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ISSUED FOR 1897.

PALÆONTOGRAPHICAL SOCIETY.

VOLUME LI.

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ISSUED FOR 1897.

DECEMBER, 1897.

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I. A CATALOGUE OF THE WORKS ALREADY PUBLISHED;

II. A CLASSIFIED LIST OF THE MONOGRAPHS COMPLETED, IN COURSE OF PUBLICATION, AND IN PREPARATION, WITH THE NAMES OF THEIR RESPECTIVE AUTHORS;

III. THE DATES OF ISSUE OF THE ANNUAL VOLUMES;

IV. A GENERAL SUMMARY, SHOWING THE NUMBER OF THE PAGES, PLATES, FIGURES, AND SPECIES IN EACH MONOGRAPH;

V. A STRATIGRAPHICAL LIST OF THE BRITISH FOSSILS FIGURED AND DESCRIBED IN THE YEARLY VOLUMES.

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§ I. CATALOGUE OF WORKS

ALREADY PUBLISHED BY

THE PALÆONTOGRAPHICAL SOCIETY:

Showing the ORDER *of publication; the* YEARS *during which the Society has been in operation; and the* CONTENTS *of each yearly Volume.*

Vol. I.	Issued for the Year	1847	The Crag Mollusca, Part I, Univalves, by Mr. S. V. Wood, 21 plates.
„ II.	„	1848	The Reptilia of the London Clay, Vol. I, Part I, Chelonia, &c., by Profs. Owen and Bell, 38 plates. The Eocene Mollusca, Part I, Cephalopoda, by Mr. F. E. Edwards, 9 plates.
„ III.*	„	1849	The Entomostraca of the Cretaceous Formations, by Mr. T. R. Jones, 7 plates. The Permian Fossils, by Prof. Wm. King, 29 plates. The Reptilia of the London Clay, Vol. I, Part II, Crocodilia and Ophidia, &c., by Prof. Owen, 18 plates. The Fossil Corals, Part I, Crag, London Clay, Cretaceous, by Messrs. Milne Edwards and Jules Haime, 11 plates.
„ IV.	„	1850	The Crag Mollusca, Part II, No. 1, by Mr. S. V. Wood, 12 plates. The Mollusca of the Great Oolite, Part I, Univalves, by Messrs. Morris and Lycett, 15 plates. The Fossil Brachiopoda, Vol. I, Part III, No. 1, Oolitic and Liassic, by Mr. Davidson, 13 plates.
„ V.	„	1851	The Reptilia of the Cretaceous Formations, by Prof. Owen, 39 plates. The Fossil Corals, Part II, Oolitic, by Messrs. Milne Edwards and Jules Haime, 19 plates. The Fossil Lepadidæ, by Mr. Charles Darwin, 5 plates.
„ VI.	„	1852	The Fossil Corals, Part III, Permian and Mountain-limestone, by Messrs. Milne Edwards and Jules Haime, 16 plates. The Fossil Brachiopoda, Vol. I, Part I, Tertiary, by Mr. Davidson, 2 plates. The Fossil Brachiopoda, Vol. I, Part II, No. 1, Cretaceous, by Mr. Davidson, 5 plates. The Fossil Brachiopoda, Vol. I, Part III, No. 2, Oolitic, by Mr. Davidson, 5 plates. The Eocene Mollusca, Part II, Pulmonata, by Mr. F. E. Edwards, 6 plates. The Radiaria of the Crag, London Clay, &c., by Prof. E. Forbes, 4 plates.

* The Volume for the year 1849 consists of two separate portions, each of which is stitched in a paper cover, on which are printed the dates 1848, 1849, and 1850. The one portion contains 'Cretaceous Entomostraca' and 'Permian Fossils;' the other, 'London Clay Reptilia,' Part II, and 'Fossil Corals,' Part I.

CATALOGUE OF WORKS—Continued.

Vol. VII.	Issued for the Year 1853	The Fossil Corals, Part IV, Devonian, by Messrs. Milne Edwards and Jules Haime, 10 plates. The Fossil Brachiopoda, Introduction to Vol. I, by Mr. Davidson, 9 plates. The Mollusca of the Chalk, Part I, Cephalopoda, by Mr. D. Sharpe, 10 plates. The Mollusca of the Great Oolite, Part II, Bivalves, by Messrs. Morris and Lycett, 8 plates. The Mollusca of the Crag, Part II, No. 2, Bivalves, by Mr. S. V. Wood, 8 plates. The Reptilia of the Wealden Formations, Part I, Chelonia, by Prof. Owen, 9 plates.
„ VIII.*	„ 1854	The Fossil Brachiopoda, Vol. I, Part II, No. 2, Cretaceous, with Appendix and Index to Vol. I, by Mr. Davidson, 8 plates. The Reptilia of the Wealden Formations, Part II, Dinosauria, by Prof. Owen, 20 plates. The Mollusca of the Great Oolite, Part III, Bivalves, by Messrs. Morris and Lycett, 7 plates. The Fossil Corals, Part V, Silurian, by Messrs. Milne Edwards and Jules Haime, 16 plates. The Fossil Balanidæ and Verrucidæ, by Mr. Charles Darwin, 2 plates. The Mollusca of the Chalk, Part II, Cephalopoda, by Mr. D. Sharpe, 6 plates. The Eocene Mollusca, Part III, No. 1, Prosobranchiata, by Mr. F. E. Edwards, 8 plates.
„ IX.†	„ 1855	The Mollusca of the Crag, Part II, No. 3, Bivalves, by Mr. S. V. Wood, 11 plates. The Reptilia of the Wealden Formations, Part III, by Prof. Owen, 12 plates. The Eocene Mollusca, Part III, No. 2, Prosobranchiata, continued, by Mr. F. E. Edwards, 4 plates. The Mollusca of the Chalk, Part III, Cephalopoda, by Mr. D. Sharpe, 11 plates. The Tertiary Entomostraca, by Mr. T. R. Jones, 6 plates. The Fossil Echinodermata, Oolitic, Vol. I, Part I, by Dr. Wright, 10 plates.
„ X.	„ 1856	The Fossil Echinodermata, Oolitic, Vol. I, Part II, by Dr. Wright, 12 plates. The Fossil Crustacea, Part I, London Clay, by Prof. Bell, 11 plates. The Fossil Brachiopoda, Vol. II, Part IV, Permian, by Mr. Davidson, 4 plates. The Fossil Brachiopoda, Vol. II, Part V, No. 1, Carboniferous, by Mr. Davidson, 8 plates. The Reptilia of the Wealden Formations, Part IV (Supplement No. 1), by Prof. Owen, 11 plates. The Reptilia of the London Clay, Vol. I (Supplement), by Prof. Owen, 2 plates.
„ XI.	„ 1857	The Fossil Echinodermata, Oolitic, Vol. I, Part III, by Dr. Wright, 14 plates. The Fossil Brachiopoda, Vol. II, Part V, No. 2, Carboniferous, by Mr. Davidson, 8 plates. The Reptilia of the Cretaceous Formations (Supplement No. 1), by Prof. Owen, 4 plates. The Reptilia of the Wealden Formations (Supplement No. 2), by Prof. Owen, 8 plates. The Polyzoa of the Crag, by Prof. Busk, 22 plates.
„ XII.	„ 1858	The Fossil Echinodermata, Oolitic, Vol. I, Part IV, by Dr. Wright, 7 plates. The Eocene Mollusca, Part III, No. 3, Prosobranchiata continued, by Mr. F. E. Edwards, 6 plates. The Reptilia of the Cretaceous Formations (Supplements No. 2, No. 3), by Prof. Owen, 7 plates. The Reptilia of the Purbeck Limestones, by Prof. Owen, 1 plate. The Fossil Brachiopoda, Vol. II, Part V, No. 3, Carboniferous, by Mr. Davidson, 10 plates.
„ XIII.	„ 1859	The Fossil Brachiopoda, Part V, No. 4, Carboniferous, by Mr. Davidson, 20 plates. The Reptilia of the Oolitic Formations, No. 1, Lower Lias, by Prof. Owen, 6 plates. The Reptilia of the Kimmeridge Clay, No. 1, by Prof. Owen, 1 plate. The Eocene Mollusca, Part IV, No. 1, Bivalves, by Mr. S. V. Wood, 13 plates.
„ XIV.	„ 1860	The Fossil Brachiopoda, Vol. II, Part V, No. 5, Carboniferous, by Mr. Davidson, 8 plates. The Reptilia of the Oolitic Formations, No. 2, Lower Lias, by Prof. Owen, 11 plates. The Reptilia of the Kimmeridge Clay, No. 2, by Prof. Owen, 1 plate. The Fossil Estheriæ, by Prof. Rupert Jones, 5 plates. The Fossil Crustacea, Part II, Gault and Greensand, by Prof. Bell, 11 plates.
„ XV.	„ 1861	The Fossil Echinodermata, Oolitic, Vol. II, Part I (Asteroidea), by Dr. Wright, 13 plates. Supplement to the Great Oolite Mollusca, by Dr. Lycett, 15 plates.

* This Vol. is marked on the outside 1855.
† This Vol. is marked on the outside 1856.

CATALOGUE OF WORKS—Continued.

Vol. XVI.	Issued for the Year 1862	The Fossil Echinodermata, Cretaceous, Vol. I, Part I, by Dr. Wright, 11 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part I (Devonian and Silurian), by Mr. J. W. Salter, 6 plates. The Fossil Brachiopoda, Vol. III, Part VI, No. 1, Devonian, by Mr. Davidson, 9 plates. The Eocene Mollusca, Part IV, No. 2, Bivalves, by Mr. S. V. Wood, 7 plates. The Reptilia of the Cretaceous and Wealden Formations (Supplements), by Prof. Owen, 10 plates.
,, XVII.	,, 1863	The Trilobites of the Silurian, Devonian, &c., Formations, Part II, by Mr. J. W. Salter, 8 plates. The Fossil Brachiopoda, Vol. III, Part VI, No. 2, Devonian, by Mr. Davidson, 11 plates. The Belemnitidæ, Part I, Introduction, by Prof. Phillips. The Reptilia of the Liassic Formations, Part I, by Prof. Owen, 16 plates.
,, XVIII.	,, 1864	The Fossil Echinodermata, Oolitic, Vol. II, Part II (Liassic Ophiuroidea), by Dr. Wright, 6 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part III, by Mr. J. W. Salter, 11 plates. The Belemnitidæ, Part II, Liassic Belemnites, by Prof. Phillips, 7 plates. The Pleistocene Mammalia, Part I, Introduction, Felis spelæa, by Messrs. W. Boyd Dawkins and W. A. Sanford, 5 plates. Title-pages, &c., to the Monographs on the Reptilia of the London Clay, Cretaceous, and Wealden Formations.
,, XIX.*	,, 1865	The Crag Foraminifera, Part 1, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady, 4 plates. Supplement to the Fossil Corals, Part I, Tertiary, by Dr. Duncan, 10 plates. The Fossil Merostomata, Part I, Pterygotus, by Mr. H. Woodward, 9 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 1, Silurian, by Mr. Davidson, 12 plates.
,, XX.*	,, 1866	Supplement to the Fossil Corals, Part IV, No. 1, Liassic, by Dr. Duncan, 11 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part IV (Silurian), by Mr. J. W. Salter, 6 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 2, Silurian, by Mr. Davidson, 10 plates. The Belemnitidæ, Part III, Liassic Belemnites, by Prof. Phillips, 13 plates.
,, XXI.*	,, 1867	Flora of the Carboniferous Strata, Part I, by Mr. E. W. Binney, 6 plates. Supplement to the Fossil Corals, Part IV, No. 2, Liassic, by Dr. Duncan, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part II, by Dr. Wright, 14 plates. The Fishes of the Old Red Sandstone, Part I, by Messrs. J. Powrie and E. Ray Lankester, 5 plates. The Pleistocene Mammalia, Part II, Felis spelæa, continued, by Messrs. W. Boyd Dawkins and W. A. Sanford, 14 plates.
,, XXII.*	,, 1868	Supplement to the Fossil Corals, Part II, No. 1, Cretaceous, by Dr. Duncan, 9 plates. The Fossil Merostomata, Part II, Pterygotus, by Mr. H. Woodward, 6 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 3, Silurian, by Mr. Davidson, 15 plates. The Belemnitidæ, Part IV, Liassic and Oolitic Belemnites, by Prof. Phillips, 7 plates. The Reptilia of the Kimmeridge Clay, No. 3, by Prof. Owen, 4 plates. The Pleistocene Mammalia, Part III, Felis spelæa, concluded, with F. lynx, by Messrs. W. Boyd Dawkins and W. A. Sanford, 6 plates.
,, XXIII.*	,, 1869	Supplement to the Fossil Corals, Part II, No. 2, Cretaceous, by Dr. Duncan, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part III, by Dr. Wright, 10 plates. The Belemnitidæ, Part V, Oxford Clay, &c., Belemnites, by Prof. Phillips, 9 plates. The Fishes of the Old Red Sandstone, Part I (concluded), by Messrs. J. Powrie and E. Ray Lankester, 9 plates. The Reptilia of the Liassic Formations, Part II, by Prof. Owen, 4 plates. The Crag Cetacea, No. 1, by Prof. Owen, 5 plates.
,, XXIV.*	,, 1870	The Flora of the Carboniferous Strata, Part II, by Mr. E. W. Binney, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part IV, by Dr. Wright, 10 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 4, Silurian, by Mr. Davidson, 13 plates. The Eocene Mollusca, Part IV, No. 3, Bivalves, by Mr. S. V. Wood, 5 plates. The Fossil Mammalia of the Mesozoic Formations, by Prof. Owen, 4 plates.

