower margin, become strengthened into concentric ridges and grooves.

Dimensions.—Fig. 27, Pl. II., a left valve, measures: antero-posteriorly, 21 mm.; dorso-ventrally, 20 mm.

Localities.—Middle Llandoverly of Woodland Point and Newlands.

Observations.—This species, which shows strongly marked generic affinities with *M. subovalis*, with which species it also occurs, differs so markedly in general contour and

in surface ornament that I have no hesitation in erecting it into a new species. None of the many species of the genera which ULRICH has described from the Lower Silurian rocks of Ohio have the subcircular shape of the species under description. Fortunately, a specimen from Newlands is in the form of an internal cast, which shows all details of the interior except the cardinal region of the hinge plate.

Genus *Paracyclas*, Hall, 1843.

Paracyclas, Hall, 1843, *Geol. Surv. N. York Rep.*, 4th Dist., p. 171.

Lucina, Portlock, 1843, *Rep. Geol. Londonderry*, p. 571.

„ M'Coy, 1844, *Synops. Carb. Foss. Ireland*, p. 53.

Paracyclas, Hall, 1885, *Geol. Surv. N. York, Pal.*, vol. v., pt. i., Lamell., ii., p. xxxviii.

„ Beushausen, 1895, *Die Lamell. rheinisch. Devon.*, p. 165; *Abh. königl. preuss. Geol. Landes.*, n.f., pt. xvii.

Generic Characters.—Shell equivalve, subequilateral, suborbicular or broadly sub-elliptical. Anterior end regularly rounded, posterior end rounded or subtruncate, somewhat more produced below than the anterior. Beaks small and low, generally rising little above the hinge line. Hinge line short. Post-cardinal slope more or less defined by an oblique furrow or depression, which sometimes leaves the extremity subalate. Surface concentrically striate, sometimes with strong concentric ridges marking the exterior. Structure of hinge not fully observed. Ligament supported on each side internally by a narrow plate, and leaving in the cast two narrow grooves directed forward from the beak. Muscular impression in the post-umbonal slope. Pallial line parallel with, and a little within, the margin of the shell.

Observations.—The above is HALL's full diagnosis in 1885 (*op. supra cit.*). The shells that I now refer to the genus are smaller than those species which are known in the Devonian or Carboniferous rocks. Unfortunately, I have gained no definite knowledge of the hinge plate in the older species.

Paracyclas minor, sp. nov. (Pl. IV., figs. 32-35.)

Specific Characters.—Shell small, suborbicular, very moderately gibbose. Anterior end rounded. Inferior border almost semicircular. The posterior subtruncate. The hinge line arched. The umbones small, subcentral, slightly raised, obtuse. The dorsal slope is compressed.

Interior.—Not exposed.

Exterior.—The shell is ornamented with regular, fine, close, concentric lines, often separated into groups by deeper concentric linear grooves, especially near the lower margin.

Dimensions.—Fig. 32, Pl. III., measures: antero-posteriorly, 10 mm.; dorso-ventrally, 10 mm.; elevation of valve, 8 mm.

Localities.—Shalloch Mill, Middle Bala; Thraive and the Star-fish bed, Upper Bala; Woodland Point, Middle Llandoverly.

Observations.—There are several specimens of the shell in the collection labelled Woodland Point, one only from each of the other localities. That from the Star-fish bed is crushed, and it is possible that I may be wrong in referring it to the same species. The Thraive specimen seems to agree in all details with those from Woodland Point. The ornament and general contour agree typically with HALL'S diagnosis of the genus, and I have no hesitation in referring them for the present to *Paracyclas*, until further details of the interior are available for study.

Cyrtodonta, Billings, 1858.

Cyrtodonta, Billings, 1858, *Canad. Nat. and Geol.*, vol. iii. p. 431.

Palæarca, Hall, 1859, *Pal. N.Y.*, vol. iii. p. 270.

” ” ” *12th Rep. Regents New York Mus. Nat. Hist.*, p. 10.

” . Salter, 1866, *Mem. Geol. Survey Gt. Brit.*, vol. iii. p. 341.

Angellum, Miller, 1878, *Jour. Cincinnati Soc. Nat. Hist.*, vol. i. p. 105.

Cyrtodonta, Ulrich, 1897, *Geol. Minnesota, Fin. Rep.*, vol. iii., pt. ii., p. 534.

Generic Characters.—Shell transversely ovate or subcircular, gibbose, umbones swollen, placed at the anterior third of the hinge line. Dorsal slope compressed.

Interior.—Hinge plate of 3–5 oblique teeth in front, becoming smaller as they pass backwards, and sloping forwards; elongate, slightly diverging teeth behind, thin in front, but becoming thicker as they pass backwards. Anterior adductor scar shallow, triangular, placed beneath the hinge teeth, remote from the margin. Posterior adductor scar shallow and large, placed below the posterior hinge teeth, with hollow of the dorsal slope. Pallial line simple.

Exterior.—The surface is ornamented with concentric lines and rugæ of growth.

Observations.—There has been a good deal of obscurity as to the synonymy of this genus, the whole history of which is given by ULRICH in the final report of the geology of Minnesota (*op. supra cit.*). I agree with him that BILLINGS' name should stand. HALL evidently agreed that his *Palæarca* must fall, but thought that *Cypricardites*, Conrad, should take its place. This genus, according to ULRICH, was insufficiently described, and the hinge described as characteristic of *Cypricardites* does not correspond to that of *Cyrtodonta*. ULRICH goes on to say, p. 536 (*op. supra cit.*): “He (CONRAD) represents the cardinal teeth as diverging from the beak, much as in a *Lyrodosma*, and says that the anterior one is the ‘largest and most prominent.’ Neither of these conditions is ever present in *Cyrtodonta*. On the contrary, the teeth are subparallel, and to be called horizontal rather than radial, while the anterior one, if any can be so called, is the smaller.” This criticism only adds to the difficulty, and makes it questionable whether ULRICH is dealing with shells of the character of BILLINGS' species, the more so when on p. 533 he, in discussing the relation of *Cyrtodonta* to the *Arcidæ*, and with *Macrodon* in particular, says: “I should hold that *Macrodon* was not a member of *Arcidæ*, since that genus most certainly did not arise in *Ctenodonta*.” The last sentence expresses a fact which no one will dispute, but there is no connection at all

between *Ctenodonta*, a nuculiform shell, and *Macrodon*, a typical arciform genus. Hence one cannot but arrive at the conclusion that ULRICH had not been fortunate enough to see the whole of the hinge of *Cyrtodonta*.

SALTER (*op. supra cit.*) helped to confuse the synonymy also, giving a hypothetical date to *Palæarca*, 1857, saying: "*Palæarca* appears to have been in some way in print in 1847. It is unfortunate that it escaped the notice of Mr BILLINGS, as it seems to have done that of all others." This date must also be misprinted, as is the date SALTER gives to *Cyrtodonta*, Billings, 1848 for 1858 (p. 341). It is a pity that SALTER did not give the exact reference to the first publication of *Palæarca*, because HALL discarded it in favour of *Cypricardites*, Conrad, 1841, and it never seems to have been adopted by subsequent American authors.

Observations.—Mr SALTER gave at length his reasons for retaining *Palæarca*, Hall, in preference to *Cypricardites*, 1841, Conrad. MILLER (*N. American Geol. and Pal.*, p. 476) says: "If the genus can stand, it must be based on this type (*C. curtus*) (all other specimens are referred to other genera), because this species alone has a hinge-line like the one CONRAD made." *Palæarca* seems to have been dropped in America. MILLER places it as a synonym of *Cypricardites*. I am of opinion that SALTER'S *Palæarca bulla*, *P. obscura*, and *P. socialis* cannot in any sense be considered to belong to the same genus as *P. Billingsiana*.

Palæarca is closely allied to *Grammatodon*, under which name Carboniferous and Mesozoic arciform shells should now be placed. The hinge plate is very similar in both genera, but the teeth in front of the umbo slope forwards and not backwards. The Ordovician shells are not so carinate as the Mesozoic species, but several Carboniferous examples, e.g., *G. (Parallelodon) squamifer*, *G. fallax*, and *G. Fraiponti*, are not carinate. For the present, therefore, the obliquity of the anterior hinge teeth alone distinguishes the genus *Cyrtodonta* from *Grammatodon*, and I see no reason whatever to hesitate in placing both genera in the Arcidæ.

Cyrtodonta penkillense, sp. nov. (Pl. IV., fig. 21.)

Specific Characters.—Shell below medium size, transversely oblong, slightly oblique, inequilateral, obliquely somewhat gibbose. The anterior end is short, its margin rounded. The inferior border very slightly convex; the posterior obliquely truncate, almost straight, making an obtuse angle with the hinge plate, which is straight and slightly elevated posteriorly. The umbones are small, incurved, placed somewhat anteriorly; a well-marked subangular ridge passes backwards from the umbo to the postero-inferior angle, and a more rounded shorter ridge marks off the umbo from the small anterior end; and the dorsal slope is compressed and hollowed.

Interior.—Not observed in the specimen.

Exterior.—The surface is almost smooth, but here and there on the body of the valve concentric striæ of growth may be seen.

Dimensions.—Fig. 21, Pl. IV., measures: antero-posteriorly, 14 mm.; dorso-ventrally, 10 mm.

Locality.—Upper Llandovery at Penkhill.

Observations.—This specimen is provisionally referred to the genus *Cyrtodonta*, though no details of the hinge plate are to be seen. It is much more modioliform and has its posterior end more expanded than *C. quadrata*, Salter, sp., with the type of which I have been able to compare it. The specimen consists of a slab with both valves lying open, of which the right has lost its lower border.

Cyrtodonta gibbosa, Salter. (Pl. IV., fig. 17.)

Specific Characters.—Shell of medium size, oblique, gibbose, subquadrate, inequilateral. The anterior end is compressed, its border rounded. The inferior border is strongly convex. The posterior, oblique, truncate, almost straight. The hinge line straight, equalling in length the longest antero-posterior diameter of the shell. Postero-superior angle obtuse. The umbones are swollen, incurved, and pointed, and placed at the junction of the anterior and middle thirds of the hinge line. The body of the shell is strongly convex, the dorsal slope much compressed. Anteriorly there is a small oblique compression.

Interior.—The hinge plate consists of two anterior oblique teeth separated by grooves. Posteriorly, two long oblique teeth, which become thickened as they pass backwards.

The anterior adductor muscle scar well marked, round, and deeply placed within the umbonal hollow, remote from the margins; the posterior shallow and inconspicuous.

Exterior.—The surface is ornamented with fine concentric lines of growth, somewhat flexuous in front, and towards the inferior margin separated into grooves by a deeper concentric groove.

Dimensions.—Fig. 17, Pl. IV., a left valve, measures: antero-posteriorly, 28 mm.; dorso-ventrally, 25 mm.; from side to side, 15 mm. (estimated).

Locality.—Lower Llandovery of Mulloch Hill.

Observations.—A single specimen, a cast of the left valve, is in the collection. The hinge plate is most perfectly preserved, and all details of the interior are exposed. The inferior part shows some details, however, of the surface marking.

Cyrtodonta Billingsiana, Salter, 1866. (Pl. IV., fig. 18.)

Palæarca Billingsiana, Salter, 1866, p. 342, woodcut 12, fig. 4.

Specific Characters.—Shell rhomboid, ovate, moderately gibbose, inequilateral. The anterior end the shorter, compressed at its antero-superior angle, which is a right angle. The anterior margin is sinuous above, bluntly rounded below. The inferior border broadly convex. The posterior obliquely truncate, nearly straight; the postero-superior angle well defined, somewhat obtuse. The hinge line is almost straight. The

umbones are small, pointed, and incurved, slightly raised, placed a little anterior to the middle line. The valves are obliquely swollen, and a very compressed and hollowed dorsal slope is separated from the rest of the shell by a bluntly rounded oblique ridge which passes from the umbo to the posterior inferior angle, becoming less angular as it approaches the border of the shell.

Interior.—The hinge consists of three short radiating teeth separated by grooves posteriorly, and in front of four very fine oblique teeth. The anterior adductor muscle scar is small and placed low down, immediately within the margin of the valve; the posterior is shallow and placed in the hollow of the dorsal slope, distant from the hinge line.