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Vol. XXV.*	Issued for the Year 1871	The Flora of the Carboniferous Strata, Part III, by Mr. E. W. Binney, 6 plates. The Fossil Merostomata, Part III, Pterygotus and Slimonia, by Mr. H. Woodward, 5 plates. Supplement to the Crag Mollusca, Part I (Univalves), by Mr. S. V. Wood, with an Introduction on the Crag District, by Messrs. S. V. Wood, jun., and F. W. Harmer, 7 plates and map. Supplement to the Reptilia of the Wealden (Iguanodon), No. IV, by Prof. Owen, 3 plates The Pleistocene Mammalia, Part IV, Felis pardus, &c., by Messrs. W. Boyd Dawkins and W. A. Sanford, 2 plates. The Pleistocene Mammalia, Part V, Ovibos moschatus, by Mr. W. Boyd Dawkins, 5 plates.
„ XXVI.*	„ 1872	Supplement to the Fossil Corals, Part III (Oolitic), by Prof. Duncan, with an Index to the Tertiary and Secondary Species, 7 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part V, by Dr. Wright, 5 plates. The Fossil Merostomata, Part IV (Stylonurus, Eurypterus, Hemiaspis), by Mr. H. Woodward, 10 plates. The Fossil Trigoniæ, No. I, by Dr. Lycett, 9 plates.
„ XXVII.*	„ 1873	The Fossil Echinodermata, Cretaceous, Vol I, Part VI, by Dr. Wright, 8 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part I (Tertiary and Cretaceous), by Mr. Davidson, 8 plates. Supplement to the Crag Mollusca, Part II (Bivalves), by Mr. S. V. Wood, 5 plates. Supplement to the Reptilia of the Wealden (Iguanodon), No. V, by Prof. Owen, 2 plates. Supplement to the Reptilia of the Wealden (Hylæochampsa) No. VI, by Prof. Owen. The Fossil Reptilia of the Mesozoic Formations, Part I, by Prof. Owen, 2 plates.
„ XXVIII.*	„ 1874	The Post-Tertiary Entomostraca, by Mr. G. S. Brady, Rev. H. W. Crosskey, and Mr. D. Robertson, 16 plates. The Carboniferous Entomostraca, Part I (Cypridinadæ), by Prof. T. Rupert Jones and Messrs. J. W. Kirkby and G. S. Brady, 5 plates. The Fossil Trigoniæ, No. II, by Dr. Lycett, 10 plates.
„ XXIX.*	„ 1875	The Flora of the Carboniferous Strata, Part IV, by Mr. E. W. Binney, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part VII, by Dr. Wright, 10 plates. The Fossil Trigoniæ, No. III, by Dr. Lycett, 8 plates. The Fossil Reptilia of the Mesozoic Formations, Part II, by Prof. Owen, 20 plates.
„ XXX.*	„ 1876	The Carboniferous and Permian Foraminifera (the genus Fusulina excepted), by Mr. H. B. Brady, 12 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part II, No. 1 (Jurassic and Triassic), by Mr. Davidson, 8 plates. Supplement to the Reptilia of the Wealden (Poikilopleuron and Chondrosteosaurus), No. VII, by Prof. Owen, 6 plates.
„ XXXI.*	„ 1877	Supplement to the Eocene Mollusca (Bivalves), by Mr. S. V. Wood, 2 plates. The Fossil Trigoniæ, No. IV, by Dr. Lycett, 13 plates. The Eocene Mollusca (Univalves), Part IV, by Mr. S. V. Wood, 1 plate. The Carboniferous Ganoid Fishes, Part I (Palæoniscidæ), by Dr. Traquair, 7 plates. The Fossil Reptilia of the Mesozoic Formations, Part III, by Prof. Owen, 2 plates. The Fossil Elephants (E. antiquus), Part I, by Prof. Leith Adams, 5 plates.
„ XXXII.*	„ 1878	The Fossil Echinodermata, Cretaceous, Vol. I, Part VIII, by Dr. Wright, 8 plates. Index and Title Page to the Fossil Echinodermata, Oolitic, Vol. I (Echinoidea), by Dr. Wright. The Fossil Merostomata, Part V (Neolimulus, &c.), by Dr. H. Woodward, 6 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part II, No. 2 (Jurassic and Triassic), by Mr. Davidson, 13 plates. The Lias Ammonites, Part I, by Dr. Wright, 8 plates. The Sirenoid and Crossopterygian Ganoids, Part I, by Prof. Miall, 6 plates. Supplement to the Reptilia of the Wealden (Goniopholis, Petrosuchus, and Suchosaurus), No. VIII, by Prof. Owen, 6 plates. The Pleistocene Mammalia, Part A (Preliminary Treatise), by Prof. Boyd Dawkins.

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CATALOGUE OF WORKS—Continued.

Vol. XXXIII.*	Issued for the Year	1879	The Eocene Flora, Vol. I, Part I, by Mr. J. S. Gardner and Baron Ettingshausen, 5 plates. Second Supplement to the Crag Mollusca (Univalves and Bivalves), by Mr. S. V. Wood, 6 plates. The Fossil Trigoniæ, No. V (*Conclusion*), by Dr. Lycett, 1 plate. The Lias Ammonites, Part II, by Dr. Wright, 10 plates. Supplement to the Reptilia of the Wealden (Goniopholis, Brachydectes, Nannosuchus, Theriosuchus, and Nuthetes), No. IX, by Prof. Owen, 4 plates. The Fossil Elephants (E. primigenius), Part II, by Prof. Leith Adams, 10 plates.
,, XXXIV.*	,,	1880	The Eocene Flora, Vol. I, Part II, by Mr. J. S. Gardner and Baron Ettingshausen, 6 plates. The Fossil Echinodermata, Oolitic, Vol. II, Part III (Asteroidea and Ophiuroidea), by Dr. Wright, 3 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part III (Permian and Carboniferous), by Mr. Davidson, 8 plates. The Lias Ammonites, Part III, by Dr. Wright, 22 plates. The Reptilia of the London Clay, Vol. II, Part I (Chelone) by Prof. Owen, 2 plates.
,, XXXV.*	,,	1881	The Fossil Echinodermata, Cretaceous, Vol. I, Part IX, by Dr. Wright, 6 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part IV (Devonian and Silurian, from Budleigh-Salterton Pebble Bed), by Mr. Davidson, 5 plates. The Fossil Trigoniæ (Supplement No. 1), by Dr. Lycett. The Lias Ammonites, Part IV, by Dr. Wright, 10 plates. The Reptilia of the Liassic Formations, Part III (*Conclusion*), by Prof. Owen, 13 plates. The Fossil Elephants (E. primigenius and E. meridionalis), Part III (*Conclusion*), by Prof. Leith Adams, 13 plates.
,, XXXVI.*	,,	1882	The Eocene Flora, Vol. I, Part III (*Conclusion*), by Mr. J. S. Gardner and Baron Ettingshausen, 2 plates. Third Supplement to the Crag Mollusca, by the late Mr. S. V. Wood, 1 plate. The Fossil Echinodermata, Cret., Vol. I, Part X (*Conclusion*), by Dr. Wright, 5 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part V (*Conclusion*), by Dr. Davidson. Do., Vol. V, Part I (Devonian and Silurian), by Dr. Davidson, 7 plates. The Lias Ammonites, Part V, by Dr. Wright, 22 plates.
,, XXXVII.*	,,	1883	The Eocene Flora, Vol. II, Part I, by Mr. J. S. Gardner, 9 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part V (*Conclusion*), by the late Mr. J. W. Salter. The Carboniferous Trilobites, Part I, by Dr. H. Woodward, 6 plates. Supplement to the Fossil Brachiopoda, Vol. V, Part II (Silurian), by Dr. Davidson, 10 plates. The Fossil Trigoniæ (Supplement No. 2), by the late Dr. Lycett, 4 plates. The Lias Ammonites, Part VI, by Dr. Wright, 8 plates.
,, XXXVIII.*	,,	1884	The Eocene Flora, Vol. II, Part II, by Mr. J. S. Gardner, 11 plates. The Carboniferous Entomostraca, Part I, No. 2 (*Conclusion*), by Prof. T. Rupert Jones, Mr. J. W. Kirkby, and Prof. G. S. Brady, 2 plates. The Carboniferous Trilobites, Part II, by Dr. H. Woodward, 4 plates. Supplement to the Fossil Brachiopoda, Vol. V, Part III (*Conclusion*), by Dr. Davidson, 4 plates. The Lias Ammonites, Part VII, by Dr. Wright, 10 plates.
,, XXXIX.*	,,	1885	The Eocene Flora, Vol. II, Part III (*Conclusion*), by Mr. J. S. Gardner, 7 plates. The Stromatoporoids, Part I, by Prof. Alleyne Nicholson, 11 plates. The Fossil Brachiopoda (Bibliography), Vol. VI (*Conclusion*), by the late Dr. Davidson and Mr. W. H. Dalton. The Lias Ammonites, Part VIII (*Conclusion*), by the late Dr. Wright, 1 plate.
,, XL.*	,,	1886	The Morphology and Histology of Stigmaria Ficoides, by Prof. W. C. Williamson, 15 plates. The Fossil Sponges, Part I, by Dr. G. J. Hinde, 8 plates. The Jurassic Gasteropoda, Part I, No. 1, by Mr. W. H. Hudleston. The Inferior Oolite Ammonites, Part I, by Mr. S. S. Buckman, 6 plates. The Pleistocene Mammalia, Part VI, by Prof. Boyd Dawkins, 7 plates.
,, XLI.*	,,	1887	The Fossil Sponges, Part II, by Dr. G. J. Hinde, 1 plate. The Palæozoic Phyllopoda, Part I, by Prof. T. R. Jones and Dr. Woodward, 12 plates. The Jurassic Gasteropoda, Part I, No. 2, by Mr. W. H. Hudleston, 6 plates. The Inferior Oolite Ammonites, Part II, by Mr. S. S. Buckman, 8 plates.

* These Volumes are issued in two forms of binding; first, with all the Monographs stitched together and enclosed in one cover; secondly, with each of the Monographs separate, and the whole of the separate parts placed in an envelope.

CATALOGUE OF WORKS—Continued.

Vol. XLII.*	Issued for the Year 1888	The Stromatoporoids, Part II, by Prof. Alleyne Nicholson, 8 plates. The Tertiary Entomostraca (Supplement), by Prof. T. Rupert Jones and Mr. C. D. Sherborn, 3 plates. The Jurassic Gasteropoda, Part I, No. 3, by Mr. W. H. Hudleston, 5 plates. The Inferior Oolite Ammonites, Part III, by Mr. S. S. Buckman, 10 plates. The Devonian Fauna of the South of England, Part I, by the Rev. G. F. Whidborne, 4 plates. Title-pages to the Monographs on the Reptilia of the Wealden and Purbeck (Supplements), Kimmeridge Clay, and Mesozoic Formations, and on the Cetacea of the Red Crag.
„ XLIII.*	„ 1889	The Cretaceous Entomostraca (Supplement), by Prof. T. Rupert Jones and Dr. G. J. Hinde, 4 plates. The Jurassic Gasteropoda, Part I, No. 4, by Mr. W. H. Hudleston, 5 plates. The Inferior Oolite Ammonites, Part IV, by Mr. S. S. Buckman, 13 plates. The Devonian Fauna of the South of England, Part II, by the Rev. G. F. Whidborne, 12 plates.
„ XLIV.*	„ 1890	The Stromatoporoids, Part III, by Prof. Alleyne Nicholson, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. II, Part I (Asteroidea), by Mr. W. Percy Sladen, 8 plates. The Inferior Oolite Ammonites, Part V, by Mr. S. S. Buckman, 8 plates. The Devonian Fauna of the South of England, Part III, by the Rev. G. F. Whidborne, 9 plates. Title-pages to the Supplement to the Fossil Corals, by Prof. Duncan.
„ XLV.*	„ 1891	The Jurassic Gasteropoda, Part I, No. 5, by Mr. W. H. Hudleston, 4 plates. The Inferior Oolite Ammonites, Part VI, by Mr. S. S. Buckman, 12 plates. The Devonian Fauna of the South of England, Part IV (*Conclusion of* Vol. I), 7 plates. „ „ Vol. II, Part I, by the Rev. G. F. Whidborne, 5 plates.
„ XLVI.*	„ 1892	The Stromatoporoids, Part IV (*Conclusion*), by Prof. Alleyne Nicholson, 4 plates. The Palæozoic Phyllopoda, Part II, by Prof. T. R. Jones and Dr. Woodward, 5 plates. The Jurassic Gasteropoda, Part I, No. 6, by Mr. W. H. Hudleston, 6 plates. The Inferior Oolite Ammonites, Part VII, by Mr. S. S. Buckman, 20 plates. The Devonian Fauna of the South of England, Vol. II, Part II, by the Rev. G. F. Whidborne, 5 plates.
„ XLVII.*	„ 1893	The Fossil Sponges, Part III, by Dr. G. J. Hinde, 10 plates. The Fossil Echinodermata, Cretaceous, Vol. II, Part II (Asteroidea), by Mr. W. Percy Sladen, 8 plates. The Inferior Oolite Ammonites, Part VIII, by Mr. S. S. Buckman, 16 plates. The Devonian Fauna of the South of England, Vol. II, Part III, by the Rev. G. F. Whidborne, 7 plates.
„ XLVIII.*	„ 1894	The Jurassic Gasteropoda, Part I, No. 7, by Mr. W. H. Hudleston, 6 plates. Carbonicola, Anthracomya, and Naiadites, Part I, by Dr. W. Hind, 11 plates. The Inferior Oolite Ammonites, Part IX, by Mr. S. S. Buckman, 11 plates. The Fishes of the Old Red Sandstone, Part II, No. 1, by Dr. R. H. Traquair, 4 plates.
„ XLIX.*	„ 1895	The Crag Foraminifera, Part II, by Prof. T. R. Jones, 3 plates. The Jurassic Gasteropoda, Part I, No. 8, by Mr. W. H. Hudleston, 8 plates. Carbonicola, Anthracomya, and Naiadites, Part II, by Dr. W. Hind, 9 plates. The Devonian Fauna of the South of England, Vol. II, Part IV, by the Rev. G. F. Whidborne, 7 plates.
„ L.*	„ 1896	The Crag Foraminifera, Part III, by Prof. T. R. Jones. The Jurassic Gasteropoda, Part I, No. 9 (*Conclusion*), by Mr. W. H. Hudleston, 4 plates. Carbonicola, Anthracomya, and Naiadites, Part III (*Conclusion*), by Dr. W. Hind, 1 plate. The Carboniferous Lamellibranchiata, Part I, by Dr. W. Hind, 4 plates. The Devonian Fauna of the South of England, Vol. III, Part I, by the Rev. G. F. Whidborne, 16 plates.
„ LI.*	„ 1897	The Crag Foraminifera, Part IV (*Conclusion*), by Prof. T. R. Jones. The Carboniferous Lamellibranchiata, Part II, by Dr. W. Hind, 13 plates. The Carboniferous Cephalopoda of Ireland, Part I, by Dr. A. H. Foord, 7 plates. The Devonian Fauna of the South of England, Vol. III, Part II, by the Rev. G. F. Whidborne, 5 plates.

* These Volumes are issued in two forms of binding; first, with all the Monographs stitched together and enclosed in one cover; secondly, with each of the Monographs separate, and the whole of the separate parts placed in an envelope.

§ II. LIST OF MONOGRAPHS
Completed, in course of Publication, and in Preparation.

1. MONOGRAPHS which have been COMPLETED, and which may be bound as separate Volumes, with directions for the BINDING :—

The Morphology and Histology of Stigmaria ficoides by Prof. W. C. Williamson. (*Complete with Title-page and Index in the Volume for the year* 1886.)

The Eocene Flora, Vol. I (Filices), by Mr. J. S. Gardner and Baron Ettingshausen. (*Complete in the Volumes for the years* 1879, 1880, *and* 1882. *Title-page, Index, and directions for the binding, will be found in the Volume for* 1882.)

The Eocene Flora, Vol. II (Gymnospermæ), by Mr. J. S. Gardner. (*Complete in the Volumes for the years* 1883, 1884, *and* 1885. *Title-page, Index, and directions for the binding, will be found in the Volume for* 1885.)

The Crag Foraminifera, by Prof. T. Rupert Jones, W. K. Parker, and H. B. Brady, assisted by H. W. Burrows, C. D. Sherborn, F. W. Millett, R. Holland, and F. Chapman. (*Complete in the Volumes for the years* 1865, 1895, 1896, *and* 1897. *Title-page, Index, and directions for the binding, will be found in the Volume for* 1897.)

The Carboniferous and Permian Foraminifera (the genus Fusulina excepted), by Mr. H. B. Brady. (*Complete in the Volume for the year* 1876.)

The Stromatoporoids, by Prof. Alleyne Nicholson. (*Complete in the Volumes for the years* 1885, 1888, 1890, and 1892. *The Title-page, Index, and directions for binding will be found in the Volume for the year* 1892.)

The Tertiary, Cretaceous, Oolitic, Devonian, and Silurian Corals, by MM. Milne-Edwards and J. Haime. (*Complete in the Volumes for the years* 1849, 1851, 1852, 1853, *and* 1854. *The Title-page and Index, with corrected explanations of Plates XVII and XVIII, will be found in the Volume for the year* 1854.)

Supplement to the Tertiary, Cretaceous, Liassic, and Oolitic Corals, by Prof. Martin Duncan. (*Complete in the Volumes for the years* 1865, 1866, 1867, 1868, 1869, 1872, *and* 1890. *The Title-page, with directions for binding, will be found in the Volume for the year* 1890.)

The Polyzoa of the Crag, by Mr. G. Busk. (*Complete with Title-page and Index in the Volume for the year* 1857.)

The Tertiary Echinodermata, by Professor Forbes. (*Complete with Title-page in the Volume for the year* 1852.)

The Fossil Cirripedes, by Mr. C. Darwin. (*Complete in the Volumes for the years* 1851, 1854, *and* 1858. *The Title-page will be found in the Volume for the year* 1854, *and the Index in the Volume for the year* 1858.

The Post-Tertiary Entomostraca, by Mr. G. S. Brady, the Rev. H. W. Crosskey, and Mr. D. Robertson. (*Complete, with Title-page and Index, in the Volume for the year* 1874.)

The Tertiary Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1855.)

Supplement to the Tertiary Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1888.)

The Cretaceous Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1849.)

Supplement to the Cretaceous Entomostraca, by Prof. T. Rupert Jones and Dr. G. J. Hinde. (*Complete, with Title-page and Index, in the Volume for the year* 1889.)

The Carboniferous Entomostraca, Part I (Cypridinadæ and their allies), by Prof. T. Rupert Jones, Mr. J. W. Kirkby, and Prof. G. S. Brady. (*Complete in the volumes for the years* 1874 *and* 1884. *The Title-page and Index will be found in the Volume for the year* 1884.)

The Fossil Estheriæ, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1860.)

The Trilobites of the Cambrian, Silurian, and Devonian Formations, by Mr. J. W. Salter. (*Complete in the Volumes for the years* 1862, 1863, 1864, 1866, *and* 1883. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1883.)

The Fossil Merostomata, by Dr. H. Woodward. (*Complete in the Volumes for the years* 1865, 1868, 1871, 1872, *and* 1878. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1878.)

The Fossil Brachiopoda (Tertiary, Cretaceous, Oolitic, and Liassic), Vol. I, by Mr. T. Davidson. (*Complete in the Volumes for the years* 1850, 1852, 1853, *and* 1854. *The Index will be found in the Volume for the year* 1854, *and corrected Title-page in that for* 1870.)

The Fossil Brachiopoda (Permian and Carboniferous), Vol. II, by Mr. T. Davidson. (*Complete in the Volumes for the years* 1856, 1857, 1858, 1859, *and* 1860. *The Index will be found in the Volume for the year* 1860, *and corrected Title-page in that for* 1870.)

The Fossil Brachiopoda (Devonian and Silurian), Vol. III, by Mr. T. Davidson. (*Complete in the Volumes for the years* 1862, 1863, 1865, 1866, 1868, *and* 1870. *The Title-page and Index will be found in the Volume for the year* 1870.)

The Fossil Brachiopoda, Vol. IV, by Dr. T. Davidson. Supplements: Tertiary, Cretaceous, Jurassic, Triassic, Permian, and Carboniferous. (*Complete in the Volumes for the years* 1873, 1876, 1878, 1880, 1881, *and* 1882. *The Title-page and Index, with directions for the binding will be found in the Volume for the year* 1882.)

The Fossil Brachiopoda, Vol. V, by Dr. T. Davidson. Supplements: Devonian and Silurian. Appendix to Supplements, General Summary, Catalogue and Index of the British Species. (*Complete in the Volumes for the years* 1882, 1883, *and* 1884. *The Title-page, with directions for the binding will be found in the Volume for the year* 1884.)

The Fossil Brachiopoda, Vol. VI, by Dr. T. Davidson and Mr. W. H. Dalton. Bibliography. (*Complete in the Volume for the year* 1885.)

The Eocene Bivalves, Vol. I, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volumes for the years* 1859, 1862, *and* 1870. *The directions for the binding will be found in the Volume for the year* 1870.)

Supplement to the Eocene Bivalves, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year* 1877.)

The Eocene Cephalopoda and Univalves, Vol. I, by Mr. F. E. Edwards and Mr. S. V. Wood. (*Complete in the Volumes for the years* 1848, 1852, 1854, 1855, 1858, *and* 1877. *The Title-page, Index, and directions for the binding, will be found in the Volume for the year* 1877.)

The Mollusca of the Crag, Vol. I, Univalves, by Mr. S. V. Wood. (*The Text, Plates, and Index, will be found in the Volume for the year* 1847, *and the Title-page will be found in the Volume for the year* 1855.)

The Mollusca of the Crag, Vol. II, Bivalves, by Mr. S. V. Wood. (*Complete in the Volumes for the years* 1850, 1853, 1855, 1858, *and* 1873. *The Title-page will be found in the Volume for the year* 1873, *and the Index will be found in the Volume for the year* 1855, *and a Note in the Volume for the year* 1858).

The Mollusca of the Crag, Vol. III, Supplement, by Mr. S. V. Wood. (*Complete in the Volumes for the years* 1871 *and* 1873. *The Title-page and Index will be found in the Volume for the year* 1873.)

Second Supplement to the Crag Mollusca, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year* 1879.)

The Gasteropoda of the Inferior Oolite, by Mr. W. H. Hudleston. (*Complete in the Volumes for the years* 1886, 1887, 1889, 1891, 1892, 1894, 1895, *and* 1896. *The Title-page, Index, and directions for the binding will be found in the Volume for the year* 1896.)

Third Supplement to the Crag Mollusca, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year* 1882.)

The Great Oolite Mollusca, by Professor Morris and Dr. Lycett. (*Complete in the Volumes for the years* 1850, 1853, *and* 1854. *The Title-page and Index will be found in the Volume for the year* 1854.)

The Fossil Trigoniæ, by Dr. Lycett. (*Complete in the Volumes for the years* 1872, 1874, 1875, 1877, *and* 1879. *The directions for the binding will be found in the Volume for the year* 1879.)

Supplement to the Fossil Trigoniæ, by Dr. Lycett. (*Complete in the Volumes for the years* 1881 *and* 1883. *The Title-page, Index, with directions for the binding, will be found in the Volume for the year* 1883.)

Carbonicola, Anthracomya, and Naiadites, by Dr. Wheelton Hind. (*Complete in the Volumes for the years* 1894, 1895, *and* 1896. *The Title-page and Index will be found in the Volume for the year* 1896.)

The Oolitic Echinodermata, Vol. I, Echinoidea, by Dr. Wright. (*Complete in the Volumes for the years* 1855, 1856, 1857, 1858, *and* 1878. *Title-page, Index, and directions for the binding, will be found in the Volume for the year* 1878.)

The Oolitic Echinodermata, Vol. II, Asteroidea, by Dr. Wright. (*Complete in the Volumes for the years* 1861, 1864, *and* 1880. *Title-page, Index, and directions for the binding, will be found in the Volume for the year* 1880).

The Cretaceous Echinodermata, Vol. I, Echinoidea, by Dr. Wright. (*Complete in the Volumes for the years* 1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, *and* 1882. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1882.)

The Cretaceous (Upper) Cephalopoda, by Mr. D. Sharpe. (*Complete in the Volumes for the years* 1853, 1854, *and* 1855, *but wants Title-page and Index.*)

The Lias Ammonites, by Dr. Wright. (*Complete in the Volumes for the years* 1878, 1879, 1880, 1881, 1882, 1883, 1884, *and* 1885. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1885.)

The Fossils of the Permian Formation, by Professor King. (*Complete, with Title-page and Index, in the Volume for the year* 1849. *Corrected explanations of Plates XXVIII and XXVIII* will be found in the Volume for the year* 1854.)

The Reptilia of the London Clay (and of the Bracklesham and other Tertiary Beds), Vol. I, by Professors Owen and Bell. (*Complete in the Volumes for the years* 1848, 1849, 1856, *and* 1864. *Directions for the binding, Title-page, and Index, will be found in the Volume for the year* 1864.) Part I of Vol. II, containing Chelone gigas (*to be found in the Volume for the year* 1880), can be added.

The Reptilia of the Cretaceous Formations, by Prof. Owen. (*Complete in the Volumes for the years* 1851, 1857, 1858, 1862, *and* 1864. *Directions for the binding, Title-page, and Index, will be found in the Volume for the year* 1864.)

The Reptilia of the Wealden and Purbeck Formations, by Professor Owen. (*Complete in the Volumes for the years* 1853, 1854, 1855, 1856, 1857, 1858, 1862, *and* 1864. *Directions for the binding, Title-pages, and Index, will be found in the Volume for the year* 1864.)

The Reptilia of the Wealden and Purbeck Formations (Supplements 4—9), by Professor Owen. (*Complete in the Volumes for the years* 1871, 1873, 1876, 1878, 1879, *and* 1888. *Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year* 1888.)

The Reptilia of the Kimmeridge Clay Formation, by Professor Owen. (*Complete in the Volumes for the years* 1859, 1860, 1868, and 1888. *Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year* 1888.)

The Reptilia of the Liassic Formations, by Professor Owen. (*Complete in the Volumes for the years* 1859, 1860, 1863, 1869, *and* 1881. *Directions for the binding, Title-pages, and Index, will be found in the Volume for the year* 1881.)

The Reptilia of the Mesozoic Formations, by Professor Owen. (*Complete in the Volumes for the years* 1873, 1875, 1877, *and* 1888. *Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year* 1888.)

The Red Crag Cetacea, by Professor Owen. (*Complete in the Volumes for the years* 1869 *and* 1888. *Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year* 1888.)

The Fossil Mammalia of the Mesozoic Formations, by Professor Owen. (*Complete, with Title-page and Table of Contents, in the Volume for the year* 1870.)

The Fossil Elephants, by Professor Leith Adams. (*Complete in the Volumes for the years* 1877, 1879, *and* 1881. *Directions for the binding, Title-page, and Index will be found in the Volume for the year* 1881.)

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2. MONOGRAPHS in course of PUBLICATION :*—

The Fossil Sponges, by Dr. G. J. Hinde.

The Carboniferous Lamellibranchiata, by Dr. Wheelton Hind.

The Palæozoic Phyllopoda, by Prof. T. Rupert Jones and Dr. H. Woodward.

The Trilobites, by Dr. H. Woodward.

The Inferior Oolite Ammonites, by Mr. S. S. Buckman.

The Belemnites, by Professor Phillips.†

The Carboniferous Cephalopoda of Ireland, by Dr. A. H. Foord.

The Sirenoid and Crossopterygian Ganoids, by Professor Miall.

The Fishes of the Carboniferous Formation, by Dr. R. H. Traquair.

The Fishes of the Old Red Sandstone, by Messrs. J. Powrie and E. Ray Lankester, and Professor Traquair.

The Pleistocene Mammalia, by Messrs. Boyd Dawkins and W. A. Sanford.

The Fauna of the Devonian Formation of the South of England, by the Rev. G F. Whidborne.

3. MONOGRAPHS which are promised or are in course of PREPARATION :*—

The Fossil Cycadeæ, by Mr. A. C. Seward.

The Graptolites, by Prof. Lapworth.

The Carboniferous Entomostraca, Part II, by Messrs. T. Rupert Jones and J. W. Kirkby.

The Wealden, Purbeck, and Jurassic Entomostraca, by Prof. T. Rupert Jones, and Messrs. C. D. Sherborn and F. Chapman.

The Cretaceous Lamellibranchiata, by Mr. H. Woods.

The Cambrian Fossils, by Dr. H. Hicks.

The Silurian Fish Bed, by Dr. Harley.

The Fossils of the Budleigh Salterton Pebble Bed, by the Rev. G. F. Whidborne.

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* Members having specimens which might assist the authors in preparing their respective Monographs are requested to communicate in the first instance with the Honorary Secretary.

† Unfinished through the death of the Author, but will be continued by Mr. G. C. Crick.

§ III. Dates of the Issue of the Yearly Volumes of the Palæontographical Society.

Volume	I	for	1847	was	issued	to	the Members,	March, 1848.
,,	II	,,	1848	,,	,,		,,	July, 1849.
,,	III	,,	1849	,,	,,		,,	August, 1850.
,,	IV	,,	1850	,,	,,		,,	June, 1851.
,,	V	,,	1851	,,	,,		,,	June, 1851.
,,	VI	,,	1852	,,	,,		,,	August, 1852.
,,	VII	,,	1853	,,	,,		,,	December, 1853.
,,	VIII	,,	1854	,,	,,		,,	May, 1855.
,,	IX	,,	1855	,,	,,		,,	February, 1857.
,,	X	,,	1856	,,	,,		,,	April, 1858.
,,	XI	,,	1857	,,	,,		,,	November, 1859.
,,	XII	,,	1858	,,	,,		,,	March, 1861.
,,	XIII	,,	1859	,,	,,		,,	December, 1861.
,,	XIV	,,	1860	,,	,,		,,	May, 1863.
,,	XV	,,	1861	,,	,,		,,	May, 1863.
,,	XVI	,,	1862	,,	,,		,,	August, 1864.
,,	XVII	,,	1863	,,	,,		,,	June, 1865.
,,	XVIII	,,	1864	,,	,,		,,	April, 1866.
,,	XIX	,,	1865	,,	,,		,,	December, 1866.
,,	XX	,,	1866	,,	,,		,,	June, 1867.
,,	XXI	,,	1867	,,	,,		,,	June, 1868.
,,	XXII	,,	1868	,,	,,		,,	February, 1869.
,,	XXIII	,,	1869	,,	,,		,,	January, 1870.
,,	XXIV	,,	1870	,,	,,		,,	January, 1871.
,,	XXV	,,	1871	,,	,,		,,	June, 1872.
,,	XXVI	,,	1872	,,	,,		,,	October, 1872.
,,	XXVII	,,	1873	,,	,,		,,	February, 1874.
,,	XXVIII	,,	1874	,,	,,		,,	July, 1874.
,,	XXIX	,,	1875	,,	,,		,,	December, 1875.
,,	XXX	,,	1876	,,	,,		,,	December, 1876.
,,	XXXI	,,	1877	,,	,,		,,	February, 1877.
,,	XXXII	,,	1878	,,	,,		,,	March, 1878.
,,	XXXIII	,,	1879	,,	,,		,,	May, 1879.
,,	XXXIV	,,	1880	,,	,,		,,	May, 1880.
,,	XXXV	,,	1881	,,	,,		,,	May, 1881.
,,	XXXVI	,,	1882	,,	,,		,,	June, 1882.
,,	XXXVII	,,	1883	,,	,,		,,	October, 1883.
,,	XXXVIII	,,	1884	,,	,,		,,	December, 1884.
,,	XXXIX	,,	1885	,,	,,		,,	January, 1886.
,,	XL	,,	1886	,,	,,		,,	March, 1887.
,,	XLI	,,	1887	,,	,,		,,	January, 1888.
,,	XLII	,,	1888	,,	,,		,,	March, 1889.
,,	XLIII	,,	1889	,,	,,		,,	March, 1890.
,,	XLIV	,,	1890	,,	,,		,,	April, 1891.
,,	XLV	,,	1891	,,	,,		,,	February, 1892.
,,	XLVI	,,	1892	,,	,,		,,	November, 1892.
,,	XLVII	,,	1893	,,	,,		,,	December, 1893.
,,	XLVIII	,,	1894	,,	,,		,,	November, 1894.
,,	XLIX	,,	1895	,,	,,		,,	October, 1895.
,,	L	,,	1896	,,	,,		,,	October, 1896.
,,	LI	,,	1897	,,	,,		,,	December, 1897.