Exterior.—The surface is ornamented with fine, somewhat irregular concentric lines and striæ of growth.

Dimensions.—Fig. 18, Pl. IV., a left valve, measures: antero-posteriorly, 37 mm.; dorso-ventrally, 26 mm.; elevation of valve, 8 mm.

Locality.—Lower Llandovery of Mulloch Hill.

Observations.—The only example in the collection consists of a cast of the interior and its mould, showing the external surface of the valve. The hinge plate is well exposed.

It will be noted that SALTER says his shell was rather compressed. I have described this example as moderately gibbose, and we differ as to the position of the umbones, for I do not think that his figure warrants the description: "The beak is anterior, beyond the anterior fourth." SALTER'S type appears to have a more angular ridge from the umbones to the posterior inferior angle than the Scotch specimen, but I fancy there has been some compression of the former, and that this character is largely accidental.

Cyrtodonta transversa, sp. nov. (Pl. IV., figs. 19, 20.)

Specific Characters.—Shell below medium size, transverse, gibbose. Anterior end much narrower than the posterior in the dorso-ventral diameter, very inequilateral. The anterior end is narrowed, its border rounded. The inferior border is elongate and descends, becoming almost straight posteriorly. The posterior border oblique, bluntly rounded below, almost straight above. The hinge line is straight, raised posteriorly. The umbones are elongate, obtuse, inrolled and twisted forward, placed far forwards but not terminal. Proceeding from the umbo towards the postero-inferior angle is a blunt, rounded gibbosity, above which the dorsal slope is so much compressed as to be concave. Anteriorly the valve is slightly compressed above the middle lower border.

Interior.—The hinge plate is normal. Adductor muscle scars normal.

Exterior.—Ornamented by concentric grooves and rugose lines of growth.

Dimensions.—Fig. 19, Pl. IV., a left valve, measures: antero-posteriorly, 19 mm.; dorso-ventrally, 13 mm.

Locality.—Upper Bala, Star-fish bed.

Observations.—Two specimens, a right and a left valve, are in the Gray Collection. The latter shows the hinge plate, and both are casts of the interior, but show indications of the surface ornament. SALTER'S *C. quadrata*, sp., has something of the appearance of *C. transversa*, but the latter has an expanded posterior end, and the upper and lower margins are not so nearly parallel.

Genus *Vanuxemia*, Billings, 1858.

Vanuxemia, Billings, 1858, *Rep. Prog. Geol. Surv. Canada*, p. 186.

„ Miller, 1889, *North Amer. Geol. and Pal.*, p. 515.

„ Ulrich, 1897, *Geol. Minnesota, Final Rep.*, vol. iii., pt. ii., p. 549.

Generic Characters.—Shell ventricose, oblique, very inequilateral. Umbones anterior, raised, incurved, distant, a well-marked ligamental area.

Interior.—Hinge plate massive, with two to four oblique cardinal and lateral teeth. Anterior adductor muscle scar deep, and placed apparently in a hollow of the anterior end of the thickened hinge plate. Pallial line entire.

Exterior.—The surface is marked by fine lines of growth.

Observations.—The umbones of *Vanuxemia* are more terminal than those of *Cyrtodonta*, to which it has a close affinity, as demonstrated by the structure of the hinge plate. ULRICH (*op. supra cit.*) points out the important difference in the position of the anterior adductor muscle scar “being excavated out of the hinge plate instead of being placed on the floor of the valve.” He says he knows twenty to twenty-five valid species, all of Lower Silurian age.

Vanuxemia distans, sp. nov. (Pl. V., figs. 31–33.)

Specific Characters.—Shell small, obliquely gibbose, subquadrate. The anterior end is compressed and thin, subalate; its margin descends and curves backwards, the inferior border is narrowed and rounded, the posterior margin almost straight, oblique, the hinge line straight. The umbones are large and pointed and incurved, and twisted slightly forwards, widely separated and elevated, subcentral. The valve is obliquely swollen, the dorsal slope subalate.

Interior.—The posterior hinge teeth are normal. Unfortunately, no more details are exposed.

Exterior.—Ornamented with fine concentric lines of growth.

Dimensions.—Fig. 33, Pl. V., a right valve, measures: antero-posteriorly, 19 mm.; dorso-ventrally, 12 mm.; gibbosity of valve, 7 mm.

Locality.—Scotland: Llandeilo beds, Balclatchie, Dowhill, Craighead.

Observations.—This peculiarly shaped shell resembles the gasteropod *Capulus* in shape, but, as I find both right and left valves, there is no doubt that it is a Pelecypod. There are several specimens in the Gray Collection from the above localities. Several

are crushed so that the umbones and oblique swelling become angular. I can find no described form at all like the shells under description, and have given them the specific name of *distans*, on account of the widely separated umbones.

Genus *Pararca*, Hall, 1885.

Pararca, Hall, 1885, *Geol. Surv. New York*, vol. v., pt. i., Lamell., ii., p. xxxvi.

Generic Characters.—“Shell equivalve, inequilateral, transversely subelliptical or rhomboidal in outline. Posterior end often subtruncate. Anterior end short and rounded. Valves moderately convex. Cardinal line about half the length of the valve, arching at the beaks. Umbonal slope often defined. Surface marked with more or less slender radii with narrow interspaces and with fine concentric striæ of growth.

“Hinge narrow and long, furnished with a series of minute crenulations. Ligament apparently contained in a narrow groove along the cardinal border. Muscular impressions and pallial line unknown.”

Observations.—I have quoted HALL'S diagnosis of the genus, to which he assigns six species from the Devonian rocks of North America, of which *P. transversa* most closely resembles the Scotch specimen. There is some little difficulty in settling which is the type; after the name of the genus we find in brackets, “Types, *P. transversa*, *P. venusta*, *P. Sao*, *P. recta*,” but the description of *P. precedens* comes first, and *P. transversa* second.

Pararca tenuilineata, sp. nov. (Pl. IV., fig. 22.)

Specific Characters.—Shell small, transverse, slightly inequilateral, regularly swollen. The borders are formed by a single curve of varying radius. The hinge line gently arcuate. The umbones are subcentral, small, moderately raised.

Interior.—Unknown.

Exterior.—The surface is everywhere crossed by close, fine, radiating lines, visible under the microscope. These lines are a little thicker where they terminate at the margin of the valve. There are several concentric undulations of growth on the surface of the valve.

Dimensions.—Fig. 22, Pl. IV., measures: antero-posteriorly, 10 mm.; dorso-ventrally, 6 mm.

Locality.—Penkhill, Upper Llandovery.

Observations.—This is a very distinct little shell, and I regret that only one specimen, and that one far from perfect, is at my disposal. It is very closely allied to *P. transversa*, Hall, but it has a close resemblance to *C. inequistriata*, Beushausen, from the Upper Devonian (*Abh. König. Preuss. Geol. Landesanstalt*, Neue Folge, Heft xvii.; *Die Lamell. des rheinischen Devon.*, p. 347, pl. xxxvi. fig. 11).

This author shows the posterior side of the shell to be a little longer than the anterior, and if this obtains in the Penkhill specimen the latter will be a left valve.

I question whether BEUSHAUSEN'S species should be referred to *Cardiola*. It is clearly more nearly allied to *Pararca*, Hall. HALL shows that the posterior side of the shell is the longer.

Genus *Mytilarca*, Hall, 1870.

Mytilarca, Hall, 1870, *Prelim. Notice Lamell. Shells*, p. 19.

„ Hall, 1884, *Geol. Surv. New York*, vol. v., Pal., i., Lamell., pt. ii., p. xiv.

„ Miller, 1889, *North American Geol. and Pal.*, p. 493.

Generic Characters.—“Shell equivalve, inequilateral and mytiliform, with terminal beaks and short hinge line, which is bordered by a flattened, longitudinally striated ligamental area of greater or less extent. Cardinal teeth small, situated beneath the beak. Posterior teeth small and oblique, situated at the post-cardinal extremity of the hinge. Test free from radii, with a single known exception.”

Mytilarca, sub-gen. *Plethomytilus*, Hall, 1884.—“Equivalve, mytiloid, gibbous. Shells with a finely striated ligamental area. Posterior side subalate. Hinge line transverse. Lateral teeth small and oblique. No cardinal teeth have been observed. Test with concentric striæ.”

Observations.—It is very questionable whether the sub-genus *Plethomytilus* is necessary. In *Naiadites*, *Myalina*, and other mytiliform genera, it is found that the species have been formed by differences in the length of the hinge line. For example, *M. Verneuilli* has an elongate hinge line, and *M. Flemingi* a very short one. *N. modiolaris* has a long one, and *N. carinata* and *N. triangularis* much shorter.

Mytilarca is closely related to *Ambonychia*, but there seems to be no byssal notch, judging from the figured specimens in HALL'S work.

Mytilarca is well represented in Devonian rocks.

Mytilarca (Plethomytilus) mytilimeris, Conrad, sp. 1842. (Pl. II., figs. 11, 12.)

Inoceramus mytilimeris, Conrad, 1842, *Jour. Acad. Nat. Sc.*, vol. viii. p. 241.

Mytilus mytilimeris, Salter, 1848, *Mem. Geol. Surv. Gt. Britain*, vol. ii., pt. i., p. 364, pl. xx. figs. 7, 8, 9.

Plethomytilus mytilimeris, Miller, 1889, *North American Geol. and Pal.*, p. 503.

Specific Characters.—Shell of moderate size, compressed, ovate. No anterior side. The valves are deepest at the anterior border, which descends almost vertically downwards at first, then forms the well-rounded inferior margin. The posterior margin is slightly oblique, almost straight, forming a continuous curve with the lower border, and almost a right angle with the hinge line above. The hinge line is short and straight. The umbones are pointed, twisted forward, and terminal, projecting over the anterior border. The postero-superior angle is compressed and subalate.

Interior.—I am able to give no details, except that the hinge plate was thick in the neighbourhood of the umbo.

Exterior.—The surface seems to have been almost smooth.

Dimensions.—Fig. 11, Pl. II., measures: antero-posteriorly, 30 mm.; dorso-ventrally, 45 mm.; elevation of valve, 3 mm.

Locality.—Woodland Point, Middle Llandovery; Star-fish beds, Upper Bala.

Observations.—Fig. 11, Pl. II., agrees well with the specimen figured by SALTER (*op. supra cit.*). Amongst the specimens is one which I conceive has been much compressed laterally, so that it appears to be a very narrow but deep shell; and there is a specimen (Pl. II., fig. 12) that I think may be a very senile form, though it is not unlike *P. ponderosus* of HALL.

SALTER suggested that the *Inoceramus trigonus* of PORTLOCK might be a form of *P. mytilimeris*, but the hinge line is much too long for this species.

Genus *Nucula*, Lamarck, 1799.

For synonymy, *vide* Hind, 1897, *Mono. Brit. Carb. Lamell.*, p. 175.

Generic Characters.—Shell equivalve, inequilateral, close all round, more or less gibbose. Hinge angular, multidenticate; hinge teeth in two sets, separated by a small fossa for the ligament, which is internal. Adductor muscle impressions well marked. Pallial line entire. No lunule or escutcheon.

Observations.—I have thought it well to refer two species to this genus, on the general characters and shape, although I have not been able to verify the generic character of the hinge plate. Conversely to what obtains in Carboniferous times, *Nucula* is only represented in Ordovician rocks by two species, while *Ctenodonta* has assumed many different forms.

For a fuller discussion of the relations of *Nucula*, *Nuculana*, and *Ctenodonta*, I would refer to my monograph (*op. supra cit.*).

Nucula levata, Hall, sp., 1847. (Pl. III., figs. 29–31, 31a.)

Nucula levata, M'Coy, 1855, *Brit. Pal. Foss.*, p. 285, pl. iv. figs. 4, 5.

„ „ Hall, 1847, *Pal. New York*, vol. i. p. 150, pl. xxxiv. figs. 1a–4.

Specific Characters.—Shell obliquely sub-rhomboidal, gibbose. The anterior end is rounded, inferior margin slightly convex, posterior margin oblique and almost straight, making a bluntly rounded angle with the lower margin, and a very obtuse angle with the hinge line. Hinge line almost straight, elevated, short. Umbones elevated, swollen, pointed, incurved, and contiguous, placed almost about the centre of the hinge line. No lunule or escutcheon. Dorsal slope hollowed and depressed.