§ IV. SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* DECEMBER, 1897): *showing in the* FIRST *column whether each Monograph hitherto published be* complete, *or in the* course of completion; *in the* SECOND *column, the yearly volumes which contain each particular Monograph (as a guide to binding the same); and in the* FOURTH *and following columns, the number of pages, plates, figures, and species described in the different Monographs.*

I. SUBJECT OF MONOGRAPH.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III *m*. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
The Morphology and Histology of Stigmaria ficoides, by Prof. W. C. Williamson, COMPLETE	1886	1887	66	15	91	1
The Eocene Flora, by Mr. J. S. Gardner and Baron Ettingshausen. Vol. I, COMPLETE	1879, 1880, 1882	1879, 1880, 1882	87	13	151	23
,, ,, by Mr. J. S. Gardner. Vol. II, COMPLETE	1883, 1884, 1885	1883, 1884, 1886	159	27	400	31
The Flora of the Carboniferous Strata, by Mr. E. W. Binney, *in course of completion*	1867, 1870, 1871, 1875	1868, 1871, 1872, 1875	147	24	141	16
The Fossil Sponges, by Dr. G. J. Hinde, *in course of completion*.....	1886, 1887, 1893	1887, 1888, 1893	254	19	602	106
The Crag Foraminifera, by Messrs. T. Rupert Jones, W. K. Parker, H. B. Brady, H. W. Burrows, C. D. Sherborn, F. W. Millett, R. Holland, and F. Chapman, COMPLETE	1865, 1895, 1896, 1897	1866, 1895, 1896, 1897	417	7	395	156
The Carboniferous and Permian Foraminifera, by Mr. H. B. Brady, COMPLETE.....	1876	1876	166	12	266	62
The Stromatoporoids, by Prof. Alleyne Nicholson, COMPLETE	1885, 1888, 1890, 1892	1886, 1889, 1891, 1892	237	29	415	44
The Tertiary, Cretaceous, Oolitic, Devonian, and Silurian Corals, by MM. Milne-Edwards and J. Haime, COMPLETE (*k*)	1849, 1851, 1852, 1853, 1854	1850, 1851, 1852, 1853, 1855	406	72	800	319*g*
Supplement to the Tertiary, Cretaceous, Oolitic, and Liassic Corals, by Prof. Duncan, COMPLETE	1865, 1866, 1867, 1868, 1869, 1872, 1890	1866, 1867, 1868, 1869, 1870, 1872, 1891	232	49	797	149
The Polyzoa of the Crag, by Mr. G. Busk, COMPLETE	1857	1859	145	22	641	122
The Tertiary Echinodermata, by Prof. Forbes, COMPLETE	1852	1852	39	4	144	44
The Oolitic Echinodermata, by Dr. Wright. Vol. I, COMPLETE (*l*)	1855, 1856, 1857, 1858, 1878	1857, 1858, 1859, 1861, 1878	491	43	724	120*h*
,, ,, Vol. II, COMPLETE	1861, 1864, 1880	1863, 1866, 1880	207	22	232	35
The Cretaceous Echinodermata, by Dr. Wright. Vol. I, COMPLETE.....	1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, 1882	1864, 1868, 1870, 1871, 1872, 1874, 1875, 1878, 1881, 1882	390	87	1119	113
,, ,, by Mr. W. Percy Sladen. Vol. II, *in course of completion*	1890, 1893	1891, 1893	66	16	173	19
The Fossil Cirripedes, by Mr. C. Darwin, COMPLETE	1851, 1854, 1858*a*	1851, 1855, 1861	137	7	320	54
The Fossil Merostomata, by Dr. H. Woodward, COMPLETE	1865, 1868, 1871, 1872, 1878	1866, 1869, 1872, 1872, 1878	265	36	365	51
The Post-Tertiary Entomostraca, by Mr. G. S. Brady, Rev. H. W. Crosskey, and Mr. D. Robertson, COMPLETE	1874	1874	237	16	515	134
The Tertiary Entomostraca, by Prof. Rupert Jones, COMPLETE	1855	1857	74	6	233	56
,, ,, ,, and Mr. C. D. Sherborn (Supplement), COMPLETE	1888	1889	55	3	134	48
The Cretaceous Entomostraca, by Prof. Rupert Jones, COMPLETE	1849	1850	41	7	176	31
,, ,, ,, and Dr. G. J. Hinde (Supplement), COMPLETE	1889	1890	78	4	258	46
The Carboniferous Entomostraca, by Prof. Rupert Jones and Messrs. J. W. Kirkby and Prof. G. S. Brady. Part I, COMPLETE.....	1874, 1884	1874, 1884	95	7	374	81
The Fossil Estheriæ, by Prof. Rupert Jones, COMPLETE	1860	1863	139	5	158	19*i*
		CARRIED FORWARD...	4630	552	9624	1880

SUBJECT OF MONOGRAPH.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III *m*. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
		BROUGHT FORWARD...	4620	552	9624	1880
The Palæozoic Phyllopoda, by Prof. Rupert Jones and Dr. H. Woodward, *in course of completion*	1887, 1892	1888, 1892	124	17	226	72
The Trilobites of the Cambrian, Silurian, and Devonian Formations, by Mr. J. W. Salter, COMPLETE	1862, 1863, 1864, 1866, 1883	1864, 1865, 1866, 1867, 1883	224	31	703	114
The Carboniferous Trilobites, by Dr. H. Woodward, COMPLETE	1883, 1884	1883, 1884	86	10	148	31
The Malacostracous Crustacea (comprising those of the London Clay, Gault, and Greensands), by Prof. T. Bell, *in course of completion*	1856, 1860	1858, 1863	88	22	215	50
The Fossil Brachiopoda, Vol. I. The Tertiary, Cretaceous, Oolitic, and Liassic Brachiopoda, by Mr. T. Davidson, COMPLETE	1850, 1852, 1853, 1854	1851, 1852, 1853, 1855	409	42	1855	160
,, ,, Vol. II. The Permian and Carboniferous Brachiopoda, COMPLETE	1856*d*, 1857, 1858, 1859, 1860	1858, 1859, 1861, 1861, 1863	331	59	1909	157
,, ,, Vol. III. The Devonian and Silurian Brachiopoda, COMPLETE	1862, 1863, 1865, 1866, 1868, 1870	1864, 1865, 1866, 1867, 1869, 1871	528	70	2766	321
,, ,, Vol. IV. Supplements, Tertiary to Carboniferous, COMPLETE	1873, 1876, 1878, 1880, 1881, 1882	1874, 1876, 1878, 1880, 1881, 1882	383	42	1664	215
,, ,, Vol. V. Supplements, Devonian and Silurian, COMPLETE	1882, 1883, 1884	1882, 1883, 1884	476	21	1135	116
,, ,, Vol. VI. Bibliography, COMPLETE	1885	1886	163	—	—	—
The Fossil Trigoniæ, by Dr. Lycett, COMPLETE	1872, 1874, 1875, 1877, 1879	1872, 1874, 1875, 1877, 1879	246	41	446	115
Supplement to the Fossil Trigoniæ, by Dr. Lycett, COMPLETE	1881, 1883	1881, 1883	19	4	53	9*h*
The Mollusca of the Crag, by Mr. S. V. Wood. Vol. I. (Univalves), COMPLETE	1847, 1855*b*	1848, 1857	216	21	581	244
Vol. II. (Bivalves), COMPLETE	1850, 1853, 1855, 1858*c*	1851, 1853, 1857, 1861	344	31	691	253
Supplements to the Crag Mollusca, No. I, II, and III, by Mr. S. V. Wood, COMPLETE	1871, 1873, 1879, 1882	1872, 1874, 1879, 1882	346	19	546	245
The Eocene Mollusca, Cephalopoda and Univalves, by Mr. F. E. Edwards, continued by Mr. S. V. Wood. Vol. I, COMPLETE	1848, 1852, 1854, 1855, 1858, 1877	1849, 1852, 1855, 1857, 1861, 1877	361	34	625	275
The Eocene Mollusca, Bivalves, by Mr. S. V. Wood. Vol. I, COMPLETE	1859, 1862, 1870	1861, 1864, 1871	182	25	531	194
Supplement to the Eocene Mollusca, by Mr. S. V. Wood (Bivalves). Vol. I, COMPLETE	1877	1877	24	2	66	30
The Inferior Oolite Gasteropoda, by Mr. W. H. Hudleston, COMPLETE	1886, 1887, 1888, 1889, 1891, 1892, 1894, 1895, 1896	1887, 1888, 1889, 1890, 1892, 1892, 1894, 1895, 1896	514	44	1295	455
The Great Oolite Mollusca, by Prof. Morris and Dr. Lycett, COMPLETE	1850, 1853, 1854	1851, 1853, 1855	282	30	846	419
,, ,, ,, Supplement by Dr. Lycett, COMPLETE	1861	1863	129	15	337	194
Carbonicola, Anthracomya, and Naiadites, by Dr. Wheelton Hind, COMPLETE	1894, 1895, 1896	1894, 1895, 1896	182	21	704	45
The Carboniferous Mollusca, by Dr. Wheelton Hind	1896, 1897	1896, 1897	208	15	419	62
The Inferior Oolite Ammonites, by Mr. S. S. Buckman, *in course of completion*	1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894	1887, 1888, 1889, 1890, 1891, 1892, 1892, 1893, 1894	456	104	1137	168
The Liassic Ammonites, by Dr. Wright, COMPLETE	1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885	1878, 1879, 1880, 1881, 1882, 1883, 1884, 1886	503	91	726	107
		CARRIED FORWARD...	11454	1363	29248	5931

I. SUBJECT OF MONOGRAPH.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III *m*. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
BROUGHT FORWARD...			11454	1363	29248	5931
The Belemnites, by Prof. Phillips, *in course of completion*	1863, 1864, 1866, 1868, 1869	1865, 1866, 1867, 1869, 1870	128	36	622	69
The Upper Cretaceous Cephalopoda, by Mr. D. Sharpe, COMPLETE	1853, 1854, 1855	1853, 1855, 1857	67	27	319	79
The Carboniferous Cephalopoda of Ireland, by Dr. A. H. Foord, *in course of completion*	1897	1897	22	7	74	23
The Fossils of the Permian Formation, by Prof. King, COMPLETE	1849, 1854*e*	1850, 1855	287	29	511	138
The Fauna of the Devonian Formation, by the Rev. G. F. Whidborne, Vol. I, COMPLETE	1888, 1889, 1890, 1891	1889, 1890, 1891, 1892	346	32	770	206
" " " Vol. II, *in course of completion*	1891, 1892, 1893, 1895	1892, 1892, 1893, 1895	212	24	489	176
" " " Vol. III, *in course of completion*	1896, 1897	1896, 1897	178	21	440	140
The Sirenoid Ganoids, by Prof. Miall, *in course of completion*	1878	1878	32	6	61	6
The Fishes of the Carboniferous Formation, by Dr. Traquair, *in course of completion*	1877	1877	60	7	58	5
The Fishes of the Old Red Sandstone, by Messrs. J. Powrie, E. Ray Lankester, and Dr. Traquair, *in course of completion*	1867, 1869, 1894	1868, 1870, 1894	90	18	232	22
The Reptilia of the London Clay [and of the Bracklesham and other Tertiary Beds], by Profs. Owen and Bell, Vol. I, COMPLETE‡	1848, 1849, 1856*f*	1849, 1850, 1859	150	58	304	39
" " Vol. II, Part I, by Prof. Owen, COMPLETE	1880	1880	4	2	4	1
The Reptilia of the Cretaceous Formations, by Prof. Owen, COMPLETE‡	1851, 1857, 1858, 1862	1851, 1859, 1861, 1864	184	59	519	26
The Reptilia of the Wealden and Purbeck Formations (with Supplements 1, 2, 3), by Prof. Owen, COMPLETE ‡	1853, 1854, 1855, 1856, 1857, 1858, 1862	1853, 1855, 1857, 1858, 1859, 1861, 1864	155	62	251	17
The Reptilia of the Wealden and Purbeck Formations (Supplements 4—9), COMPLETE	1871, 1873, 1876, 1878, 1879, 1888*n*	1872, 1874, 1876, 1878, 1879, 1889	85	21	175	15
The Reptilia of the Kimmeridge Clay Formation, by Prof. Owen, COMPLETE	1859, 1860, 1868, 1888*n*	1861, 1863, 1869, 1889	16	6	23	4
The Reptilia of the Liassic Formations, by Prof. Owen, COMPLETE	1859,‖ 1860,‖ 1863, 1869, 1881*n*	1861, 1863, 1865, 1870, 1881	174	50	276	20
The Reptilia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1873, 1875, 1877, 1888*n*	1874, 1875, 1877	101	24	165	17
The Red Crag Cetacea, by Prof. Owen, COMPLETE	1869, 1888*n*	1870, 1889	42	5	43	9
The Fossil Elephants, by Prof. Leith Adams, COMPLETE	1877, 1879, 1881*n*	1877, 1879, 1881	265	28	216	3
The Pleistocene Mammalia, by Messrs. W. Boyd Dawkins and W. A. Sanford, *in course of completion*	1864, 1867, 1868, 1871, 1878, 1886	1866, 1868, 1869, 1872, 1878, 1887	333	39	340	12
The Mammalia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1870	1871	115	4	247	30
TOTAL.....			14500	1928	35387	6988

a Index. *b* Title-page to Univalves. *c* Note to Crag Mollusca. *d* Contains the Permian. *e* Two corrections of Plates. *f* Supplement.
g Many of the species are described, but not figured. *h* British species only reckoned. *i* British species only reckoned. *k* A Supplement is now in course of publication.
l Index will be found in 1878 vol. *m* Useful for establishing the dates of new species. *n* Contains title-pages and directions for binding.
‡ Title-pages and Index will be found in the 1864 Volume. ‖ Marked on outside label 'Reptilia of Oolitic Formations.'

§ V. Stratigraphical Table *exhibiting the* British Fossils *already figured and described in the* Annual Volumes (1847—1897) *of the* Palæontographical Society.

	PLANTS.	PROTOZOA.		RADIATA.		ARTICULATA.					
		Sponges.	Foraminifera.	Stromatoporoids and Corals.	Echinodermata.	Cirripedes.	Cypridæ, Cytherinæ, &c.	Phyllopoda.	Merostomata.	Trilobites.	Malacostracous Crustacea.
Pleistocene	...	...	...	...	.....	.....	1874, 1888				
Crag	...	...	1865, 1895, 1896, 1897	1849	1852	1851, 1854	1888				
Eocene	1879, 1880, 1882, 1883, 1884, 1885	...	...	1849, 1865	1852	1851, 1854	1855, 1888	...	.....	.....	1856
Cretaceous	...	...	...	1849, 1868, 1869	1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, 1882, 1890, 1893	1851, 1854	1849, 1889	...	.....	.....	1860
Wealden	...	...	...	...	.....	.....	...	1860			
Oolitic	...	1893	...	1851, 1872	1855, 1856, 1857, 1858, 1861, 1878, 1880	1851	...	1860			
Liassic	...	1893	...	1851, 1866, 1867	1855, 1856, 1858, 1861, 1864						
Triassic	...	...	...	...	1880	.....	...	1860			
Permian	1849	1849	1849, 1876	1849, 1852	1849	.....	1849	1860			
Carboniferous	1867, 1870, 1871, 1875, 1886	1887	1876	1852	.....	.....	1874, 1884	1860, 1887	1872, 1878	1883, 1884	
Devonian	...	1887	...	1853, 1885, 1888, 1890, 1892	1895	.....	1888	1860	1865, 1868, 1872, 1878	1862, 1888	
Silurian	...	1886, 1887	...	1854, 1885, 1890	.....	.....	...	1887, 1892	1868, 1871, 1872, 1878	1862, 1863, 1864, 1866	
Cambrian	...	1886, 1887	...	1890	.....	.....	...	1887	.....	1864	

Note.—The numbers in the above List refer to the Volumes issued for those Dates.

STRATIGRAPHICAL TABLE *exhibiting the* BRITISH FOSSILS *already figured and described in the* ANNUAL VOLUMES (1847—1897) *of the* PALÆONTOGRAPHICAL SOCIETY (*continued*).

	MOLLUSCA.				VERTEBRATA.		
	Polyzoa.	Brachiopoda.	Monomyaria, Dimyaria, and Gasteropoda.	Cephalopoda.	Fishes.	Reptiles.	Mammalia.
Pleistocene	...	1873	.....	...	...	.....	1864, 1867, 1868, 1871, 1877, 1878, 1879, 1881, 1886
Crag	1857	1852, 1873, 1879	1847, 1850, 1853, 1855, 1871, 1873, 1879, 1882	...	...	.....	1869, 1881, 1888
Eocene	...	1852, 1873	1852, 1854, 1855, 1858, 1859, 1862, 1870, 1877	1848	...	1848, 1849, 1856, 1880	
Cretaceous.....	...	1852, 1854, 1873, 1884	1872, 1875, 1877, 1879	1853, 1854, 1855	...	1851, 1857, 1858, 1862, 1873, 1888	
Wealden	...	... ..	.....	...	...	1853, 1854, 1855, 1856, 1857, 1862, 1871, 1873, 1875, 1876, 1878, 1879	
Oolitic	...	1850, 1852, 1876, 1878, 1884	1850, 1853, 1854, 1872, 1874, 1875, 1877, 1879, 1883, 1886, 1887, 1888, 1889, 1891, 1892, 1894, 1895, 1896	1850, 1861, 1868, 1869, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1894	...	(Purbeck) 1853, 1858 (Kim. Clay), 1859, 1860, 1868, 1873, 1875, 1877, 1888 (Great Oolite) 1875, 1888	1870
Liassic	...	1850, 1852, 1876, 1878, 1884	1874, 1877, 1879, 1883	1863, 1864, 1866, 1868, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885	...	1859, 1860, 1863, 1869, 1873, 1881	
Triassic.....	...	1876, 1878	1879	.....	1878	.....	1870
Permian	1849	1849, 1856, 1880	1849	1849	1849	1849	
Carboniferous ...	...	1856, 1857, 1858, 1859, 1860, 1880, 1884	1894, 1895, 1896, 1897	1897	1877		
Devonian	1895	1862, 1863, 1881, 1882, 1884, 1893	1890, 1891, 1892, 1893, 1896, 1897	1889	1867, 1869, 1894		
Silurian.....	...	1865, 1866, 1868, 1870, 1881, 1882, 1883					
Cambrian							

NOTE.—The numbers in the above List refer to the Volumes issued for those Dates

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1897.

LONDON

MDCCCXCVII.

A MONOGRAPH

OF THE

FORAMINIFERA OF THE CRAG.

PART IV.

CONTAINING

PAGES xiii—xv; GENERAL TITLE-PAGE; vii—xv; 315—402.

BY

PROFESSOR T. RUPERT JONES, F.R.S., F.G.S.,

HON. MEM. GESELL. ISIS DRESDEN, SOC. BELG. MICROSC., AND SOC. GÉOL. PALÉONTOL. HYDROL. BRUX.,
GEOL. ASSOC. LOND., GEOL. SOCS. EDIN., GLASG., ROY. IRISH GEOL. SOC., AND ANTHROP.
INST. LOND.; CORRESP. MEM. OF THE K.-K. GEOLOG. REICHSANST. VIENNA,
AND ACAD. NAT. SCI. PHILAD., ETC.

ASSISTED BY

H. W. BURROWS, Esq., A.R.I.B.A., &c.; C. D. SHERBORN, Esq., F.G.S., F.Z.S., &c.;
F. W. MILLETT, Esq., F.R.M.S., &c.; R. HOLLAND, Esq.;
and F. CHAPMAN, Esq., A.L.S., F.R.M.S., &c.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1897.

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

CONTENTS OF PART IV.

LIST OF GENERA AND SPECIES DESCRIBED AND FIGURED IN PART IV.

WOODCUTS IN PART IV.

CORRECTIONS FOR PART IV.

Page 315, after line 16 from the top, *insert* Heterolepa, *Franzenau*.

„ „ after line 5 from the bottom, *insert* Heterolepa grosserugosa, *Franzenau*, 1885. 'Természetrajzi Fuzetek' (Budapest), vol. ix, p. 93, pl. vii, fig. 2.

„ 329, line 11 from bottom, *for* Magt. Klein. *read* Magt van het Kleine,

„ 333 „ 10 from the top, *add* Mr. Millett has it from the St.-Erth beds.

„ 337, *insert* additional synonyms of Nonionina :

Rotalina, *Williamson*.
Rotalia, *von Reuss*.
Pullenia, *von Hantken*.
Anomalina (?), *Schwager*.
Pulvinulina, *Andreae*.

For Robulina add *Kübler and Zwingli*.

For Polystomella add *Goës*.

„ 343, line 7 from bottom, *after* nov. insert *Jones*.

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLXVI—MDCCCXCVII.

MONOGRAPH OF THE FORAMINIFERA OF THE CRAG.

DIRECTIONS TO THE BINDER.

The Monograph of the Foraminifera of the Crag will be found in the Volumes of the Palæontographical Society issued for the years 1865, 1895, 1896, and 1897.

Cancel the Title-pages of Parts I, II, III, and IV in the Volumes for the years 1865, 1895, 1896, and 1897, and *substitute* the General Title-page in the Volume for the year 1897. *Cancel* pages i—vii in Volume for 1895, ix—xii in Volume for 1896, and xiii—xv in Volume for 1897, and *substitute* pages vii—xv (signatures B, c) in Volume for 1897.

ORDER OF BINDING AND DATES OF PUBLICATION.

PAGES	PLATES	ISSUED IN VOL. FOR YEAR	PUBLISHED
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A MONOGRAPH

OF THE

FORAMINIFERA OF THE CRAG.

COMPRISING

PART I (1866), CONTAINING PAGES i—vi, 1—72; APPENDICES I AND II, AND PLATES I—IV.

BY T. RUPERT JONES, W. K. PARKER, AND H. B. BRADY.

PART II (1895), CONTAINING PAGES 73—210 AND PLATES V, VI, VII.

BY

PROFESSOR T. RUPERT JONES, F.R.S., F.G.S.,

HON. MEM. GESELL. ISIS DRESDEN, SOC. BELG. MICROSC., AND SOC. GÉOL. PALÉONTOL. HYDROL. BRUX., GEOL. ASSOC. LOND., GEOL. SOCS. EDIN., GLASG., ROY. IRISH GEOL. SOC., AND ANTHROP. INST. LOND.; CORRESP. MEM. OF THE K.-K. GEOLOG. REICHSANST. VIENNA, AND ACAD. NAT. SCI. PHILAD., ETC.

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PART III (1896), CONTAINING PAGES 211—314.

BY THE SAME.

PART IV (1897), CONTAINING PAGES vii—xv, 315—402.

BY THE SAME.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY

1866—1897.

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

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LIST OF GENERA AND SPECIES DESCRIBED AND FIGURED.

IN PART I (1866).

NOTE.—The above are repeated, with modifications, in the later Parts, II, III, and IV.

IN PART II (1895).

LIST OF THE ILLUSTRATIONS IN THE MONOGRAPH (1866—1897).

PLATES I—IV (1866); V—VII (1895).

WOODCUTS IN PART II (1895).

WOODCUT IN PART III (1896).

WOODCUTS IN PART IV (1897).

LIST OF CORRECTIONS.

PART I (1866).

Page 15, last line but one in the synonyms, *instead of* p. 466 *read* p. 470.

„ 21, *insert*, after line 8 from the top, A good specimen of *Orbiculina numismalis* (one of the stages of growth of *O. adunca*) from the Crag of Ramsholt, collected by the late S. V. Wood, F.G.S., is in the Geological Society's Collection; also another, less perfect; both in coarse, sandy, light brown shell-grit.

„ 26, line 8 from bottom, *for* Schlotheim *read* Geinitz.

„ „ „ 7 „ „ Kirby „ Kirkby.

„ 32, 15th line of the synonyms, *instead of* Ib. *read* Ann. Mag. Nat. Hist., ser. 2.

„ 34, 5th „ „ *for* 307 *read* 317.

„ „ 6th „ „ „ p. 6 „ pp. 268, 269; and *for* pl. i *read* pl. v.

„ 40, line 2 from bottom, *for* Pliocene *read* Pleistocene.

„ 44, 2nd line of the synonyms, *for* 319 *read* 318.

„ „ 4th „ „ „ 40, 41 „ 90, 91.

„ 47, 48, 55, 59, 61, *for* Neuegeboren *read* Neugeboren.

„ 48, 52, 70, *for* Upper Trias of Chellaston *read* Lias of Leicestershire (?).

„ 53, line 20 from top, for *raphanius* read *raphanus*.

Footnote at page 61 *for* Marguline *read* Marginuline.

Page 64, line 8 from bottom, *for* Genus *read* Species.

„ 69 „ 2 „ of text, *for* Smith's *read* Smithsonian.

„ 70 „ 11 „ delete *granum* and its reference (Signor Fornasini has shown that this is a four-sided form).

PART II (1895).

Page 78, line 3 from bottom, in footnote, and p. 81, line 7 from bottom of the text, *for* Appendix *read* Table of Distribution, &c., at the end of the volume.

„ 93, in footnote, *for* p. 21 *read* p. 96.

„ 108, last line in list of synonyms, *for* p. 35 *read* p. 109.

„ 114, line 3 from top, *for* p. 33 *read* p. 107.

„ 119, 1st line, *for* 3 *a*, 3 *b*, *read* 4 *a*, 4 *b*.

„ 123, line 6 from top, for *Montagu* read *Walker and Jacob*.

„ 137 „ 11 from bottom, *for* 10 *read* 16.

„ 146 „ 16 „ *add* Mr. Millett has collected it from the Crag at Gomer, near Gedgrave.

„ 146 „ 15 „ *after* sp. nov. *add Jones*.

„ 153 „ 22 from top, *for* 19 *read* 10.

„ „ „ 34 „ *delete* this line.

„ 156 „ 8 „ *for* 1092 *read* 109^2.

„ 156 „ 24 „ *for* INÆQUILATERALIS *read* ÆQUILATERALIS.

„ 157, 1st line, TEXTULARIA GLOBULOSA, *Woodward and Thomas*, 1885 . . . . figs. 1—5, is T. GIBBOSA, and should be transferred to p. 153.

„ 159, 1st and 2nd lines, *read* Charente-Inf. Annales.

„ „ line 4 from top, *for* (Reud.) *read* (Rend.).

Page 159, last line but one from bottom, *for* Ak.-Wiss. *read* Ak. Wiss.
" " " *for* 274 *read* 275, and *for* vii *read* vi.
" 160 " *for* zone f *read* zone g.
" 167, in the heading, *for* BOLIVINA PUNCTATA *read* VIRGULINA SCHREIBERSIANA.
" 174, line 6 from top, *delete* dash and *add* OBLONGA before *Andreae*.
" " " 8 " *delete* dash and *add* CRASSA before Egger.
" 175, 1st line, *insert before* LAGENIDÆ, &c.—III. VITREA, HYALINA, vel PERFORATA.—Shell calcareous; perforate and hyaline in structure. (Those of the *Perforata* that in part take on an *arenaceous* investment are included in the *Arenacea*.)
" 177, line 9 from bottom of text, *for* figs. 8 and 9, *add* note:—In the 'Rivista Ital. Paleont.,' June, 1896, Signor C. Fornasini, having examined the original specimens, states that Costa's fig. 8 is probably either a *Polymorphina* or an incipient *Marginulina*, and that Costa's fig. 9 is a *Glandulina*.
" " " 10 from bottom, delete *Phialina oviformis* and reference (Fornasini finds it to refer to two different things).
" 179 " 8 from top, and p. 182, line 13, for *Meriani* read *Mariani*.
" 183 " 7 " *for* viii *read* xviii.
" " " 12 from bottom, after *Soldani* add 1798.
" 184 " 7 " *for* 38—40 *read* 38, 39.
" " " 4 " *for* Pierzpuhl *read* Pietzpuhl.
" 187 " 26 from top, for *Idem* read *Haeusler*, and *for* Ibid. *read* Neues Jahrb. for 1887, part 1.
" " " 28 " *delete* this line.
" " " 29 " *read* — SULCATA, *Brady*, 1888.
" 189 " 12 from bottom, *for* 7, 10, *read* 7—10.
" " " 11 " *for* 563 *read* 583.
" 190 " 12 from top, *for* 327 *read* 326.
" " " 14 " *after* SULCATA (pars) *add* var. SEMISTRIATA.
" " " 15 " *after* 350 *for* pl. xvi, fig. 6, *read* pl. xiii, fig. 23.
" " " 23 " *delete* this line and transpose SEMISTRIATA to the line below.
" " " 29 " *for* Fenille *read* Feuille.
" 191 " 9 from bottom, *add* and woodcut, fig. 20.
" " " 4 " *for* 10 *read* 9.
" 193 " 7 from top, *add* and woodcut, fig. 21.
" 199 " 14 from bottom, *for* v *read* iii.
" " " 8 " *read* 1889. Math. Természett. Értésitö, vol. vii, p. 68, pl. iii, fig. 4; and Math. u. Nat. Berichte aus Ungarn, vol. vii, 1890, pl. iii, fig. 4.
" " " last line, *for* CATERINLOSA *read* CATENULOSA.
" 201 " 16 from top, *delete* this line.
" " " 17 " *read* LAGENA *before* VULGARIS, and for *Idem* read *O. Jones*, and *for* Ibid. *read* Tr. Linn. Soc., vol. xxx.
" " " 18 " *for* p. 43 *read* figs. 42, 43.
" 204 " 16 from bottom, *for* 82, *read* 81.

PART III (1896).

Page 221, line 9 from top, *for* Vignettes *read* Vignette 1.
" 226 " 21 " Cornu Hammonis should not have been printed in capitals.

Page 226, in the foot-note, 2nd line from the bottom, *for* a *read* as.
,, 229, heading and line 11 from top, *for* LINARIS *read* LINEARIS.
,, 231, 1st line, after sp. nov. insert *Jones.*
,, 238, line 23 from bottom, *insert* NONIONINA.—*Römer, von Reuss, von Gümbel.*
,, 250 ,, 7 ,, in footnote, *for* laxum *read* laxus.
,, 253 ,, 2 ,, ,, *after* Zelanti, *add* Acireale.
,, 257 ,, 2 ,, in the text, *for* Neapol. *read* Neapel (without the full stop).
,, 271 ,, 5 ,, *after* BREVIS *add* nov., *Jones.*
,, 272, 1st line, *after* LINEATA *add* nov., *Jones.*
,, 275, 5th and 6th lines from the top to be *deleted.* Signor Fornasini states that figs. 16 and 17 are *Marginulinæ*, and that figs. 18 and 26 are not determinable.
,, ,, lines 17, 18, and 23 to be *deleted.*
,, 278, line 17 from top, *after* Appendix *add* I, Table, No. 59; and *for* Tables *read* Table.
,, 279 ,, 19 ,, *for* 4 *read* 2.
,, 286 ,, 5 ,, add *Seguenza.*
,, 288 ,, 4 ,, *for* 5 *read* 3; and *for* ROTALIDÆ *read* ROTALIIDÆ.
,, 290 ,, 10 ,, after nov. add *Jones.*
,, ,, ,, 11 from bottom, *for* ROTALINÆ *read* ROTALIINÆ.
,, 291, after the last line, *insert* — — *Chapman*, 1894. Quart. Journ. Geol. Soc., vol. l, p. 719.
,, 293, line 6 from top, *for* Neapol *read* Neapel.
,, ,, after line 17 from top, *insert* — — *Chapman*, 1896. Journ. Roy. Micr. Soc., p. 590, pl. xiii, figs. 11 *a—c.*
,, 296, line 14 from top, *insert* — — *Chapman*, 1894. Quart. Journ. Geol. Soc., vol. l, p. 719.
,, 301 ,, 15 from bottom, *for* 4 *read* 3.
,, 306 ,, 18 ,, *after* Selsk. *add* Christiania.
,, 312 ,, 3 from top, *for* often *read* sometimes.
,, ,, ,, 5 ,, *delete* the comma *as well as* blunt.
,, ,, ,, 8 ,, ,, indefinite.
,, ,, ,, 12 and 13 from top, *for* the few *read* some of those.
,, ,, ,, 13 from top, *delete* (from Sutton and Sudbourne).