Interior.—Not known.

Exterior.—The surface is almost smooth.

Dimensions.—Fig. 30, Pl. III., measures: antero-posteriorly, 14 mm.; dorso-ventrally, 11 mm.; from side to side, 10 mm.

Locality.—Scotland: Llandeilo beds, Balclatchie, Ardmillan. Wales: Dinas Bran.

Observations.—This species was stated by HALL to vary considerably, and the

Scotch specimens agree better with the description than the figures. Whether the genus is correctly stated as *Ctenodonta* I doubt, but in the absence of definite knowledge I can only say that the shape and general character of the shell would lead me to suggest *Nucula*. The species is not uncommon.

Nucula? *varicosa*, Salter, 1854. (Pl. III., figs. 32–37.)

Nucula varicosa, Salter, 1854, *Q.J.G.S.*, vol. x. p. 75.

Ctenodonta varicosa, Salter, *Siluria*, 2nd ed., p. 213, fig. 4.

„ „ „ 1866, *Mem. Geol. Surv. Gt. Britain*, vol. iii. p. 345, Woodcut xiii. fig. 1.

Specific Characters.—Shell obliquely and triangularly ovate, gibbose. Umbones subcentral, raised, incurved, and somewhat prosogyrous. The cardinal margin is subangular, the inferior bluntly rounded.

Interior.—The anterior adductor scar is deep and rounded, placed some way within the margin and half-way down; the posterior is rounded and placed low down. The hinge plate is multidenticulate, but I am unable to say whether there is a fossa between the anterior and posterior rows of teeth.

Exterior.—The surface is almost smooth; but towards the lower margin are some deep, distant, concentric lines.

Dimensions.—Fig. 32, Pl. III., measures: antero-posteriorly, 10 mm.; dorso-ventrally, 9 mm.

Localities.—Scotland: Llandeilo series at Ardmillan and Dowhill. England: Caradoc beds, Onny River, Bala, Conway Falls, Horderly.

Observations.—I am unable to decide whether this species should be referred to *Nucula* or *Ctenodonta*. The shape and general characters of the shell incline me to adopt SALTER'S first view and to retain the species in *Nucula*. *Ctenodonta*, as far as I know from a study of the Carboniferous species, never assumes the peculiar shape of the species under discussion.

Genus *Nuculana*, Link., 1807.

For synonymy, *vide* Hind, 1897, *Mono. Brit. Carb. Lamell.* (Pal. Soc.), p. 192.

Generic Characters.—Shell transverse, more or less narrowed behind and produced into a beak. Umbones small and contiguous; lunule and escutcheon well marked. Cardinal border somewhat angular. Hinge teeth numerous, in two sets, which do not extend very far on each side of the umbo, separated by a fossa for the ligament, which is internal, placed between the anterior and posterior sets of teeth. Posterior slope more or less keeled. Pallial line sinuated or not. Surface ornamented with fine, regular, concentric, parallel grooves and lines.

Observations.—The generic characters are quoted from my monograph on the Carboniferous lamellibranchs (*op. supra cit.*). It is interesting to find specimens of the

genus with their main characters agreeing closely with Carboniferous forms in much older rocks, and indicates that the ancestry of the genus must be looked for in still older rocks. The ornament seems to have a permanence of character and to be preserved even in recent forms.

I have referred several species to the genus, and it is of interest to note that the tendency to the varietal development of the species is analogous to that which obtains in the Carboniferous forms.

Nuculana lobata, sp. nov. (Pl. IV., figs. 1-3, 3a.)

Specific Characters.—Shell small, irregular in shape. The main portion of the shell is triangular and gibbose; the anterior superior angle is much compressed and expanded into a lobe which projects forwards. The anterior margin is thin and descends obliquely downwards and backwards. The inferior margin convex. The posterior end is apparently narrowed, compressed, its margin obliquely truncate, straight above and rounded below. The hinge line is erect and compressed anterior to the umbones, erect and sloping posteriorly, moderately short, making an obtuse angle with the posterior margin. The umbones are comparatively large, elevated, incurved, pointed, contiguous, placed in front of the centre of the shell. The anterior umbonal slope is marked off from the anterior lobe by a sudden and steep continuation. There is a very large, deep escutcheon, bounded by a curved, rounded ridge which passes from the umbo to the posterior margin.

Interior.—The hinge is normal. Adductor muscle scars small and shallow. Pallial line entire.

Exterior.—The surface is covered with fine, close, regular lines of growth, which may become interrupted by one or two deep concentric grooves, near the lower margin of the valve.

Dimensions.—Fig. 1, Pl. IV., measures: antero-posteriorly, 13 mm.; dorso-ventrally, 10 mm.; from side to side, 7 mm.

Locality.—Upper Bala beds, Drummuck, Thraive Glen.

Observations.—This species is easily identified by the peculiar shape, caused by the anterior lobe and the deep escutcheon. Fortunately, the collection contains a very good specimen as a cast of the interior, so that the internal anatomy of the shell is demonstrated. The presence of the well-developed escutcheon and the ornament have determined me to place the shell in the genus *Nuculana*.

Nuculana imbricata, Portlock, 1846. (Pl. IV., figs. 4-7, 7a.)

Nucula acuta, var. *imbricata*, Portlock, 1843, *Geol. Rep. Londonderry*, p. 430, pl. xxxiv. fig. 10.

„ *subacuta*, McCoy, 1846, *Sil. Foss. Ireland*, p. 19, pl. ii. fig. 3.

Specific Characters.—Shell small, transversely ovate, acute. Anterior end rounded; posterior, narrowed and pointed. The inferior margin is convex. The hinge line arched, the posterior limb descending rapidly, with a curve, whose convexity is upwards.

The umbones are tumid, subcentral, elevated, and moderately large. A large lunule and escutcheon.

Interior.—Hinge multidenticulate, anterior and posterior rows of teeth not continuous. Adductor muscle scars normal. In casts, the fossil is much cut away posterior to the umbo, corresponding to the large escutcheon.

Exterior.—The surface is adorned with numerous distinct, raised, parallel concentric lines.

Dimensions.—Fig. 4, Pl. IV., a right valve, measures: antero-posteriorly, 5 mm.; dorso-ventrally, 4 mm.

Locality.—Scotland: Llandeilo beds, Ardmillan, Craighead, Balclatchie. Ireland: Desertcreat, Co. Tyrone.

Observations.—M'COY should, I think, have preserved PORTLOCK's varietal name, instead of substituting a new one. PORTLOCK, it was very evident, thought his species, though very closely allied in form to SOWERBY's Coal Measures form *N. acuta*, distinct. He says: "Mr SOWERBY's figures so closely agree with our specimen that it is difficult to separate them; still, however, it is probable that they are not the same." He then proceeded to point out differences, and on that account gave the varietal name *imbricata*, which I adopt on grounds of priority. The species has all the characters of the genus *Nuculana*. The special concentric linear ornament is only found in this genus of the Nuculidæ in Carboniferous rocks.

Nuculana concentrica, sp. nov. (Pl. IV., figs. 8, 9.)

Specific Characters.—Shell small, transverse, deep anteriorly, narrowed posteriorly, moderately compressed. The anterior margin bluntly rounded, the inferior gently convex. The posterior border narrow, bluntly rounded. The hinge line arched, much depressed posteriorly. The umbones small, erect, excavated posteriorly by the well-marked dorsal slope and escutcheon, incurved, apparently directed backwards, subcentral. The valves are gently swollen, with a very marked depressed, shallowed dorsal slope.

Interior.—Hinge multidenticulate, but the cartilage fossa below the umbo has not been seen.

Exterior.—The surface is adorned with fine raised concentric lines, with sulci between them of a width double that of the line.

Dimensions.—Fig. 8, Pl. IV., measures: antero-posteriorly, 13 mm.; dorso-ventrally, 7.5 mm.

Locality.—Woodland Point, Middle Llandovery.

Observations.—A well-marked species, which I have referred to *Nuculana* rather than to *Ctenodonta* on account of its shape and ornament, and of the fact that there seems to be a well-marked escutcheon. Three specimens, all from the same locality, are in the collection, one of which shows both valves flattened out on a slab, the left valve being somewhat crushed, but in the right valve the anterior part of the hinge plate is exposed.

Nuculana curta, sp. nov. (Pl. IV., figs. 10–14, 14a.)

Specific Characters.—Shell small, triangular, ovate, gibbose, inequilateral. The anterior end rounded, the posterior narrowed at the expense of its upper margin. The anterior margin rounded, the inferior convex, the posterior narrow and blunt. The hinge line arched. The umbones large, raised, incurved and pointed, placed at the junction of the anterior and middle thirds of the hinge plate. The lunule small, escutcheon large and wide.

Interior.—The hinge plate appears to have a central cartilage pit between the anterior and posterior rows of teeth. Muscle scars normal, but no impression within the umbonal cavity. Pallial line entire.

Exterior.—The surface is ornamented with close, regular, fine, linear, concentric lines.

Dimensions.—Fig. 11, Pl. IV., measures: antero-posteriorly, 10 mm.; dorso-ventrally, 6 mm.

Localities.—Middle Bala, Shalloch Mill; Upper Bala, Thraive Glen and Star-fish bed; Lower Llandoverly, Mulloch Hill.

Observations.—A very well-marked little shell, which must be placed under *Nuculana* on account of the large escutcheon and the arrangement of the hinge plate. Not uncommon; several examples show casts of the interior. This species is much less transverse and pointed than *N. imbricata*, which occurs in the Llandeilo beds of Ardmillan.

Genus *Ctenodonta*, Salter, 1851.

Ctenodonta, Salter, 1851, *Rep. Brit. Assoc. for 1851* (1852), p. 64.

„ Hind, 1898, *Mono. Brit. Carb. Lamell.* (Pal. Soc.), p. 209.

Generic Characters.—Shell more or less transverse, ovate. Hinge consists of a long row of teeth, which become smaller as they approach the centre from either extremity. There is no cartilage pit below the umbo separating the hinge teeth into an anterior and posterior set. Pallial line entire. No lunule or escutcheon.

Observations.—On pp. 177 and 209, *op. supra cit.*, I have discussed the synonymy of this genus, which was established for a Canadian species by SALTER, and it is unnecessary to say more here. The genus was represented by many more species in Ordovician than Carboniferous times. In the Devonian rocks of North America, HALL shows that the number of species reached its maximum, and in Carboniferous times only two species survived. The range in time is much less than either of its closely allied genera *Nucula* and *Nuculana*.

Most of the species which have been included in the Gray Collection have been described previously, but one species I consider to be new, *C. triangularis*.

Ctenodonta dissimilis, Portlock, sp., 1843. (Pl. III., figs. 5–7.)

Arca dissimilis, Portlock, 1843, *Rep. Geol. Londonderry*, p. 428, pl. xxxiv. fig. 5.

Specific Characters.—Shell below medium size, moderately compressed, inequilateral, obliquely oval. The anterior end is narrowed, chiefly at the expense of its lower margin; its border bluntly rounded. The inferior border convex; the posterior bluntly rounded. The hinge line very gently arcuate. The umbones pointed, raised, incurved, and hollowed out in front; placed in front of the middle line. The umbonal region is moderately gibbose, but the valve is rapidly compressed towards its margin.

Interior.—The hinge plate is normal.

Exterior.—The surface is ornamented by fine concentric lines.

Locality.—Drummuck, Thraive Glen, Upper Bala.

Dimensions.—Fig. 7, Pl. III., measures: antero-posteriorly, 9 mm.; dorso-ventrally, 7 mm.

Observations.—After comparison with PORTLOCK'S type, I have referred four specimens to his species provisionally. There is doubt, from PORTLOCK'S description of the hinge plate, that the species belongs to *Ctenodonta* rather than to *Arca*, although he says "the species approximates in the arrangement of the teeth to the genus *Arca*." Only four specimens have been obtained in Scotland.

Ctenodonta lingualis, Phillips, sp., 1848. (Pl. III., figs. 8, 9.)