PART IV (1897).

Page 315, after line 16 from the top, *insert* HETEROLEPA, *Franzenau.*
,, ,, after line 5 from the bottom, *insert* HETEROLEPA GROSSERUGOSA, *Franzenau*, 1885. 'Természetrajzi Fuzetek' (Budapest), vol. ix, p. 93, pl. vii, fig. 2.
,, 329, line 11 from bottom, *for* Magt. Klein. *read* Magt. van het Kleine.
,, 333 ,, 10 from the top, *add* Mr. Millett has it from the St.-Erth beds.
,, 336 ,, 8 from the bottom, *for* 6 *read* 4.
,, 337, *insert* additional synonyms of NONIONINA:

ROTALINA, *Williamson.*
ROTALIA, *von Reuss.*
PULLENIA, *von Hantken.*
ANOMALINA (?), *Schwager.*
PULVINULINA, *Andreae.*

For ROBULINA add *Kübler and Zwingli.*
For POLYSTOMELLA add *Goës.*

,, 343, line 7 from bottom, *after* nov. insert *Jones.*

CORRECTIONS IN THE EXPLANATIONS OF THE PLATES I—IV, PART I (1866).

Plate I, fig. 21, should be *Marginulina costata* (Batsch).
„ „ 29—31, should be *Lagena lagenoides*, Williamson.
„ „ 42, 43 „ *Lagena acuticosta*, Reuss.
„ „ 55—58 „ *Polymorphina nodosaria*, Reuss.
„ „ 61 „ *Dimorphina tuberosa*, d'Orb.
„ „ 66 „ *Dimorphina compacta*, B., P., and J.
„ „ 69 „ *Polymorphina frondiformis*, S. V. Wood, Var. *lineata*, nov.
„ „ 70—75 „ tubulose forms chiefly of *Polymorphina gibba*, d'Orb.
„ II „ 8—10 „ *Truncatulina refulgens* (Montfort).
„ „ 16—18 „ *Rotalia calcar*, d'Orb.
„ „ 22—24 „ *Pulvinulina punctulata* (d'Orb.).
„ „ 25—27 „ *Pulvinulina repanda* (d'Orb.).
„ „ 36, 37 „ *Nonionina umbilicatula* (Montagu), thick variety.
„ „ 44, 45 „ *Nonionina scapha* (F. and M.), thick variety.
„ „ 51, 52 „ *Nummulites Boucheri* (*?*), de-la-Harpe.
„ III „ 7—9 „ *Textilaria sagittula*, Defrance.
„ „ 19 „ *Bigenerina nodosaria*, d'Orb.
„ „ 20—22 „ *Spirillina vivipara*, Ehrenb., Var. *complanata*, nov.
„ „ 22 „ *Radiolarian ?*
„ „ 24 „ *Dactyloporoid ?*
„ „ 31—34 „ *Miliolina*, not *Triloculina*.
„ „ 35,36,41,42 „ *Miliolina*, not *Quinqueloculina*.
„ „ 45—47 „ *Orbitolites complanatus*, Lamarck.
„ „ 48, 49 „ *Peneropolis* (*Dendritina*) *arbuscula* (d'Orb.).
„ IV „ 1 „ *Miliolina triangularis* (d'Orb.).
„ „ 2 „ *Miliolina bicornis* (W. and J.), Var. *Brongniartii* (d'Orb.).
„ „ 3 „ *Miliolina pulchella* (d'Orb.).
„ „ 4 „ *Miliolina Ferussacii* (d'Orb.).
„ „ 7 „ *Lagena reticulata* (Macgillivray).
„ „ 8 „ *Nodosaria proxima*, Silvestri.
„ „ 18 „ *Truncatulina Haidingeri* (d'Orb.).

Genus 4.—ANOMALINA, *d'Orbigny*, 1826.

Brady, 1884, *Report 'Challenger,' pp.* 73, 627, 671.

ANOMALINA, *d'Orbigny, Bronn, von Münster, Römer, von Reuss, Costa, Parker and Jones, Egger, Carpenter, Karrer, Seguenza, Brady, M. Sars, von Schlicht, Siddall, Martonfi, Schwager, von Gümbel, Berthelin, Terquem, Basset, Sherborn and Chapman, Nicolucci, Franzenau, Bütschli, Walther, Sander Rang, Williamson, Schrodt, De Amicis, A. Silvestri*, and others.
PLANULINA, *d'Orbigny, Bronn, Münster, Römer, von Reuss, Norman.*
ROTALINA, *d'Orbigny.*
ROSALINA, *von Reuss, Stache.*
ROTALIA, *von Reuss, Stache, von Gümbel.*
NONIONINA, *von Reuss.*
DISCORBINA, *von Reuss, Seguenza.*
PLANORBULINA, *Parker, Jones, Brady, von Reuss, Wright.*
TRUNCATULINA, *von Gümbel, von Hantken.*

General Characters.—Test free, rotaliform or subnautiloid; the two faces subconcave and nearly alike; the upper face shows a nearly plain spire of many chambers; the lower face has fewer chambers and a deeper umbilicus. Aperture a nearly symmetrical slit at the base of the last chamber.

1. ANOMALINA GROSSERUGOSA (*Gümbel*), 1868, variety. Plate VII, figs. 30 *a—c*.

Synonyms of the Type-form:

TRUNCATULINA GROSSERUGOSA, *Gümbel*, 1868. Abhandl. k. bayer. Akad. Wiss., vol. x, p. 660, pl. ii, figs. 104 *a—c*.
— — *Hantken*, 1875. Mitth. Jahrb. k. Ung. Geol. Anstalt, vol. iv, p. 74, pl. ix, figs. 6 *a—c*.
— GRANOSA, *Hantken*, 1875. Ibid., vol. iv, p. 74, pl. x, figs. 2 *a—c*.
ANOMALINA GROSSERUGOSA *Brady*, 1884. Report 'Challenger,' p. 673, pl. xciv, figs. 4 *a—c*, 5 *a—c*.
— — *Sherborn and Chapman*, 1889. Journ. R. Micros. Soc. for 1889, p. 487, pl. xi, fig. 34.
— — *Burrows, Sherborn, and Bailey*, 1890. Ibid., 1890, p. 563, pl. xi, figs. 25 *a, b*.

Rosalina, sp., *Beissel*, 1891. Abhandl. k. Preuss. Geol. Landes., n. s., part 3, p. 75, pl. xvi, figs. 17—22.
Anomalina grosserugosa, *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 450.
— — *Chapman*, 1895, Proceed. Zool. Soc., 1895, p. 41.

Characters.—Subnautiloid in shape, unequally concave on the two faces. Less symmetrical than *A. ammonoides*, Reuss, and, like it, subject to variation in details.

Our figured specimen appears to be rather thicker than Gümbel's and thinner than Brady's figures, and shows fewer chambers than either. Von Hantken's figure shows a close alliance with ours; and that given by B., S., and B. is thicker than our specimen, and has its aperture contracted and more medial.

There are several published figures of varieties of this form:—*Rosalina rudis*, Gümbel (1868), is possibly the same; and with the two faces equally convex there are *Anomalina moniliformis*, Reuss (1845), and *Truncatulina pusilla*, Deecke (1886).

Occurrence.—Found living here and there in the Atlantic and Pacific at depths ranging from 345 to 2160 fathoms. It occurs fossil in Eocene strata in the Bavarian Alps, and in the London Basin; and in the Miocene of Hungary.

Genus 5.—Pulvinulina, *Parker and Jones*, 1862.

Carpenter, '*Introd. Foram.*,' 1862, p. 210; *Brady*, *Report* '*Challenger*,' 1884, pp. 73, 627, 681.

Nautilus, *Soldani, Fichtel and Moll.*
Serpula, *Montagu.*
Cidarollus, Eponides, and Cancris, *de Montfort.*
Pulvinulus, *Lamarck.*
Cristellaria, *Lamarck.*
Placentula, *Lamarck, Berthelin.*
Crepidulina, *Blainville and Defrance.*
Rotalites, *Blainville and Defrance.*
Rotalia, *d'Orbigny, von Reuss, Parker and Jones, Morris and Quekett, Karrer, Schwager, von Gümbel.*
Rosalina, *d'Orbigny, Parker and Jones, von Gümbel, and Terquem.*
Turbinulina and Planorbulina, *d'Orbigny.*
Omphalophacus, *Ehrenberg.*
Rotalina, *d'Orbigny, von Reuss, Czjzek, Bailey, Ehrenberg, Bornemann, Egger, Williamson, Karrer, Seguenza, Alcock, Terquem, Parfitt, von Schlicht, Schlumberger.*

Valvulina, *d'Orbigny, Terquem.*
Gyroidina, *Römer.*
Planulina, *Römer, Ehrenberg.*
Platycœcus and Spiropleurites, *Ehrenberg.*
Pulvinulina, *Parker and Jones, Carpenter, Brady, S. Owen, von Reuss, Karrer, M. Sars, von Hantken, Dawson, Fischer, Miller and Vanden Broeck, Schulze, Norman, Blake, Wright, Siddall, Terrigi,* and others.
Discorbina, *Schwager, Seguenza.*
Truncatulina, *Karrer, Seguenza.*
Epistomina, *Terquem, Uhlig.*

General Characters.—Rotaliform; "superior" face generally thicker; shell usually very finely porose; chambers fewer than in other Rotalines; sutures usually thickened; aperture variable, typically a large slit at the umbilical margin of the last chamber.

1. Pulvinulina repanda (*Fichtel and Moll*), 1803. Plate II, figs. 25—27 ("*P. pulchella*").

Part I, 1866, Appendices I and II, Tables, No. 84 ("*P. pulchella*").

Nautilus repandus, *Fichtel and Moll*, 1803. Testac. Micros., p. 35, pl. iii, figs. *a—d.*
Eponides repandus, *Montfort*, 1808. Conchyl. Systèm., vol. i, p. 126, 32e genre.
Pulvinulus repandus, *Lamarck*, 1816. Tabl. Encycl. Méth., pl. cccclxvi, figs. 9 *a—d.*
Placentula pulvinata, *Lamarck*, 1822. Anim. Sans Vert., vol. vi, p. 621, No. 1.
— — *Defrance*, 1824 (fide *Blainville*). Dict. Sci. Nat., vol. xxxii, p. 180; vol. xli, p. 193; Atlas Conch., pl. xv, fig. 5.
— — *Blainville*, 1825. Manuel Malacol., p. 374, pl. vii, fig. 5.
Rotalina concamerata, *Williamson*, 1858. Rec. For. Gt. Br., p. 52, pl. iv, figs. 101—103.
Rotalia repanda, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 110, Table.
— — *Parker and Jones*, 1860. Ann. Nat. Hist., ser. 3, vol. v, p. 175, No. 25; p. 290, No. 42; vol. vi, p. 341, No. 18.
Pulvinulina repanda, *Parker and Jones*, 1862. In Carpenter's Introd., App., p. 311.
— — — 1863. Ann. Mag. Nat. Hist., ser. 3, vol. xii, p. 215, No. 106.
— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 78.

PULVINULINA REPANDA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, pp. 390—393.
ROTALINA CONCAMERATA, *Alcock*, 1865. Proc. Lit. Phil. Soc. Manch., vol. iv, p. 206.
PULVINULINA REPANDA, *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 359, &c.
ROTALINA CONCAMERATA, *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 71.
PLACENTULA REPANDA, *Berthelin*, 1878. Ann. Soc. Acad. Nantes, ser. 5, vol. viii, Reprint, p. 41, No. 68.
PULVINULINA REPANDA, *Terrigi*, 1880. Atti Accad. Pontif. N. Lincei, vol. xxxiii, p. 206, pl. iii, fig. 61.
— — *Goës*, 1882. K. Sv. Vet.-Ak. Handl., vol. xix, No. 4, p. 110, pl. viii, figs. 276–282.
— — *Terrigi*, 1883. Att. Acc. P. N. Lincei, p. 198, pl. iii, fig. 42.
— — *Brady*, 1884. Report 'Challenger,' pp. 627, 684, pl. civ, figs. 18 *a—c*.
— — *Sherborn and Chapman*, 1886. Journ. R. Microsc. Soc., p. 757, pl. xvi, figs. 18 *a—c*.
— — *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. v, p. 164.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 921.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 405, pl. xviii, figs. 34—36.
— — *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 95, pl. xvi, figs. 801 *a*, *b*.
— — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 55 and 63.

Characters.—The typical *Pulvinulina repanda* has a trochoid or discoidal shell, formed of about two and a half revolutions, all visible on the upper (spiral) surface, the outermost alone visible on the lower. Outermost convolution consisting of six or eight slightly convex segments. Septa (in normal specimens) on the upper surface more or less limbate, the raised line of shell-substance prolonged round the external margin of the segments forming an obtuse peripheral carina. On the inferior surface segments convex, especially the later ones; septa depressed, often obscure; surface sometimes tuberculate, sometimes marked by large perforations, radiating from the irregular umbilicus. Peripheral margin almost entire, sometimes lobulate, the peripheral convexity of the ultimate and penultimate segments being most prominent.

The figured specimen (Pl. II, figs. 25—27), shows one of the modifications which have fewer chambers than the large forms and are more compact, forming a more or less conical shell, with neatly limbate sutures on the aboral face. It is near *P. pulchella* (d'Orb., 1829), but of stronger build.

Occurrence.—*Pulvinulina repanda*, according to the 'Challenger' Report, is a shallow-water form commonly found at depths ranging from the shore-line down to 200 fathoms, and sparingly down to 1000 fathoms. Egger, in the 'Gazelle'

Memoir, records specimens from several stations at depths exceeding 1000 fathoms—his lowest record being 2740 fathoms. Geographically the range of the species is wide, but it is most commonly met with in tropical and subtropical latitudes.

Fossil specimens have been recorded from the Chalk of Swanscombe and Taplow; from the Eocene (London Clay); from the Miocene of Italy and Muddy Creek, Victoria; the Pliocene of Italy; and the Pleistocene of Norway. In the Coralline Crag we have found specimens in nearly every zone examined.

2. Pulvinulina punctulata (*d'Orbigny*), 1826. Plate II, figs. 22—24 ("*P. repanda*").

Part I, 1866, Appendices I and II, Tables, No. 83 ("*P. repanda*").

Rotalia punctulata, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 273, No. 25, Modèle, No. 12.

Rosalina calabra, *Costa*, 1856. Atti Accad. Pont., vol. vii, part 2, pl. xiv, fig. 6.

— vesicularis, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 292, pl. x, figs. 22—24.

Pulvinulina repanda, var. punctulata, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 394, pl. xiv, figs. 12, 13.

— punctulata, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 20, pl. iii, fig. 82.

— repanda, *J., P., and B.*, 1866. Monogr. Foram. Crag, pl. ii, figs. 22—24.

— punctulata, *Brady*, 1884. Report 'Challenger,' pp. 683, 685, pl. civ, figs. 17 *a—c*.

— — var., *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 758, pl. xvi, figs. 22 *a—c*, 23 *a—c*.

? Rosalina d'Orbignyi, *Walther*, 1888. Mitth. Zool. Stat. Neapel, vol. viii, p. 382, pl. xx, figs. 12 *a—c*.

Pulvinulina punctulata, *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 96, pl. xvi, figs. 797—800.

— — *Chapman*, 1895. Proceed. Zool. Soc., 1895, p. 43.

Characters.—A large but somewhat depressed, modified form of *P. repanda*, with inflated segments and non-limbate sutures; the inferior (umbilical) face is sunken, and usually has many large perforations, and sometimes a few tubercles. It is one of the largest of the rotaliform Foraminifera.

The Crag specimens are distinguished from the typical *Pulvinulina repanda* by their comparatively enormous size, complanate shape, and inflated segments,

together with the somewhat peculiar perforation of the shell-wall on the lower surface.

Occurrence.—Living at depths of from 60 to 290 fathoms in the North Atlantic, Mediterranean, and Adriatic, and at one spot off the west coast of Patagonia. It is a known fossil in the London Clay, the Crag of Suffolk, the Pliocene of Italy, and the Post-Tertiary of Norway.

Amongst Messrs. Crosskey and Robertson's gatherings from the Glacial Clay (Post-Tertiary) of the coast of Norway, examples precisely similar to those found in the Crag occur. It is a matter of some interest in connection with these fossils that the genus *Pulvinulina*, though well represented over a large portion of the area of the British seas, is almost unknown as a recent Foraminifer on our eastern coast, neither does it occur amongst the sub-fossilised microzoa of the Fens.

The large specimens—such as our figures are taken from—are in Mr. Searles Wood's Collection from Sutton; smaller examples were found in the Polyzoan débris from Sudbourne.

3. Pulvinulina auricula (*Fichtel and Moll*), 1803. Plate II, figs. 33—35.

Part I, 1866, Appendices I and II, Tables, No. 85.

Hammoniæ subconicæ, &c., *Soldani*, 1789. Testaceographia, vol. i, part 1, p. 56, pl. xxxviii, fig. H; p. 61, pl. l, fig. Y.

Nautilus auricula, *Fichtel and Moll*, 1803. Testac. Microscop., p. 108, var. *a*, pl. xx, figs. *a—c*.

Cancris auriculatus, *Montfort*, 1808. Conchyl. Syst., vol. i, p. 266, 67e genre.

Cristellaria auricula, *Lamarck*, 1822. Anim. Sans Vert., vol. vii, p. 608, No. 4.

Crepidulina auricula, *Defrance* (fide *Blainville*), 1824. Dict. Sci. Nat., vol. xxxii, p. 188.

Nonionina auricula, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 295, No. 24.

Rotalia Brongniartii, *d'Orbigny*, 1826. Ibid., p. 273, No. 27.

Valvulina excavata, *d'Orbigny*, 1839. Foram. Canaries, p. 137, pl. i, figs. 43—45.

Rotalina sagra, *d'Orbigny*, 1839. Foram. Cuba, p. 77, pl. v, figs. 13—15.

— Brongniartii, *d'Orbigny*, 1846. For. Foss. Vienne, p. 158, pl. viii, figs. 22—24.

— — *Egger*, 1857. Neues Jahrb. für Min., Jahrg. 1857, p. 274, pl. vii, figs. 5—7.

— oblonga, *Williamson*, 1858. Rec. For. Gt. Br., p. 51, pl. iv, figs. 98—100.

— — *Dawson*, 1860. Canad. Nat., vol. v, p. 191, fig. 1.

ROTALIA AURICULA, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 117 (Table).

— — *Parker and Jones*, 1860. Ann. Nat. Hist., ser. 3, vol. v, p. 177, No. 27.

— REPANDA, var. AURICULA, *P. and J.*, 1860. Ibid., p. 289, No. 66.

— AURICULA, *P. and J.*, 1860. Ibid., vol. vi, p. 344, No. 52.

— CONTRARIA, *Reuss*, 1861. Sitzungsb. Ak. Wiss. Wien, vol. xlii, p. 358.

— — — 1862. Bullet. Acad. Roy. Belg., ser. 2, vol. xv, p. 154, No. 51.

PULVINULINA AURICULA, *Parker and Jones*, 1862. Carpenter's Introd., p. 311, Appendix.

— — *P. and J.*, 1863. Ann. Nat. Hist., ser. 3, vol. xii, p. 202, No. 5.

— REPANDA, var. AURICULA, *P. and J.*, 1863. Ibid., p. 433, No. 21.

— AURICULA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 79.

ROTALINA OBLONGA, *Alcock*, 1865. Proc. Lit. and Phil. Soc. Manch., vol. iv, p. 206.

PULVINULINA AURICULA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 393.

— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Append., No. 85, pl. ii, figs. 33—35.

ROTALINA OBLONGA, *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 71.

PULVINULINA AURICULA, *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 306.

— CONTRARIA, *Reuss*, 1870. Sitzungsb. k. Ak. Wiss. Wien, vol. lxii, p. 490, No. 3.

ANOMALINA, No. 376, *Schlicht*, 1870. Pietzpuhl, p. 65, pl. xxii, figs. 10—13.

PULVINULINA AURICULA, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 173, No. 75.

— — *Terrigi*, 1880. Att. Acc. P. N. Lincei, vol. xxxiii, p. 206, pl. iii, fig. 58.

VALVULINA OVALIS, *Terquem*, 1882. Mém. Soc. Geol. France, ser. 3, vol. ii, Mém. iii, p. 103, pl. xix, fig. 10.

PULVINULINA AURICULA, *Goës*, 1882. Svensk. Vet. Ak. Handl., vol. xix, No. 4, p. 109, pl. viii, figs. 273—275.

— — *Brady*, 1884. Report 'Challenger,' p. 688, pl. cvi, figs. 5 *a—c*.

— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 164—166, 170, 173, 198.

— — *Malagoli*, 1887. Atti Soc. Nat. Modena, ser. 3, vol. iii, p. 110, pl. i, fig. 16.

— — *Brady*, 1887. Journ. R. Micr. Soc., p. 922.

— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. viii, p. 415, pl. xvii, figs. 26—28.

— — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 98, pl. xvi, figs. 809, 810.

— — *Fornasini*, 1894. Foram. Coll. Soldani, Sagg. Oritt., p. 19.

PULVINULINA AURICULA, *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, p. 224, pl. iii, figs. 43, 43 *a*, 43 *b*.

— — *De Amicis*, 1895. Nat. Sicil., vol. xiv, pp. 55 and 63.

— — *Chapman*, 1895, Proceed. Zool. Soc., 1895, p. 43.

— — *Goës*, 1896. Bull. Mus. Comp. Zool. Harvard Coll., vol. xxix, p. 77.

Characters.—Shell oblong, depressed, inequilateral, consisting of rather less than two convolutions, both of which are visible superiorly; the outermost consists of about eight or nine arcuate segments, which increase rapidly in length as they approach the end. Superior (spiral) surface smooth, almost flat; the segments scarcely ventricose. Inferior surface convex; segments more ventricose, especially the last, from the narrow end of which a small lamina projects covering the inferior umbilicus. Septal lines on the lower surface somewhat excavated, especially near the umbilicus. Periphery slightly lobulate, angular or carinate. Orifice narrow, crescentic, on the inner border of the ultimate segment, close to the preceding convolution.

Occurrence.—*Pulvinulina auricula* is found in tropical and temperate seas at depths ranging from 17 to over 500 fathoms.

Fossil specimens have been obtained from the Eocene (Calcaire Grossier); the Oligocene of Pietzpuhl; the Miocene of Muddy Creek, Victoria; the Pliocene of Garrucha and St. Erth; and the Pleistocene of Italy and elsewhere. In the Coralline Crag we have met with it at Tattingstone, zone **d**. Mr. Searles Wood found some medium-sized specimens in his Sutton gatherings, and one or two examples, of really large dimensions, were subsequently met with in material from the same locality. The figured specimens (figs. 33—35) are about equal to such as have been found off the Scilly Isles and Ushant, at 50—70 fathoms.

4. PULVINULINA KARSTENI (*Reuss*), 1855. Plate II, figs. 28—30.

Part I, 1866, Appendices I and II, Tables, No. 86.

ROTALIA KARSTENI, *Reuss*, 1855. Zeitschr. Deutsch. Geol. Gesel., vol. vii, p. 273, pl. ix, fig. 6.

PULVINULINA KARSTENI, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 470, pl. xlviii, fig. 15.

— REPANDA, var. KARSTENI, *Parker and Jones*, 1865. Phil. Trans, vol. clv, p. 396, pl. xiv, figs. 14, 15, 17; pl. xvi, figs. 38—40.

— KARSTENI, *J., P., and B.*, 1866. Monogr. Foram. Crag, Append, No. 86, pl. ii, figs. 28—30.

PULVINULINA KARSTENI, *Sars*, 1868. Vidensk.-Selsk. Forhandl. for 1868, p. 248.
— — *Brady*, 1878. Ann. Mag. Nat. Hist., ser. 5, vol. ii, p. 436, pl. xxi, fig. 11.
— CANDIDULA, *Schwager*, 1883. Palæontogr., vol. xxx, p. 133, pl. xxviii, fig. 10.
— KARSTENI, *Brady*, 1884. Report 'Challenger,' p. 698, pl. cv, figs. 8, 9.
— — — 1887. Journ. R. Micr. Soc., p. 923.
— — *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 97, pl. xvi, fig. 807.
— — *De Amicis*, 1895. Nat. Sicil., ann. xiv, p. 55.
— — *Chapman*, 1895. Proceed. Zool. Soc., 1895, p. 43.

Characters.—Shell many-chambered, compact. Upper (spiral) surface conical, smooth, and free from limbation. Lower surface convex, umbonate; septa and margin limbate. Periphery slightly lobulate.

Pulvinulina Karsteni is the small, comparatively thick, many-chambered modification of the type which seems to find a place between *P. Menardii* and *P. Schreibersii*. The wheel-like appearance of the lower surface imparted by the somewhat thickened umbo and slightly limbate sutures and margin (the upper surface retaining the normal smooth condition) is sufficiently characteristic in well-developed specimens. These characters, however, are so often more or less wanting that the species is frequently very difficult to identify.

Our figured specimen is such as has been recorded ('Phil. Trans.,' vol. clv, Table VII, p. 422), very rare and very small, in the Peterborough fens. Larger specimens occur at the Hunde Islands, in the Arctic region, and these approach closely the varieties met with in the Lias and Oolite, and these latter pass insensibly into *P. elegans*, and from that into *P. caracolla*.

Occurrence.—*Pulvinulina Karsteni* appears to be typically an Arctic form. According to the 'Challenger' Report it has not been met with south of lat. 38° 34′ in the Northern Hemisphere, and in the Southern Hemisphere north of lat. 26° 45′. This is corroborated by the total absence of the species in the gatherings of the 'Gazelle.' Fossil specimens have been recorded from the Neocomian (Bargate Beds) of Surrey, from the Phosphatic Chalk of Taplow, and from the Chalk of Mecklenburg; from the Eocene (London Clay); from the Pliocene of Italy and St. Erth; the Pleistocene of Italy and Britain. In the Coralline Crag we have one specimen from Tattingstone, zone d. It was recorded in the First Part of the Monograph from the Upper Crag of Southwold.

5. Pulvinulina elegans (*d'Orbigny*), 1826. Plate VII, figs. 32 *a*, *b*.

Part I, 1866, Appendices I and II, Tables, No. 87.

Nautili *Ammoniformes*, sive *trochiformes*, *Soldani*, 1780. Saggio Oritt., p. 99, pl. ii, figs. 13 *q*, *Q*, *R*.

Nuclei *Ammoniformes*, sive *trochiformes*, *Soldani*, 1798. Testaceographia, vol. ii, App., p. 138, pl. ii, figs. 13 *q*, *Q*, *R*.

Rotalia (Turbinulina) elegans, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 276, No. 54.

Rotalina Partschiana, *d'Orbigny*, 1846. For. Foss. Vien., p. 153, pl. vii, figs. 28–30; pl. viii, figs. 1—3.

— — *Reuss*, 1851. Zeitschr. deutsch. geol. Gesel., vol. iii, p. 74.

Rotalia elegans, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 305, No. 114; p. 455, pl. xx, fig. 46.

Rotalina Partschiana, *Karrer*, 1861. Sitzungsb. k. Ak. Wiss. Wien, vol. xliv, p. 455.

Rotalia Partschiana, *Karrer*, 1863. Ibid., vol. xlviii, pp. 79 and 92.

Rotalina Partschii, *Karrer*, 1864. Ibid., vol. l, p. 719.

Rotalia Novo-Zelandica, *Karrer*, 1864. Novara-Exped., vol. i, Palaeont. Abth., p. 80, pl. xvi, fig. 12.

Pulvinulina elegans, *Jones and Parker*, 1864. Geologist, vol. vii, p. 88.

— repanda, var. elegans, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 397, pl. xvi, figs. 44—46.

— Partschiana, *Reuss*, 1866. Denkschr. k. Ak. Wiss. Wien, vol. xxv, p. 206.

— elegans, *J., P., and B.*, 1866. Monogr. Foram. Crag, Append. i and ii, Tables, No. 87.

Rotalia flosculiformis, *Schwager*, 1866. Novara-Exped., vol. ii, Geol. Theil, p. 262, pl. vii, fig. 109.

— semiornata, *Schwager*, 1867. (In Waagen) Zone des *Ammon. Sowerbyi*, vol. i, p. 661, pl. xxxiv, fig. 20.

Rotalina Partschiana, *Karrer*, 1868. Sitz. k. Ak. Wiss. Wien, vol. lviii, p. 186.

Pulvinulina elegans, *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 361.

— Partschiana, *Fuchs and Karrer*, 1871. Jahrb. k. k. Geol. Reichsanstalt, vol. xxi, p. 71.

— — *Reuss*, 1870. Sitzungsb. k. Ak. Wiss. Wien, vol. lxii, p. 490.

Rotalina, Nos. 350 and 351, *Schlicht*, 1870. Foram. Pietzpuhl, p. 60, pl. xx, figs. 23—25, 29—31.

Pulvinulina elegans, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., p. 174, pl. xii, fig. 142.

— — *Goës*, 1882. K. Sv. V.-Ak. Handl., vol. xix, No. 4, p. 111, pl. viii, figs. 283—285.

PULVINULINA ELEGANS, *Brady*, 1884. Report 'Challenger,' pp. 684, 699, pl. cv, figs. 4—6.
— — — 1887. Journ. R. Micr. Soc., p. 923.
— — *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. v, p. 141.
— — *B., P., and J.*, 1888. Tr. Zool. Soc., vol. xii, pt. 7, p. 228, pl. xlvi, figs. 2 *a—c*.
— — *Walther*, 1888. Mitth. Zool. Stat. Neapel, vol. viii, p. 352, pl. xx, fig. 6?
ROTALIA, cf. BOUEI [EANA], *Beissel*, 1891. Abhandl. k. Preuss. Landes., n. s., part 3, p. 72, pl. xiv, figs. 25—29.
PULVINULINA ELEGANS, *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 453.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. viii, p. 410, pl. xviii, figs. 37—39.
— — *Fornasini*, 1893. Istit. Bologna, vol. iii, 1893, p. 435, pl. iii, figs. 18, 18 *a*, 18 *b*.
— — — 1894. Foram. Coll. Soldani, Sagg. Oritt., pp. 9 and 11.
— — *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 97, pl. xvi, fig. 808.
— — *De Amicis*, 1895. Nat. Siciliano, ann. xiv, pp. 55 and 63.
— — *Chapman*, 1895. Proceed. Zool. Soc., 1895, p. 42.
— — *Goës*, 1896. Bull. Mus. Comp. Zool. Harvard Coll., vol. xxix, p. 76.

Characters.—Shell trochoid or biconvex, subcarinate. Upper (spiral) surface more or less conical; lower convex, often umbonate. Septal lines and margin on both sides of the shell in some degree limbate. Septa on the under side arcuate, and usually very oblique.