Nucula lingualis, Phillips, 1848, *Mem. Geol. Surv. Great Britain*, vol. ii., pt. i., p. 367, pl. xxii. fig. 6.

Specific Characters.—Shell transversely ovate, postero-inferior angle produced, gibbose, inequilateral. The anterior border rounded, the inferior broadly convex. The posterior obliquely truncate, almost straight. Hinge line arcuate, erect posteriorly. The umbones well developed, gibbose, incurved, and twisted forwards, placed at the junction of the anterior and middle thirds of the hinge line. The dorsal slope is compressed and hollowed. No lunule or escutcheon.

Interior.—Normal.

Exterior.—The surface is ornamented with fine concentric lines and rugæ of growth.

Dimensions.—Fig. 8, Pl. III., a bivalve example, measures: antero-posteriorly, 21 mm.; dorso-ventrally, 8 mm.; from side to side, 9 mm.

Localities.—Drummuck, and Middle Bala of Shalloch Mill. England: Lower Caradoc beds of Eastnor Park.

Observations.—Three specimens in the collection I refer to PHILLIPS' species, and they differ markedly from any other forms of the same genus in general characters. The transversely oval shape, erect hinge line posteriorly, and the hollow dorsal slope at once distinguish the species from all others.

Ctenodonta triangularis, sp. nov. (Pl. III., figs. 10, 11.)

Specific Characters.—Shell compressed, triangular. The anterior end deep, the posterior narrowed and slightly produced. The anterior border descends downwards and backwards almost straight; the inferior border is bluntly curved at first, and almost straight in the posterior two-thirds. Posterior border very short, truncate. Hinge line almost straight, the longest diameter of the shell. The umbones are small, pointed, and inconspicuous, subcentral.

Interior.—The anterior part of the hinge plate only has been seen, and consists of a number of small tubercular teeth.

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

Dimensions.—Fig. 10, Pl. III., measures: antero-posteriorly, 6.5 mm.; dorso-ventrally, 4 mm.

Locality.—Llandeilo series of Ardmillan.

Observations.—Two specimens of the species have been obtained. The specimen on which my description is based is a right valve. Its shape and contour are so peculiar that it cannot be referred to any known species.

The whole of the hinge has not been seen, but for the present I refer it to *Ctenodonta*.

It has occurred to me that the *Posidonomya venusta* figured by PORTLOCK may be an example of the shell I have just described.

Ctenodonta aff. *transversa*, Portlock, sp., 1843. (Pl. III., figs. 12–14.)

Arca transversa, Portlock, 1843, *Geol. Rep. Londonderry*, p. 428, pl. xxxiv. figs. 1–4.

Specific Characters.—Shell almost equivalve, transversely oval, ends somewhat truncate, the posterior broader than the anterior, very moderately gibbose. The inferior margin broadly convex, the hinge line arched. Umbones small, very little raised, subcentral. No lunule or escutcheon.

Interior.—Normal.

Exterior.—Surface almost smooth, but the microscope shows very fine concentric lines of growth.

Dimensions.—Fig. 13, Pl. III., a left valve, measures: antero-posteriorly, 15 mm.; dorso-ventrally, 8 mm.

Localities.—Scotland: Llandeilo bed, Balclatchie, Craighead; Middle Bala of Shalloch Mill and Whitehouse Bay; Lower Llandovery, Mulloch Hill; Middle Llandovery, Woodland Point; Upper Llandovery of Penkhill.

Observations.—The Scotch specimens are very much smaller than PORTLOCK's types, which are all internal casts, and for this reason it is difficult to be certain that I

am correct in referring them to this species; but the shell is so devoid of any special characters that for the present I think it best to refer it to *C. transversa*. The specimens from the higher beds are larger, and equal the Irish specimen in size.

Ctenodonta regularis, Portlock, sp., 1843. (Pl. III., figs. 15–17.)

Arca regularis, Portlock, 1843, *Geol. Rep. Londonderry*, p. 427, pl. xxxiv. fig. 2.

Specific Characters.—Shell semicircularly oval, moderately but regularly convex, almost equilateral. The anterior and inferior margins regularly curved, the posterior slightly truncate. The hinge line almost straight. The umbones are central, raised and pointed, small. The posterior slope slightly hollowed.

Interior.—The hinge teeth are normal.

Exterior.—The surface is ornamented with fine, close, regular concentric lines.

Dimensions.—PORTLOCK'S type (holotype) measures: antero-posteriorly, 13 mm.; dorso-ventrally, 9 mm.

Localities.—Llandeilo beds at Dowhill, Craighead, and Balclatchie.

Observations.—The specimen figured by PORTLOCK is a left valve, and is either semi-decorticated or the cast of the exterior. Only one of Mrs GRAY'S specimens shows the external characters, which are similar to those which obtained in Carboniferous forms of the genus.

Ctenodonta obliqua, Portlock, sp., 1843. (Pl. III., figs. 18, 19.)

Arca obliqua, Portlock, 1843, *Geol. Rep. Londonderry*, p. 429, pl. xxxiv. fig. 6.

Ctenodonta obliqua, Murchison, 1859, *Siluria*, 3rd ed., p. 213, fig. 6.

Specific Characters.—Shell suborbicular, equilateral, moderately gibbose, with compressed dorsal slope. The anterior end is compressed, its margin rounded. Inferior border broadly curved, meeting the posterior margin at an angle. Posterior border oblique, straight, making a more or less obtuse angle with the hinge line, which is straight and short. Umbones small, tumid, incurved, slightly raised, central. Passing from the umbo to the postero-inferior angle is an oblique ridge separating the hollowed dorsal slope from the rest of the valve. No lunule or escutcheon.

Interior.—Hinge multidenticulate, normal. Adductor muscle scars normal.

Exterior.—Shell covered with fine, somewhat irregular, close concentric lines of growth; towards the lower border, strong concentric sulci.

Dimensions.—Fig. 18, Pl. III., measures: antero-posteriorly, 15 mm.; dorso-ventrally, 11 mm.; from side to side, 5 mm.

Locality.—Scotland: Upper Bala beds, Drummuck. Ireland: Desertcreat, Co. Tyrone.

Observations.—PORTLOCK'S type is the cast of the interior of the right valve. The

characteristic traits of the species are the central umbones and the angular ridge. I am in doubt as to the correctness of referring the figure given by MURCHISON (*op. cit. supra*) to PORTLOCK'S species, because the drawing shows neither of these characters.

Ctenodonta eastnori, Portlock, sp., 1843. (Pl. III., figs. 20–22.)

Arca eastnori, Portlock, 1843, *Geol. Rep. Londonderry*, p. 427, pl. xxxiv. fig. 3.

Ctenodonta eastnori, Murchison, 1859, *Siluria*, p. 233, pl. xi. fig. 9.

Specific Characters.—Shell gibbose, transversal, oval, compressed in front and behind; umbones subcentral, pointed, incurved. Posterior end slightly deeper than the anterior; junction of anterior and posterior margins with the hinge line almost a right angle. Hinge line straight, inferior margin slightly convex; anterior almost straight, passing downwards and forwards. Postero-inferior angle bluntly rounded; posterior margin straight, oblique.

Interior.—Hinge line multidenticulate, no fossa separating the anterior and posterior rows of teeth. Adductor scars small and not well marked.

Exterior.—Surface nearly smooth.

Dimensions.—Fig. 22, Pl. III., a large specimen, measures: antero-posteriorly, 25 mm.; dorso-ventrally, 16 mm.

Locality.—Scotland: Llandeilo beds, Craigland, Ardmillan, Balclatchie; Star-fish bed, Upper Bala. Ireland: Desertcreat, Co. Tyrone.

Observations.—This species seems to be rare in the Gray Collection. One specimen (fig. 22, Pl. III.) is much larger than the Irish specimens, which are casts of the interior, and fortunately show the hinge plate. I have no hesitation in referring this species to *Ctenodonta*.

C. eastnori has been obtained from the Upper Llandovery of Malvern.

Ctenodonta semitruncatus, Portlock, sp. (Pl. III., figs. 23–25.)

Pectunculus semitruncatus, Portlock, 1843, *Geol. Rep. Londonderry*, p. 429, pl. xxxiv. fig. 7.

Specific Characters.—Shell below medium size, equilateral, suborbicular, moderately gibbose. The anterior end compressed, its margin rounded. The inferior margin broadly convex, meeting the posterior border at a blunted angle. The posterior border is obliquely truncate, almost straight. The postero-superior angle obtuse. The hinge line only slightly arched. Umbones almost central, small, swollen, pointed and incurved, slightly raised above the hinge line. Dorsal slope rapidly compressed, so that there is an almost angular ridge from the umbo to the postero-inferior angle.

Interior.—The adductor muscle scars are small and normal in position. Hinge plate normal. Pallial line entire.

Exterior.—The surface is ornamented with numerous fine, raised, concentric lines, often interrupted by deeper, more irregular sulci of growth, and thus apparently grouped into bands, especially towards the lower margin.

Dimensions.—Fig. 23, Pl. III., a bivalve example, measures: antero-posteriorly, 18 mm.; dorso-ventrally, 13 mm.; from side to side, 10 mm.

Locality.—Scotland: Upper Bala beds of Drummuck; Middle Bala, Shalloch Mill. Ireland: Desertcreat, Co. Tyrone.

Observations.—PORTLOCK'S type is a cast of the interior of a left valve. In the Gray Collection is a fine bivalve shell with the test preserved, also a specimen which shows the interior of the right valve. The characteristic shape of the shell is very distinctive. The best-preserved specimens are from the Upper Bala beds, but I have referred a number of specimens from the Middle Bala of Shalloch Mill to the same species. These examples are crushed and distorted, but I note in some of them a similar ornament to that I have observed in those specimens which were obtained at Drummuck.

Genus *Palæoneilo*, Hall, 1885.

Palæoneilo, Hall, 1885, *Geol. Surv. New York*, Pal., vol. v., pt. i., Lamell., ii., p. xxvii.

„ Hind, 1900, *Q.J.G.S.*, vol. lvi. p. 46.

„ „ 1904, *Mono. Brit. Carb. Lamell.* (Pal. Soc.), p. 140.

Generic Characters.—“Nuculiform shells, transversely ovate or subelliptical, the posterior end often subrostrate, well or more or less defined sulcus along the umbonal slope. Surface marked with striæ of growth, which are often lamellose and elevated into concentric ribs. Hinge furnished with a row of regular small transverse teeth, which is sometimes interrupted beneath the beak by a change in the direction of the teeth or by several oblique teeth. Ligament external, contained in a shallow and narrow groove along the cardinal border. Muscular scars not strongly impressed, situated below the extremities of the hinge line. Pallial line simple.”

I have quoted HALL'S diagnosis, and would refer to my monograph, *op. supra cit.*, for a discussion on the subject.

Palæoneilo antiqua, sp. nov. (Pl. III., fig. 28.)

Specific Characters.—Shell small, inequilateral, transverse, elliptical. Anterior end broad, posterior narrowed, shell compressed. Anterior margin rounded; the inferior very convex, the segment of a larger circle than the anterior border. The posterior border narrow, bluntly rounded. The hinge line arched, the posterior portion sloped downwards rapidly. The umbones are obtuse, narrow, directed forwards and incurved, placed very far forwards. There is a very broad and deep escutcheon, separated from the dorsal slope by a raised, erect, narrow ridge.

Interior.—Not observed.

Exterior.—Surface without any ornaments. The periostracum appears to have been thick.

Dimensions.—Fig. 28, Pl. III., a left valve, measures: antero-posteriorly, 16 mm.; dorso-ventrally, 10 mm.

Locality.—Woodland Point, Middle Llandovery.

Observations.—I have referred this shell provisionally to *Palæoneilo*, on account of the deep and well-marked escutcheon and the smooth surface. If I am right, this species differs from many others in having no fold posteriorly below the dorsal slope. The general shape of the shell is more like *Ctenodonta*; but the latter has no escutcheon. *Nuculana* has an escutcheon; but as far as I know the shell is always marked with fine but definite regular concentric lines. The material at my disposal is a single left valve, and it is to be hoped that more specimens may be obtained with a view of the hinge plate, that the true generic affinity of the species may be settled.

Palæoneilo sinuatus, sp. nov. (Pl. III., figs. 26, 27.)

Specific Characters.—Shell below medium size, transversely subquadrate, obliquely gibbose, with a well-marked oblique sinus, reaching from the umbo to the lower margin, marking off a very small anterior end from the rest of the valve. Posterior superior angle compressed. The anterior margin short, rounded, the inferior gently sinuous, the posterior broad and bluntly convex. The hinge line straight behind, arched and depressed in front. The umbones are compressed, obtuse, and projecting over the small anterior end, which they overshadow, terminal.

Interior.—Not exposed.

Exterior.—The surface is ornamented with close, raised, concentric lines and rugæ of growth.

Dimensions.—Fig. 26, Pl. III., a right valve, measures: antero-posteriorly, 20 mm.; dorso-ventrally, 13 mm.

Localities.—Middle Llandovery of Woodland Point; Middle Bala of Whitehaven Bay and Shalloch Mill.

Observations.—I doubtfully refer this species to *Palæoneilo*, chiefly on account of the sinuate form of its posterior end. Unfortunately, no details of the interior are exposed. Six specimens are in the Gray Collection, four of which are labelled "Woodland Point."

Genus *Clidophorus*, Hall, 1847.

Cucullæa, Sowerby, 1839, *Silurian Syst.*, pt. ii. p. 602, pl. iii. figs. 1b, 12a, b.

Clidophorus, Hall, 1847, *Pal. New York*, vol. i. p. 300.

„ M'Coy, 1855, *Brit. Pal. Foss.*, p. 273.

„ Miller, 1889, *North Amer. Geol. and Pal.*, p. 471.

„ Ulrich, 1897, *Geol. Minnesota*, vol. iii., pt. ii., Pal., p. 606.

Generic Characters.—Shell transverse, compressed, oblong, obliquely gibbose, equivalve, inequilateral. Umbones small in the anterior third of the valve. Apparently no lunule or escutcheon.

Interior.—Hinge edentulous; a vertical process passes downwards from the hinge

plate, dividing off the exterior adductor muscle scar from the rest of the valve. Surface smooth or not fine concentric lines of growth.

Observations.—HALL'S name is prior to any others, and must stand. M'COY (*op. supra cit.*) says: "KING'S genus *Pleurophorus*, I find from examination of authentic specimens to be exactly equivalent to *Clidophorus*." This surely must be an error, as *Pleurophorus* is a shell with a well-marked hinge plate which has strong cardinal teeth, and does not possess the peculiar form of internal plate described by HALL in *Clidophorus*. *Cucullella*, M'COY, 1848, and *Nuculites*, Conrad, 1841, probably synonymous, denote a genus which, although it possesses the clavicular plate of *Clidophorus*, has a multidenticate hinge, and therefore must differ from that genus.

Clidophorus planulatus, Conrad, sp., 1841. (Pl. IV., fig. 15.)

Nuculites planulatus, Conrad, 1841, *Ann. Rept.*, p. 48.

Cleidophorus ,, Hall, 1847, *Pal. New York*, vol. i. p. 300, pl. lxxxii. figs. 9a-e.

Clidophorus ,, M'COY, 1855, *Brit. Pal. Foss.*, p. 273, pl. i. k. fig. 9.

Specific Characters.—Shell subelliptical, very moderately convex, broader in front than posteriorly. Anterior margin elliptical, inferior slightly convex, posterior obliquely truncate or bluntly curved. Hinge line somewhat arcuate. Umbones small, incurved, pointed, placed immediately in front of the centre. Valves uniformly curved.

Interior.—Immediately in front of the umbo is a fine oblique rib, which leaves a groove in casts, which extends one-third the distance across the valve.

Exterior.—Surface almost smooth.

Dimensions.—Fig. 15, Pl. IV., a left valve, measures: antero-posteriorly, 11 mm.; dorso-ventrally, 8 mm.

Localities.—Scotland: Middle Bala Beds, Shalloch Mill. Wales: Golden Grove, Llandeilo.

Observations.—A single example of this species occurs in the Gray Collection, from the Middle Bala. It shows the characteristic process in front of the umbo, which distinguishes the genus. *Nuculites* also has a similar process, but in this genus the hinge is furnished with numerous transverse narrow teeth, of which I can see no trace in the Scotch specimen. The species is not uncommon in the Utica Slate and Hudson River group of North America. M'COY has recorded the species from Llandeilo.

Genus *Cardiomorpha*, de Koninck, 1842.

For synonymy, see Hind, *Carboniferous Lamellibranchiata* (Pal. Soc.), 1898, p. 256.

Generic Characters.—Shell equivalve, inequilateral, gibbose, of obliquely rounded or subquadrilateral shape. The umbones are swollen and elevated, with the beaks

markedly prosogyrous. Lunule absent. The hinge plate is edentulous, the ligament small and external. The muscle scars are shallow, and the pallial line entire. Shell thin, either ornamented with fine, regular, concentric lines, or smooth. ULRICH (*Final Rep. Geol. Surv. Minnesota*, vol. iii. p. 575) has established the genus *Plethocardia* for Lower Silurian shells having the external characters of *Cardiomorpha*. It seems to me very questionable whether this genus is necessary.

Cardiomorpha prisca. (Pl. V., figs. 1, 1a.)

Specific Characters.—Shell small, very oblique, very inequilateral, gibbose. The anterior end very small and narrow, overhung by the prosogyrous umbones, its margin rounded. The inferior border descends downwards and backwards, and is almost straight. The posterior end broad, its margin bluntly rounded. The hinge line arcuate; the umbones large, gibbose, raised, and markedly prosogyrous, so that they project some distance in front of the anterior end. No lunule or escutcheon, but a groove behind the umbo parallel to the hinge plate, for the external ligament.

Interior.—Not examined.

Exterior.—The surface in the umbonal region is smooth, but near the lower margin are some irregular sulci and lines of growth.

Dimensions.—Fig. 1, Pl. V., measures: antero-posteriorly, 18 mm.; dorso-ventrally, 13 mm.

Locality.—The Llandeilo series of Ardmillan.

Observations.—I consider this shell to be very typical of the genus *Cardiomorpha*. The characteristic groove for the ligament is apparent. The specimen has evidently been somewhat crushed along the dorsal slope, and the ridge in that region is evidently adventitious.

Genus *Edmondia*, de Koninck, 1843.

For synonymy, see Hind, 1899, *Brit. Carb. Lamell.* (Pal. Soc.), p. 286.

Generic Characters.—Shell transversely ovate, equivalve, close all round, convexly swollen. Hinge edentulous, simple, erect, possessing a transverse, deeply situated, thickened ridge, separated from the edge of the valve by a smooth groove. No lunule or escutcheon.

Observations.—The shells of this genus are in shape regular and featureless, and have, as a rule, a simple ornament of more or less rugged concentric lines of growth. In one group there are distinct sulcations, separated by concentric ridges, which may be acute or rounded.

I have provisionally referred three species of Ordovician shells to this genus; one, *E. silurica*, has much the same external ornament as the Carboniferous species *E. Maccoyi*.

Edmondia silurica, sp. nov. (Pl. V., figs. 2-4.)

Specific Characters.—Shell triangularly subcircular, moderately gibbose, posterior portion a little larger than the anterior. The anterior inferior and posterior margins form an almost circular curve. Hinge line arched. Umbones small, subcentral, elevated, incurved. The valve is regularly tumid from above downwards and before backwards.

Interior.—Hinge plate bears an internal, semicircular plate which leaves an impression in casts. Adductor muscle scars normal.

Exterior.—The surface is ornamented by numerous (14) almost equidistant, raised, narrow concentric ridges, separated by broader shallow grooves.

Dimensions.—Fig. 3, Pl. V., a left valve, measures: antero-posteriorly, 7 mm.; dorso-ventrally, 5 mm.

Locality.—Scotland: Llandeilo beds, Dowhill, Ardmillan.

Observations.—Fortunately, one specimen showed the cast of the hinge plate, making the generic relationship clear. This species has a marked similarity to *Edmondia Maccoyi* of the Carboniferous rocks, but the latter is somewhat more quadrate in form. The ornament is very similar. *E. silurica* seems to be not uncommon in the Gray Collection.

Edmondia simplex, sp. nov. (Pl. V., figs. 5-7a.)

Specific characters.—Shell small, ovate, moderately convex, inequilateral. The anterior end short and compressed, margin regularly rounded. The inferior margin broadly convex, the posterior almost elliptical. The hinge line very slightly arcuate. Its umbones are erect, pointed, directed slightly forwards, not contiguous, and placed at the junction of the anterior and middle thirds of the hinge plate. The dorsal slope is convex, gradually compressed. There is an obscure oblique ridge and sulcus which extends from the umbo to the lower border in the anterior part of the valve.

Interior.—Hinge plate edentulous. The anterior adductor muscle scar is small, and placed immediately within the anterior superior angle, and is separated from the cavity of the umbo by a thick ridge of shell.

Exterior.—The surface is ornamented by fine, close, concentric lines and striæ of growth, interrupted in front as they pass over the oblique groove.

Dimensions.—Fig. 7, Pl. V., measures: antero-posteriorly, 17 mm.; dorso-ventrally, 13 mm.; from side to side, 7 mm.

Locality.—The Llandeilo series of Ardmillan; Shalloch Mill, Middle Bala; Mulloch Hill, Lower Llandovery; ? Woodland Point, Middle Llandovery.

Observations.—I have referred a number of specimens from somewhat different horizons to this species. The best material consists of two specimens from Ardmillan, one of which is a cast of the interior. The valves were close, without escutcheon or

lunule, and apparently edentulous, with a thickened hinge plate, and on these grounds I have referred the shells to *Edmondia*. The absence of any ridges or external moulding, and the simple character, agree with *Edmondia* rather than with any other genus.

Edmondia antiqua, sp. nov. (Pl. V., figs. 8–10.)

Specific Characters.—Shell small, transversal, oval, regularly gibbose. The anterior end rounded, the inferior margin broadly convex, the posterior rounded. The hinge line gently arcuate. The umbones small, blunt, slightly raised, incurved, placed at the junction of the anterior and middle thirds of the hinge line.

The valve is without ridge, and is regularly convex from above downwards and before backwards.

Interior.—The hinge plate is normal; a groove is seen in casts for the characteristic umbonal plate, long and deep; anterior adductor muscle scar large, deep, and round; posterior shallow and large, both normal in position.

Exterior.—The surface is ornamented with regular concentric rugæ and undulations of growth.

Dimensions.—Fig. 8, Pl. V., an internal cast of the right valve, measures: antero-posteriorly, 13 mm.; dorso-ventrally, 8 mm.; elevation of valve, 3 mm.

Localities.—Llandeilo beds of Ardmillan, Dowhill, and Craighead.

Observations.—Five specimens in the collection I refer to this species. One of them (Pl. V., fig. 8) is a cast of the interior, which shows the internal characters of *Edmondia*. The internal plate characteristic of the genus was well developed in the Ordovician representatives of the genus. The species has the simple, regular, featureless characters of many of the species of the genus.

Genus *Slava*, Barrande, 1881.

Cardiola, Sowerby, 1839, *Sil. Syst.*, p. 617.

Slava, Barrande, 1881, *Syst. Sil. de la Bohême*, vol. vi p. 154.

Tiariconcha, Frech, 1891, *Devon.*, S. 251.

„ Beushausen, 1895, *Die Lamell. des rheinischen Devon.*, p. 318 (*Abh. Königl. Preuss Geol. Landesanstalt*, N.F., Heft xvii.).

Generic Characters.—Shell ovate, acute. Umbones acute, slightly prosogyrous. Hinge line short and arched. Ornament consists of flat, broad, concentric, convex folds and grooves in the young part of the shell, but of fine radiating lines in the lower or older posterior.

Observations.—FRECH separated the group of *Cardiola fibrosa*, Sow., under the name of *Tiariconcha* (*supra cit.*), and referred certain Devonian forms to that genus. BEUSHAUSEN followed him, and described three species (*op. supra cit.*). Reference to

the shell figured by him, *Tiariconcha scalariformus* (pl. xxxviii. fig. 1), from the Upper Middle Devonian of Martenberg, shows a very close resemblance indeed between the Ordovician and Devonian species.

BARRANDE'S genus *Slava* has the precedence of date, and must therefore stand.

He refers SOWERBY'S *Cardiola fibrosa* to the genus, and figures it and one other species, *S. bohémica*, both from Stage E of the sequence he established for Central Bohemia.

Slava fibrosa, Sow., 1839. (Pl. V., figs. 17–19, 19a.)

Cardiola fibrosa, Sow., 1839, *Sil. Syst.*, p. 617, pl. viii. fig. 4.

Mytilus semirugatus, Portlock, 1843, *Rep. Geol. Londonderry*, p. 430, pl. xxv. A, fig. 7.

Cardiola ,, M'Coy, 1855, *Brit. Pal. Foss.*, p. 282.

Slava ,, Barrande, 1881, *Syst. Sil. de la Bohème*, vol. vi. p. 154.

Specific Characters.—Owing to the crushed condition of all specimens, the shape cannot be determined from them. They all show remains of medium-sized shells which have few concentric sulci and ridges in the upper half, and a finely radially striate portion below, the latter being of much greater extent. The umbones were pointed. The concentric ridges are often composed of two close portions separated by a fine linear groove.

Dimensions cannot be given, owing to the imperfection of the specimens.

Locality.—Bargany Pond Burn and Penhill, said to be Upper Llandovery.

Observations.—*Slava fibrosa* is a very peculiar shell, easily recognised by the characteristic ornament of transverse sulci above and fine radiating striæ below. Good figures are given in the *Silurian System* (*op. supra cit.*). If not identical, the Bargany examples are closely allied. The peculiar reduplication of the concentric ridges is not shown in the drawings of previous writers, but I doubt whether this character is more than a variation of growth.

MURCHISON stated that this shell was a Lower Ludlow species (*Siluria*, 3rd ed., p. 255). SOWERBY stated that *C. fibrosa* was one of two species "very characteristic of the lower members of Upper Silurian rocks over wide tracts." The list of fossils from the Silurian rocks of the South of Scotland in the *Fauna, Flora, and Geology of the Clyde Area* compiled for the Meeting of the British Association, quotes the species as occurring at Penwhapple and Straiton (p. 437); but in the same work, at pp. 425 and 429, Straiton is referred, in the tables of strata, to the Wenlock series, and Bargany to the Tarranon series. As M'COY points out (*op. supra cit.*), the radiating striæ can be traced in some specimens to the umbo, but they are almost obsolete on the ridges and practically absent in the sulci. M'COY'S work may be referred to for a complete description of the species.

It has occurred to me that the peculiar figures of *Mytilus semirugatus*, Portlock (*op. cit.*), may belong to this species.

Genus *Dualina*, Barrande, 1881.

Lunulicardium, Salter, 1861, *Mem. Geol. Surv. Gt. Brit.*, "Geol. Neighbourhood Edinburgh," p. 139.

Dualina, Barrande, 1881, *Syst. Sil. du centre de la Bohême*, 1^{re} partie, vol. vi. p. 77.

Beushausen, 1895, *Abh. Königl. Preuss. Geol. Landesanstalt*, Neues Folge, Heft xvii. p. 298.

Generic Characters.—Shell inequivalve, inequilateral, triangularly ovate. The anterior end the larger. The umbones raised, unequal, and not opposite or contiguous. A blunt ridge or rounded swelling passes from the umbo downwards and backwards.

Interior.—Unknown.

Exterior.—A well-marked ornament of more or less close radiating ribs seems to be present in all species.

Observations.—The curiously shaped shells described by BARRANDE under the name *Dualina* are only known by their external characters. He states that there are three principal characters which distinguish the genus:—

1. The inequality of the valves, though it seems that it is sometimes the right and sometimes the left which is the more gibbose.
2. The inequality of the umbones of the two valves; this is naturally a corollary of No. 1.
3. The more gibbose valve is inclined towards one side.

Unfortunately, there are only two shells in the collection which can be referred to the genus, and these are single valves, so that nothing more is to be learned of the characters of the genus from the material at hand.

Dualina elegans, Salter, sp., 1861. (Pl. IV., fig. 23.)

Lunulicardium elegans, Salter, 1861, *Mem. Geol. Surv. Gt. Brit.*, "Geol. Neighbourhood Edinburgh," p. 139, pl. ii. fig. 10.

Specific Characters.—Shell small, moderately compressed, triangular. The posterior end small and adpressed. The anterior and lower borders rounded; the posterior obliquely truncate. The hinge line apparently short and arched. The umbones are raised, pointed, subcentral. Passing from the umbo to the postero-inferior angle is an acute angular ridge, separating a compressed and flattened dorsal slope from the rest of the valve. The interior is not exposed.

Exterior.—The surface is ornamented by numerous fine, regular, radiating ridges, which are almost obsolete on the flattened dorsal slope. Here and there these ridges are crossed by rugæ and lines of growth.

Dimensions.—Fig. 23, Pl. IV., measures: antero-posteriorly, 16 mm.; dorso-ventrally, 15 mm.

Locality.—The Upper Llandovery of Penwhapple Glen, *Graptolites priodon* bed.

Observations.—SALTER'S species has a strong resemblance to *D. secunda*, Barrande, from Stage E in Bohemia. A single specimen occurs in the Gray Collection, a right valve,

and unfortunately it is not well preserved in the umbonal region; but it shows the peculiar dorsal slope of the genus, and has the characteristic ornament.

SALTER'S type was obtained from Deerhope, a locality assigned to Upper Ludlow beds.

Genus *Cypricardinia*, Hall, 1859.

Cypricardinia, Hall, 1859, *Geol. Surv. New York, Pal.*, iii. p. 266.

„ „ 1885, *ibid.*, vol. v., pt. i., Lamell., ii., pt. ii., p. xlvi.

„ Miller, 1889, *N. Amer. Geol. and Pal.*, p. 475.

Generic Characters.—Shell inequivalve. The right valve more convex, very inequilateral; subrhomboid, obovate or sometimes trapezoidal, wider posteriorly. Anterior end short, declining from the beaks and rounded below. Posterior end wider and obliquely truncate. Beaks subanterior, incurved and adpressed. Umbo of the right valve often prominent. Cardinal line straight or arcuate, rising from the beaks. Umbonal slope prominent, often obtusely angular.

Surface marked by strong concentric lamellose undulations with intermediate fine striæ of growth, and in some species by radiating striæ, which are interrupted at the outer margin of the lamellæ. The valves are crossed obliquely by a shallow byssal sinus.

Hinge line marked by a long fold or lateral tooth in one valve. Cardinal teeth not determined. Ligament external, strong, leaving in the cast a deep elongate groove. Anterior muscular impression small, situated just within the anterior margin of the shell. Posterior muscular impressions large and strong, situated on the cardinal and umbonal slope, a little behind the middle of the length. Pallial lines parallel with the margin of the shell.

Observations.—I have quoted Hall's 1885 description at length (*op. supra cit.*), as I had only a single fragment to study. This fragment evidently, from its sculpture, agrees more closely with *Cypricardinia* than with any other genus.

Cypricardinia lineata, sp. nov. (Pl. V., fig. 20.)

Specific Characters.—Shell small, transversely subrhomboidal, almost equilateral. Anterior end rounded, its upper angle produced. Hinge line and superior borders subparallel; posterior border obliquely truncate. The umbones are moderately gibbose, subcentral, dorsal slope compressed.

Interior.—Not known.

Exterior.—The surface is ornamented with distinct parallel, concentric, raised, equidistant ridges.

Dimensions.—Fig. 20, Pl. V., a left valve. measures: antero-posteriorly, 10 mm.; dorso-ventrally, 5 mm.

Locality.—Ardmillan, Llandeilo series.

Observations.—Unfortunately, the material on which I have been obliged to found

this species is a distorted left valve, not altogether free from matrix; but the sculpture of the valve is so remarkable that the account could not be omitted. I suppose the specimen to be a left valve, in which case the forward projection of the antero-superior angle, as shown by the curvature of the lines of the ornament, is a very curious feature.

The shell has much the same ornament as *C. planulata*, Conrad, described by SALTER from the Lower Ludlow rocks of Dudley (*Mem. Geol. Surv. Gt. Britain*, vol. ii., pt. i., p. 349, pl. xxiii. figs. 2, 3, 4).

Genus *Dexiobia*, Winchell, 1863.

Dexiobia, Winchell, 1863, *Proc. Acad. Nat. Sc. Phil.*, p. 10.

„ Miller, 1889, *N. Amer. Geol. and Pal.*, p. 478.

Generic Description.—“It is inequivalve, inequilateral, beaks separated by an undefined area. Right valve very ventricose, with a very prominent umbo, and a produced, incurved beak, inclined forwards. Left valve much less inflated, with a less prominent beak, scarcely elevated above the dorsal margin. Hinge line more or less extended, straight or slightly bent, edentulous? furnished with a thickened cartilage plate bearing a linear posterior groove.”

Observations.—WINCHELL erected this genus for two species which came from the Yellow Sandstone beneath the Burlington group of Iowa, Lower Carboniferous. I have quoted his description in its entirety. HALL (*Geol. Surv. New York*, Pal., vol. v., pt. i., Lamell., ii. p. xxxvii.) suggests that *Dexiobia* is a synonym of *Cardiopsis*, Meek and Worthen, 1861. But the latter is said to be equivalve, and for the present I retain *Dexiobia*. HALL considers *Dualina*, Barrande, 1881, to be congeneric with *Dexiobia*, which must be replaced by the earlier species. The affinities of *Dexiobia* cannot be discussed without further material, but *Dualina* has not such a well-marked umbo, and has a different habit of growth.

Dexiobia elegans, sp. nov. (Pl. IV., figs. 28, 28a, 29.)

Specific Characters.—Shell of moderate size, obliquely gibbose, ovate, acute, very inequivalve. The anterior end is short and low, its margin rounded. The inferior border is very regularly convex. The posterior border curved. The hinge line arched. The umbones are erect, elongate, acutely pointed, and twisted forwards, widely separated and placed anteriorly. The valve is regularly convex. The area wide, but not marked off by any definite line. No lunule or escutcheon.

Interior.—The hinge line is plain, no cardinal teeth, a single posterior lateral tooth. The adductor scars have not been exposed.

Exterior.—The surface is almost smooth, but towards the margin obscure, regular, radiating lines are to be seen there, marked anteriorly.

Dimensions.—Fig. 29, Pl. IV., measures: antero-posteriorly, 25 mm.; dorso-ventrally, 26 mm.; elevation of valve, 5 mm.

Localities.—Penkill, Upper Llandovery; Mulloch Hill, Lower Llandovery.

Observations.—There are three specimens in the collection which I refer to this genus provisionally. They resemble the figure of the type very closely as to general contour and size. Unfortunately, no details of the interior are exposed.

Genus *Orthonota*, Conrad.

Orthonota, Conrad, 1841, *Geol. Surv. New York, Pal. Dept. Ann. Rep.*, p. 50.

Orthonotus, pars, M'Coy, 1855, *Brit. Pal. Foss.*, p. 274.

Orthonota, Hall, 1885, *Geol. Surv. New York, Pal.*, vol. v., pt. ii., Lamell., ii., p. xlv.

„ Miller, 1889, *N. Amer. Geol. and Pal.*, p. 497.

Generic Description.—“Equivalved, profoundly elongated. Hinge and basal margins straight and parallel. Beaks near the anterior extremity; posterior extremity truncated.”

Observations.—The above is CONRAD'S original description, quoted by HALL (*op. supra cit.*). Unfortunately, the hinge characters are still unknown, and little is known of the interior. The type is *Orthonota undulata*.

M'Coy has included in the genus *Goniophora cymbæformis*, which has very different characters, the strongly keeled shell differing very strongly from the typical forms of *Orthonota*.

The true generic affinity of the genus cannot be discussed until details of the hinge plate are to hand; but it seems to me to have a close relationship with some forms of *Sanguinolites*, e.g. *S. plicatus*. The genus is represented in the Devonian rocks of North America by more than a dozen species.

Orthonota inornata, Phillips, 1848. (Pl. V., fig. 21.)

Orthonota inornata, Phillips, 1848, *Mem. Geol. Surv. Great Britain*, vol. ii., pt. i., p. 362, pl. xix. fig. 3.

Specific Characters.—Shell transverse, narrow, very inequivalve. Dorsal and ventral margins subparallel. Anterior end narrow, produced, its margin rounded, forming an angle with the hinge line. The posterior end expanded and compressed, its border truncate and oblique, making an obtuse angle with the hinge line. The umbones are small, elongate, ridged, slightly raised, and situated in the anterior third of the shell.

Proceeding from the umbo to the margin just in front of the rounded postero-inferior angle, is a well-marked angular ridge, which gradually becomes obsolete as it crosses the valve. The dorsal slope is hollow, and the anterior narrowed by a broad sulcus.

Interior.—Unknown.

Exterior.—The surface is ornamented with numerous very fine, close, concentric lines, which run parallel with the margins.

Dimensions.—Fig. 21, Pl. V., a right valve, measures: antero-posteriorly, 36 mm.; dorso-ventrally, 14 mm.

Locality.—Scotland : Star-fish bed, Upper Bala. Wales : Marloes Bay.

Observations.—Unfortunately, the specimen in the Gray Collection is crushed immediately posterior to the umbo ; the posterior end is foreshortened and expanded. I have, however, very little doubt that it belongs to PHILLIPS' species. Marloes Bay is stated (*op. supra cit.*) to belong to the middle part of the Llandeilo series.

O. inornata is much more transverse and has a more distinct linear ornament than *O. nasuta*.

Orthonota nasuta, Conrad, sp., 1841. (Pl. V., fig. 22.)

Cypricardites nasutus, Conrad, 1841, *Ann. Rep. New York*, p. 52.

„ „ Emmons, 1842, *ibid.*, p. 403, fig. 4.

Modiolopsis nasutus, Hall, 1847, *Pal. New York*, vol. i. p. 159, pl. xxxv. fig. 7.

Orthonotus nasutus, M'Coy, 1855, *Brit. Pal. Foss.*, p. 275, pl. i. fig. 23.

Specific Characters.—Shell narrow, elongate, very moderately convex, superior and inferior margins subparallel. The anterior end, much narrower than the rest of the shell, has an elliptical margin. The posterior end somewhat expanded, its margin bluntly rounded. The umbones are small, situated at the anterior fourth of the hinge line.

Interior.—Unknown.

Exterior.—The surface is ornamented with concentric lines and rugæ of growth, some of which are strong enough to merit the term subimbricating.

Dimensions.—Fig. 22, Pl. V., a right valve, measures : antero-posteriorly, 18 mm. ; dorso-ventrally, 7 mm.

Locality.—Scotland : Llandeilo beds, Dowhill. England : Caradoc Sandstone, Horderly West, Shropshire.

Observations.—This species has been figured and described by M'COY from a British locality, in the Caradoc Sandstone, a somewhat higher horizon than that whence the Scotch specimen was obtained. HALL states of his specimens, one about the same size as the Scotch : “This is probably the young of the species which appears in the Hudson River group, where it has attained a much greater magnitude.” M'COY's specimen was 32 mm. long.

Genus *Orthodesma*, Hall and Whitfield, 1875.

Orthodesma, Hall and Whitfield, 1875, *Rep. Geol. Surv. Ohio*, vol. ii., pt. ii., Pl., p. 92.

„ Miller, 1889, *N. Amer. Geol. and Pal.*, p. 497.

Generic Characters.—“More or less elongate bivalve shells having the hinge line straight and generally extended posterior to the beaks, but contracted or bent beneath or anterior to them. Hinge plate apparently edentulous. Valves united by an external ligament extending to a greater or less distance along the posterior cardinal margin. Posterior muscular scar elongate, ovate, anterior scar small, both faintly marked. Pallial line simple. Shells thin, marked externally with irregular concentric plicæ. Type, *Orthodesma recta*.”

Observations.—It seems to me that SALTER's shell, *Mytilus platyphyllus*, may be conveniently placed in this genus, the character of which I have quoted from the original source (*op. supra cit.*). Probably the genus is not far removed from *Orthonota*; but it is more modioliform and obliquely gibbose. The American species come from the Hudson River group, on the upper portion of the Lower Silurian of North America.

Orthodesma platyphyllus, Salter, 1848. (Pl. V., fig. 23.)

Mytilus platyphyllus, Salter, 1848, *Mem. Geol. Surv. Gt. Britain*, vol. ii., pt. i., p. 364, pl. xx. figs. 13, 14.

Specific Characters.—Shell transverse, very inequilateral, narrow in front, expanded posteriorly. The anterior end is depressed and prolonged, almost elliptical. The inferior border is elongate, sinuous, concave in front and convex posteriorly. The posterior border is obliquely truncate, the postero-superior angle obtuse, the postero-inferior very bluntly rounded. The hinge line is depressed in front, straight and elevated posteriorly. The umbones are small, compressed, very slightly raised, anterior. Passing obliquely from the umbo to the postero-inferior angle is a well-marked oblique ridge separating the broad expanded and compressed dorsal slope from the body of the valve. Anterior to this ridge, the valve is compressed, very broadly so towards the inferior border.

Interior.—Not exposed.

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

Dimensions.—Fig. 23, Pl. V., measures: antero-posteriorly, 33 mm.; dorso-ventrally, 17 mm. at the posterior end.

Locality.—Lower Llandovery, Craighead. South Wales: Trichrug, Llangadoc.

Observations.—SALTER's two figures differ considerably from each other, and it is the first (fig. 13, *op. supra cit.*) that I consider the Scotch specimen resembles. It is much smaller, but otherwise has the same characters. A single specimen, the right valve, is in the Gray Collection.

Genus *Goniophora*, Phillips, 1848.

Goniophora, Phillips, 1848, *Mem. Geol. Surv. Gt. Britain*, vol. iii., pt. i., p. 264.

Orthonotus, M'Coy, 1855, *Brit. Pal. Foss.*, p. 274.

Goniophora, Barrande, 1881, *Syst. Sil. du Centre Bohême*, p. 82.

„ Hall, 1885, *Geol. Surv. New York, Pal.*, vol. v., pt. i., Lamell., ii., p. xxiii.

„ Beushausen, 1895, *Abh. Königl. Pruss. Geol. Landesanstalt*, Heft xvii., *Die Lamell. des rheinischen Devon.*, p. 196.

Generic Description.—Shell equivalve, very inequilateral, rhomboidal or trapezoidal; anterior end short, narrow, and rounded; posterior expanded, obliquely truncate, and almost straight. Umbones small, much incurved and twisted forwards, placed anteriorly. From the umbo a strong carinate ridge passes downwards and backwards to the postero-inferior angle, dividing the shell into two compressed portions which meet along this ridge. The dorsal slope is hollowed. A well-marked escutcheon.

Interior.—The hinge plate has a strong oblique tooth in the left valve, with a corresponding pit in the right valve. No lateral teeth. Anterior adductor scar deep and rounded, almost marginal. The posterior less well marked. A strong process posterior to the anterior adductor scar, leaving an elongate slit in casts, as in *Clidophorus*. Pallial line entire.

Exterior.—Surface ornamented with fine concentric lines of growth.

Observations.—PHILLIPS, discussing the relationship of some palæozoic shells to the Mytilidæ, speaking of *Cypricardia cymbæformis*, says: "If, as I suppose, *C. cymbæformis* be distinct generically and include species of the Mountain Limestone, the name *Goniophora* seems suitable. It is, however, doubtless a mytiloid shell." HALL adopted PHILLIPS' proposal, and the type is to be regarded as *C. cymbæformis*. I was unable to find a single tooth in the Carboniferous forms, and invented the genus *Mytilomorpha* to receive them, *Brit. Carb. Lamell.*, p. 338, where I have discussed the systematic position of *Goniophora* at length. M'COY refers *Cypricardia cymbæformis* to *Orthonotus*. CONRAD does not seem to have noticed PHILLIPS' proposal to place it as the type of a new genus.

Goniophora antiqua, sp. nov. (Pl. IV., figs. 24–27.)

Specific Characters.—Shell transverse, strongly carinate, oblique. Postero-inferior angle produced and pointed. Anterior end small, its margin rounded. Inferior border slightly convex. Posterior border oblique, straight, making angles with the upper and lower margin. Hinge line straight, short, and erect posteriorly. Umbones, anterior almost terminal, incurved, and somewhat prosogyrous, contiguous. Proceeding from the umbo to the postero-inferior angle is a strong angular ridge along which the shell is bent on itself so that the posterior slope is placed at an angle with the rest of the valve. In front and below the ridge is two-thirds of the shell, which is very gently convex, and shows only slight indication of any constriction. The dorsal slope is rapidly compressed and flattened. There appears to be an escutcheon, marked off by a shallow curved line on each side of the raised hinge.

Interior.—Hinge not seen. Muscle scars normal.

Exterior.—The lower and anterior part of the valve is almost smooth, but the triangular depressed dorsal slope is covered by regular, equidistant, close, raised lines, parallel to the posterior margin.

Dimensions.—Fig. 24, Pl. IV., measures: antero-posteriorly, 18 mm.; dorso-ventrally, 7 mm.; from side to side, 9 mm.

Locality.—Scotland: Llandeilo beds, Ardmillan; Penkhill, Upper Llandoverly; Woodland Point, Middle Llandoverly.

Observations.—There are four specimens of this species in the Gray Collection. It differs from *G. carinata*, Hall, sp., from the Trenton Limestone, in possessing a much less produced anterior end, and has an obsolete byssal sinus.

It differs from *G. cymbæformis* of the Ludlow beds in the absence of ornament on the valve below and in front of the strong oblique keel, and in being much less transverse.

Genus *Grammysia*, de Verneuil, 1847.

Grammysia, de Verneuil, 1847, *Bull. Soc. Géol. France*, 2nd ser., vol. iv. p. 696.

Orthonota, pars, Salter, 1848, *Mem. Geol. Surv. Gt. Britain*, vol. ii., pt. i., p. 359.

Grammysia, Hall, 1885, *Geol. Surv. New York*, Pal., vol. v., pt. i., Lamell., pt. ii. p. 30.

Generic Characters.—Shell equivalve, closed. Lunule and escutcheon well marked. Umbones anterior, and a compressed dorsal slope. Valves with an oblique sinus from the umbo to the lower margin, often with an oblique fold.

Interior.—Pallial line simple. Hinge plate edentulous. Adductor muscle scars faint.

Exterior.—Ornamented with concentric grooves and sulci, which become obsolete on the dorsal slope.

Observations.—HALL gives a long account of the relations of the genus, and criticises SALTER, who considered *Grammysia* as a subgenus of *Orthonota*. There can be no doubt that the two genera are distinct. SALTER considered *Allorisma* is a synonym of *Grammysia*, and although the two genera are closely related, the former has not the oblique fold and grooves which characterise *Grammysia*, and it has a sinuate pallial line, so that it is expedient for both genera to be retained. HALL, writing of *Grammysia*, states (*op. supra cit.*): "Valves in the typical forms traversed from the beak to the base by an oblique cincture and adjacent fold, which may be duplicate and are alternating in the two valves. . . . Some species show the cincture developed in the upper part becoming obsolete before reaching the margin. Many forms show a broad cincture without an adjacent fold; and in some species the cincture is indicated by a line of slight interruptions or irregularities in the concentric undulations; other species have the surface continuous, without cincture or fold." I have doubts if shells without the distinctive character of the genus should be any longer retained in it.

Grammysia undata, Sow., sp., 1839. (Pl. V., figs. 13–16.)

Cypricardia? undata, Sow., 1839, *Sil. Syst.*, p. 607, pl. v. fig. 3.

Orthonota ,, Sow., 1859, *Siluria*, 3rd ed., pl. xxiii. fig. 4.

,, ,, 1901, *Fauna, Flora, and Geol. of Clyde Area*, Brit. Ass. Handbook, p. 437.

Specific Characters.—Shell of medium size, oblique, gibbose, very inequilateral, subcarinate, transversely ovate. The anterior end is short and narrow, its margin rounded. The antero-superior angle pointed. The inferior margin is markedly convex, somewhat sinuous anteriorly. The posterior border is broadly obtuse below, almost straight above. The hinge line is elongate and almost straight. The umbones are large, prominent, raised, twisted forwards, inwards, and downwards, and anterior in

position; the lunule is large and excavated. The escutcheon well developed. Passing from the umbo to the postero-inferior angle is a rounded ridge which separates the convex and sulcated anterior part of the valve from the compressed and almost smooth dorsal slope. The convex portion shows a very obscure oblique compression, which broadens and becomes more marked near the lower border.

Interior.—The pallial sinus appears to be entire, and there is no shelly process posterior to the anterior adductor muscle scar. Hinge plate thin and linear posteriorly.

Exterior.—The anterior two-thirds of the valve is ornamented with somewhat irregular, rugged, concentric folds and rugæ, which, owing to the peculiar gibbosity of the valves, are oblique to the long axis of the shell. These rugæ and sulci become obsolete on the dorsal slope.

Dimensions.—Fig. 16, Pl. V., measures: antero-posteriorly, 35 mm.; dorso-ventrally, 17 mm.; thickness of valve, 6 mm.

Localities.—Bargany Point Burn, Penkhill, Cuddystone Glen, Camregan Wood, Upper Llandoverly; Woodland Point, Newlands, Middle Llandoverly; Mulloch Hill, Lower Llandoverly; Star-fish bed, Upper Bala.

Observations.—The material from which I have described the species is large in amount, but most of the examples are crushed into various strange shapes, and the various details have been gathered from several specimens.

The appearance of the shell agrees closely with the figure of *Cypricardia? undata*, Sowerby, in the *Silurian System*. The figure is poor and description meagre. The species is of interest because it shows the extinction of one of the most characteristic features of the genus *Grammysia*, i.e. the oblique fold and sulcus in the anterior part of the valve. But HALL (*Pal. New York*, vol. v., pt. i., Lamell., vol. ii.) shows that both groups existed side by side in the Devonian beds of that State. The form of *G. undata* approaches closely to the *Sanguinolites* of the Carboniferous rocks, but seems to be distinctly separated by some internal characters. In shape and habit, *S. omaliana*, of the highest beds of the Carboniferous limestone of Derbyshire, has a close resemblance to the Ordovician shell. SOWERBY referred this species to M'COY's *Orthonota* in his second work; but HALL points out (*op. supra cit.*, pt. xxx., xxxi.) that *Grammysia* and *Orthonota* are quite distinct, which is undoubtedly the case.

G. undata attained a much larger size than the measured example; but as all the more adult examples are crushed, the true dimensions could not be obtained.

Grammysia scotica, sp. nov. (Pl. V., fig. 12.)

Specific Characters.—Shell of moderate size, transversely rhomboidal, very inequilateral, moderately gibbose. The anterior end short, its margin rounded. The inferior border almost straight, the posterior border bluntly rounded. The hinge line almost straight. The umbones are small, raised, incurved, and placed far forwards, near the anterior end. Lunule and escutcheon present, the latter separated from the

rest of the valve by an erect angular ridge. Passing from the umbo to the inferior border at the junction of the anterior and middle thirds of the valve is a deep, broad, oblique sulcus, becoming more marked as it approaches the margin. Posterior to this groove the shell is obliquely gibbose. The dorsal slope is rapidly compressed and hollow.

Interior.—The anterior adductor muscle scar is very large and placed close to the anterior margin. The posterior is inconspicuous; pallial line entire.

Exterior.—Apparently ornamented with concentric lines and striæ of growth.

Dimensions.—Fig. 12, Pl. V., measures: antero-posteriorly, 35 mm.; dorso-ventrally, 16 mm.; from side to side, 16 mm.

Locality.—The Star-fish bed, Upper Bala.

Observations.—A single specimen of this shell has been collected. It has many resemblances to *G. cingulatus*, Salter, but is at once separated by the absence of oblique ribs in the left valve and much shorter anterior end. The specimen which I figure is, however, the cast of the interior, and it is possible that the exterior of the valve had characters not indicated in the internal cast.

Grammysia grandis, sp. nov. (Pl. V., figs. 11, 11a.)

Specific Characters.—Shell of moderate size, transversely rhomboidal, gibbose, with well-marked oblique ridge separating a compressed and hollowed dorsal slope from the rest of the valve. The anterior end is very short, curiously compressed by an oblique sulcus, its margin rounded. The inferior border is long, marked in the anterior half by two sinuations, nearly straight. The posterior border is nearly straight, obliquely truncate above, bluntly rounded below. Postero-superior angle well marked, obtuse. The hinge line is almost straight and long, parallel with the lower border.

The umbones are obtuse, continuous with the border of the lunule in front, so that they appear to be continuous with the anterior border, incurved, contiguous, placed far forwards, deeply grooved by the deep sulcus, which passes downwards and somewhat backwards to the lower border. Lunule large; escutcheon elongate and shallow, its margin a bluntly rounded ridge.

Interior.—The adductor muscle scars are very inconspicuous. Pallial line appears to be entire.

Exterior.—The surface is ornamented with concentric ridges and sulci, somewhat irregular in size, which become almost obsolete on the dorsal slope, and are interrupted by the two oblique grooves on the surface of the valve.

Dimensions.—Fig. 11, Pl. V., measures: antero-posteriorly, 65 mm.; dorso-ventrally, 33 mm.; transversely, 33 mm.

Locality.—The Star-fish bed, Upper Bala.

Observations.—This is a large and beautiful shell, closely resembling the *Allorisma*

variabilis of the Lower Carboniferous in shape, but differing from that shell in having the characteristic oblique grooves of *Grammysia* and an entire pallial line.

The single specimen in the collection is nearly perfect and has both valves, which resemble each other in all details.

Genus *Conocardium*, Bronn, 1835.

For synonymy, *vide* Hind, 1900, *Mono. Brit. Carb. Lamell.* (Pal. Soc.), p. 449.

Generic Characters.—Shell equivalve, very inequilateral, fusiform or triangular, compressed and truncated posteriorly so as to form a posterior surface. Cordiform and often concave, bisected by a median ridge formed by the closed edges of the valve, from the upper part of which springs the tubular rostrum in those species which possess it. Anterior end triangular and produced, gaping in front. The hinge line straight. Umbones small, pointed, incurved, often carinate posteriorly. An acute ridge passes from the umbo to the postero-inferior angle. Attached to the posterior margin is often a broad shelly process or flange.

For internal characters *vide op. supra cit.* p. 451.

Exterior.—The surface in front of the flange is ornamented with radiating ribs, often obscured by shell growth, and then almost smooth, with smooth concentric lines of growth. Shell thick.

Observations.—*Conocardium* is represented in the Ordovician rocks of the West of Scotland by two species, very characteristic of the genus, showing that little or no development took place between Ordovician and Carboniferous times. Both the species have been previously described.

C. pristis, M'Coy, has the shelly extension or flange to its posterior border so characteristic of *C. hibernicum*. I have been unable to find evidence of the rostral tube in either specimen, but it is easily left in the matrix, on account of its fragile nature.

Conocardium pristis, M'Coy, sp., 1846. (Pl. V., figs. 24–26.)

Pleurorhynchus pristis, M'Coy, 1846, *Sil. Foss. Ireland*, p. 71, pl. v. fig. 4.

Conocardium pristis, Morris, 1854, *Carb. Brit. Foss.*, 2nd ed., p. 195.

Specific Characters.—Shell small, triangular, almost conical when bivalve, moderately gibbose posteriorly. The anterior end pointed, gaping. The lower border descends rapidly and is gently convex. The posterior end adpressed, forming a cordiform surface, the external margin being produced into a shelly process or shield continuous in both valves, and more produced at the inferior angle, measuring as much as the rest of the valve. The hinge-line is nearly straight. The umbones are posterior and terminal, flattened on the posterior surface, incurved, carinated, and contiguous.

Interior.—Normal.

Exterior.—In perfect specimens the surface is almost smooth, covered with fine concentric lines of growth. If the surface has been removed, regular radiating ribs are

to be seen on the front part of the shell. These ribs form the middle layer of the shell, and are joined by fine transverse trabeculæ.

Dimensions.—A specimen measured: antero-posteriorly, 7 mm.; dorso-ventrally, 10 mm.

Localities.—Mulloch Hill, Lower Llandoverly; Craigens, Middle Llandoverly. Ireland, Cappacorcoque, Cong, Co. Galway.

Observations.—A very interesting specimen, which has the same characters which are so well marked in *Conocardium hibernicum* of the Carboniferous rocks. Several specimens show the shelly fringe which was produced from the posterior border. This part of the shell is well represented in M'COY's figure, which, however, is decorticated and shows the radiating ribs of the intermediate layer of the shell. Some half-dozen specimens are in the Gray Collection, several of which show the shelly process, and, with the exception of a single example, all are from Mulloch Hill.

The Carboniferous form *C. hibernicum* shows no advance in development on this much earlier forerunner. In the latter I have never found the long rostrum possessed by many species of the genus. Whether there was one in *C. pristis* I cannot say, but none of the specimens show that part of the valve.

A third species, *C. æquicostatus*, Phillips, sp. (*Mem. Geol. Survey U.K.*, vol. ii., pt. i., pl. xvi. figs. 1, 2), is known from the Wenlock Limestones, Woolhope and Dudley, which differs much in shape and ornament and absence of process from the Llandoverly example.

I note that MORRIS (*op. supra cit.*) gives SALTER as the author of the species *C. pristis*. This is, of course, an error for M'COY.

Conocardium dipterus, Salter, sp., 1851. (Pl. V., figs. 27–30, 30a.)

Pleurorhynchus dipterus, Salter, 1851, *Q.J.G.S.*, vol. vii. p. 175, pl. viii. fig. 6.

Specific Characters.—Shell obliquely semi-trapezoidal, strongly keeled. The hinge line elongate, straight. Anterior end triangular, sub-acute, compressed. The valve is divided into two unequal portions by a strong, blunt, oblique ridge which passes from the umbo to the inferior border; the portion of the valve posterior to it is shorter but more gibbose than the anterior. The posterior margin is angular below, but above is adpressed to form a small depressed horseshoe-shaped space bounded by a ridge; within this space the margin of the valve is swollen, and from its upper and median portion springs an elongate, hollow, conical process. The umbones are small, keeled, incurved and flattened on their posterior aspect. The shell gapes anteriorly, the lower margin being thickened, its inner surface developed into a series of teeth and sockets, which are smaller and more numerous from before backwards.

Exterior.—On the anterior portion of the valve the concentric ribs are well marked, and are crossed by radiating ribs of moderate size. On that portion of the valve in front and behind the keel the radiating ribs are thick, wide apart, and concentric lines

are absent. Immediately behind the keel is a narrow space free from radiating ribs. Posteriorly, the radiating ribs become swollen and closer from behind forwards; but the ribs on the depressed cordate portion are stronger than those immediately in front of them.

Dimensions.—Fig. 30, Pl. V., measures: antero-posteriorly, 17 mm.; dorso-ventrally, 12 mm.; from side to side, 11 mm.

Locality.—Craighead and Balclatchie (Llandeilo).

Observations.—SALTER founded his species on a specimen from Craighead, and he called it *P. dipterus*, var. *rhomboidalis*. Why the varietal name was added I cannot see, and for the present I drop it.

The shell is interesting because it already has all the characters and the peculiar structure which I found in species of the genus in Carboniferous rocks. Indeed, it is closely allied to *C. alatum*, de Koninck. For my reasons for orienting the shell so that the elongate tube is posterior, and the internal structure and anatomy of the shell, I would refer to my *Monograph of British Carboniferous Lamellibranchiata*, vol. i. pp. 450–453. Developmental changes in the genus seem to have resulted chiefly in giant forms and the growth of a fringe in *C. hibernicum*, the most specialised species of the group. The general character of ornament seems to have persisted from Ordovician to Carboniferous time.

Cucullella antiqua, Sow. (Pl. IV., fig. 16.)

Cucullæa antiqua, Sow., *Sil. Syst.*, pl. iii. figs. 1b, 12a.

I find one example of this species in the Gray Collection. The genus very closely resembles *Clidophorus*, but differs from it in having a multidenticulate hinge plate of the nucula type. Casts always show the deep slit posterior to the anterior adductor muscle, which character is common to both genera.

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