The distinction between this species and *Pulvinulina Karsteni* is one of some doubt and difficulty. In general terms *P. elegans* may be said to be of larger dimensions, less neatly and compactly made, with an occasional tendency to the limbation of sutures on both surfaces of the shell, and with the septa on the lower surface taking a very oblique direction; whilst *P. Karsteni* is limbate only on its lower surface, and the septa on that side are straight and radial.

Occurrence.—Taking the records of the 'Challenger' and 'Gazelle' Reports together, *Pulvinulina elegans* appears to have an almost world-wide range; but it has apparently not been met with in Arctic and Antarctic seas. The depths from which the 'Challenger' and 'Gazelle' specimens were taken ranged from 37 to 2000 fathoms; but we have specimens in our own collections from the Indian Ocean at a depth of 2694 fathoms.

Fossil specimens have been met with in the Lower and Upper Lias; the Neocomian (Bargate Beds) of Surrey; the Phosphatic Chalk of Taplow (Bucks); the Eocene (London Clay); the Oligocene of Elsass and Pietzpuhl; the Miocene

of Malaga and Italy; and the Pliocene of Italy and St. Erth. In the Coralline Crag we have it from Tattingstone and Sudbourne, zone **d**, and Aldborough, zone **g**.

Genus 6.—Rotalia, *Lamarck*, 1804.

Carpenter, '*Introd. Foram.*,' 1862, *p.* 212; *Brady*, *Report* '*Challenger*,' 1884, *pp.* 73 *and* 702.

Nautilus, *Linné, Walker and Boys, Gaultieri, Martini, Schroeter, Murray, Pulteney, Brookes, Adams, Montagu, Maton and Rackett, Parkinson, Pennant, Dillwyn, Turton, Wood, Brown, Macgillivray*, &c.

Rotalia, *Lamarck, d'Orbigny, Fleming, Bronn, Michelotti, von Hagenow, Macgillivray, Thorpe, Parker and Jones, Reuss, Carpenter, Sowerby, Brady, M. Sars, Schwager, Karrer, Schultze, Hall, Brown, Mackie, Hertwig, Harting, von Zittel, Nicholson, Seguenza, Terrigi, Uhlig, Wright, von Gümbel, Malagoli, Marsson, Quenstedt, Mantell, Dawson, Claus, Phillips, Pilla, Dixon, Vanden Broeck, Pictet, Roemer, von Schlicht, Bailey, Kübler and Zwingli, Michelotti, Fornasini, d'Archiac, Stache, Andreae, Bütschli, Toula, Carter, Basset, A. Silvestri*, and others.

Discorbula, *Lamarck*.

Streblus, *Fischer*.

Gyroidina, *d'Orbigny, Römer, Bronn, Basset*.

Turbinulina, *d'Orbigny, Turton*.

Calcarina, *d'Orbigny, Carpenter, Parker and Jones, Brady*.

Rotalites, *Defrance*.

Asterigerina, *d'Orbigny*.

Rotalina, *d'Orbigny, von Reuss, Czjzek, Bornemann, Williamson, Terquem, Schlumberger, Egger, Karrer, Seguenza, Alcock, von Hantken, Parfitt, von Schlicht, Stewart, Terquem, Norman, Martonfi*, &c.

Rosalina, *d'Orbigny, von Reuss, Costa, Egger, Karrer, von Schlicht*, &c.

Faujasina, *Williamson*.

General Characters.—Shell roughly wheel-shaped (rotaliform), finely porous; with septal limbations and umbilical granulations. Aperture an arched slit, nearly median. Large forms have double septa and interseptal canals.

1. Rotalia Beccarii (*Linné*), 1767. Plate II, figs. 19—21.

Part I, 1866, Appendices I and II, Tables, No. 88.

Small shell, *Hooke*, 1665. Micrographia, p. 80, pl. v, fig. x.
Cornu Ammonis, *Plancus*, 1739. Conch. Min., p. 8, pl. i, figs. I a, b, c.
Ammonia unita, &c., *Gaultieri*, 1742. Index Test., pl. xix, figs. H, I.
Cornu Ammonis, *Ginanni*, 1757. Opere postume, &c., vol. ii, Test. Adriat., &c., p. 20, pl. xiv, figs. 111 and 112.
— Hammonis, *Plancus*, 1760. Conch. Min. Notis, ed. 2, p. 8, pl. i, figs. 1 a, b, c.
Nautilus Beccarii, *Linné*, 1767. Syst. Nat., 10th edit., 1758, p. 710, No. 237; 12th edit., 1767, p. 1162, No. 275.
Cornu Hammonis legitimum, &c., *Martini*, 1768. N. Syst. Conch. Cab., p. 261, pl. xix, figs. 178, 179; pl. xx, figs. 175 a, *b*, 176 a, *b*, 177 a, *b*.
Corno d'ammone, *Targioni*, 1770. Relaz. d'Alc. Viaggi, ed. 2, vol. iv, p. 13, pl. i, figs. 17—19, 21—36 (?).
Corne d'ammon, *d'Argenville* (*Favanne* and *d'Argenville*), 1780. Conchyliologie, vol. i, p. 680, p. 731, pl. lxix, D 1.
Ammoniæ *cochleatæ globoso-rotundatæ*, *Soldani*,[1] 1780. Saggio Orittogr., p. 103, pl. ii, figs. *f*, f, g.
Nautilus Beccarii, *Schröter*, 1783. Innern Bau, &c., p. 2, pl. i, fig. 3.
Nautilus spiralis umbilicatus, &c., *Walker and Boys*, 1784. Test. Min., &c., p. 18, pl. iii, fig. 63.
Nautilus Beccarii perversus, *Walker and Boys*, 1784. Test. Min., p. 18, pl. iii, fig. 64.
— — *Murray*, 1785. Amœn. Acad., vol. viii, p. 143, pl. ii, fig. 16.
— — *Linné*, 13th (Gmelin's) edit., 1788, p. 3270, No. 4.
Hammoniæ subglobosæ, *Soldani*, 1789. Testaceographia., vol. i, pt. 1, p. 56, pl. xxxv, fig. p.
— globoso-rotundatæ, *Soldani*, 1798. Testaceographia, vol. ii, Append., p. 139, pl. ii, figs. 21*f*, f, g.
Nautilus Beccarii, *Adams* (*Kanmacher*), 1798. Essays Microsc., p. 640, pl. xiv, fig. 20.
— — *Montagu*, 1803. Test. Brit., pp. 186, 187 (*N. perversus*).
Rotalites discorbula, *Lamarck*, 1806. Ann. Mus., vol. v, p. 185, No. 4; vol. viii, pl. lxii, fig. 9.

[1] Several of Soldani's figures can be referred to *Rotalia Beccarii*, var. *ammoniformis*, d'Orb., namely, Hammoniæ Beccarii vulgatissimæ, *Soldani*, 1780; Saggio Orittogr., p. 102, pl. ii, figs. *d*, D, E; Hammoniæ *Beccarii*, seu *vulgatissimæ*, *Soldani*, 1789; Testaceogr., vol. i, part 1, p. 55, pl. xxxiv, figs. K. L; Hammoniæ conico-tuberculatæ, *Soldani*, 1789; Testaceogr., vol. i, part 1, p. 56, pl. xxxv, fig. T; and Hammoniæ *Beccarrii*, *Soldani*, 1789; Testaceogr., vol. ii, Append., p. 139, pl. ii, figs. *d*, D, E.

NAUTILUS BECCARII et N. PERVERSUS, *Maton and Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 116.

— — *Montagu*, 1808. Test. Brit., Suppl., p. 74, pl. xviii, fig. 4.

— — PERVERSUS, *Montagu*, 1808. Ibid., p. 75, pl. xviii, fig. 6.

— — *Parkinson*, 1811. Org. Rem. Former World, vol. iii, p. 108, pl. xi, figs. 27, 28.

— — et N. BECCARII PERVERSUS, *Pennant*, 1812. Brit. Zool., vol. iv, p. 247.

— — *Pulteney*, 1813. Hutchins' Dorset, ed. 2, vol. iii, p. 42, pl. xix, fig. 30.

— — *Brookes*, 1815. Introd. Conch., p. 91, pl. v, fig. 58.

DISCORBULA ARIMINENSIS, *Lamarck*, 1816. Tabl. Encycl. Méth., pl. ccccLxvi, figs. 6 *a*, *b*.

STREBLUS, *Fischer*,[1] 1817. Adversaria Zoologica, fasc. ii, Mém. Soc. Imp. Nat. Moscou, vol. v, p. 449, pl. xiii, figs. 5 *a*, *b*.

NAUTILUS BECCARII, *Turton*, 1819. Conch. Dict., p. 119.

Cornu Ammonis Ariminense, *Parkinson*, 1822. Introd. Foss. Org. Rem., p. 169, pl. vi, fig. 19.

NAUTILUS BECCARII, *Brookes*, 1823. Anleit., &c., p. 80, pl. v, fig. 58.

ROTALITES DISCORBULA, *Defrance*, 1824. Dict. Sci. Nat., vol. xlvi, p. 303.

NAUTILUS BECCARII, *Wood*, 1825. Index Testac., p. 63, pl. xiii, fig. 9.

ROTALIA (TURBINULINA) TORTUOSA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 275, No. 40; Modèle, No. 74.

— — BECARII (sic), *d'Orb.*, 1826. Ibid., No. 42.

— — ITALICA (part), *d'Orb.*, 1826. Ibid., No. 43.

— CORALLINARUM, *d'Orb.*, 1826. Ibid., No. 48; Modèle, No. 75.

TURBINULINA ITALICA, *Risso*, 1826. Hist. Nat. Europ. Mérid., vol. iv, p. 18.

ROTALITES DISCORBULA, *Defrance*, 1827. Dict. Sci. Nat., vol. xlvi, p. 303.

NAUTILUS BECARII et N. PERVERSUS, *Brown*, 1827. Illustr. Recent Conch., p. 1, pl. i, figs. 11, 12; *Rotalia Beccarii*, p. 138; and 2nd edit., 1844, p. 145.

— BECCARIA [RII], *Fleming*, 1828. Brit. Anim., p. 232, No. 11.

— BECCARII-PERVERSUS, *Fleming*, 1828. Ibid., No. 12.

ROTALIA BECCARII, *Ehrenberg*, 1838. Abhandl. Ak. Berlin, vol. iv, p. 133, pl. i, figs. 1 A, *a*—*e*.

ROSALINA PARKINSONIANA, *d'Orb.*, 1839. Foram. Cuba, French ed., p. 99, pl. iv, figs. 25—27; Spanish ed., 1840, p. 105, pl. iv, figs. 25—27.

— CATESBYANA, *d'Orb.*, 1839. Ibid., Spanish, 1840, p. 105, pl. iv, figs. 22—24.

— BECCARII, *d'Orb.*, 1839. Ibid., Spanish, 1840, p. 105.

— INCA, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 45, pl. vii, figs. 1—3.

— CONSOBRINA, *d'Orb.*, 1839. Ibid., p. 46, pl. vii, figs. 4—6.

[1] Fischer de Waldheim gave no specific name to this shell. His explanation of the generic term *Streblus* ("στρεβλος, tortuosus") has been mistaken for a specific name. He refers it correctly to Gaultieri's "Ammonia unita" and to Linné's *Nautilus Beccarii*.

Nautilus Beccarii, *Macgillivray*, 1843. Moll. Anim. Aberd., p. 35; ***Rotalia***, 1844, 2nd edit., p. 35.

Rosalina Viennensis, *d'Orb.*, 1846. For. Foss. Vien., p. 177, pl. x, figs. 22—24.

Rotalia Beccarii, *Mantell*, 1850. Pictorial Atlas, p. 143, pl. lxii, figs. 3, 27, 28.

— — *Maitland*, 1851. Descript. Syst. Anim. Belg. Septentr., p. 6.

Rosalina Amaliæ, *Costa*, 1856. Atti Accad. Pont., vol. vii, p. 254, pl. xxi, figs. 12 a—c.

— radiata, *Costa*, 1856. Ibid., p. 255, pl. xxi, figs. 13 a—c.

Rotalia Beccarii, *G. B. Sowerby*, 1856. Foram. Colne Riv., p. 1, figs. 2, 3.

Rotalina Beccarii, *Williamson*, 1858. Rec. For. Gt. Br., p. 48, pl. iv, figs. 90—92.

Rotalia Beccarii, *Mackie*, 1859. Recreat. Science, vol. ii, p. 145, fig. 7.

— — *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., ser. 3, vol. iv, pp. 338 and 348.

— — — 1860. Ibid., vol. v, p. 294, No. 10.

— — *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, Table.

— — *Carpenter*, 1862. Introd. Foram., p. 212.

Rosalina inflata, *Seguenza*, 1862. Atti Accad. Gioen., ser. 2, vol. xviii, p. 106, pl. i, fig. 6.

Rotalia Beccarii, *Parker and Jones*, 1863. Ann. Nat. Hist., 3rd ser., vol. xii, p. 216, No. 123; and p. 436, No. 54.

— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 82.

Rosalina Mackayi, *Karrer*, 1864. Novara-Exped. Geol. Theil, vol. i, pt. 2, p. 82, pl. xvi, fig. 14.

Rotalia Beccarii, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 388, pl. xvi, figs. 29, 30.

— — *Brady*, 1865. Nat. Hist. Trans. Northd. and Durham, vol. i, p. 105, No. 1.

Rotalina Beccarii, *Alcock*, 1865. Proc. Lit. Phil. Soc. Manch., vol. iv, p. 206.

Rotalia Beccarii, *Sars*, 1865. Foss. Dyrelevn. Qvartærper., p. 55, &c.

— — *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 30, pl. iii, fig. 83; and p. 31, pl. iii, fig. 84.

— — — 1866. Monogr. For. Crag, Appendices, No. 88, pl. ii, figs. 19—21.

— — *Harting*, 1866. Magt. Klein., p. 101, fig. 40.

— — *Reuss*, 1867. Sitzungsb. k. Ak. Wiss. Wien vol. lv, p. 104.

— — *Karrer*, 1868. Ibid., vol. lviii, p. 187, No. 1.

— — — 1868. Jahrb. k. k. Geol. Reichsanstalt, Jahrg. 1868, p. 577.

— — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 357; Trans. Geol. Soc. Glasgow, vol. iii, p. 127.

Rotalina Becarii (sic), *Parfitt*, 1869. Rep. Trans. Devon. Assoc., vol. iii, p. 70.

Rotalia Beccarii, *Brady*, 1870. Ann. Mag. N. H., ser. 4, vol. vi, p. 303, pl. xii, figs. 8 *a—c*.

— — *Anon.*, 1870. Sci. Gossip, p. 11, fig. 26.

ROTALIA BECCARII, *G. M. Dawson*, 1870. Canad. Nat., ser. 2, vol. v, p. 179.
— — *Fuchs and Karrer*, 1871. Jahrb. k. k. Geol. Reichsanst., vol. xxi, p. 71.
— — *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 173, pl. xii, fig. 147.
— — *Brady and Robertson*, 1875. Brit. Assoc. Rep. for 1874, p. 191.
— — *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 26, pl. ii, figs. 5 *a*, *b*.
— — *Morris*, 1876. Lect. Geol. Croydon, p. 8, figs. 2—4.
— — *Zittel*, 1876. Handb. Paläont., vol. i, p. 94, fig. 32^2.
— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 26, fig. 43.
— — *Siddall*, 1878. Proc. Chester Soc. Nat. Hist., part 2, p. 55.
ROSALINA MAREMII, *Terquem*, 1878. Mém. Soc. Géol. France, sér. 3, vol. i, Mém. iii, p. 27, pl. ii (vii), fig. 15.
— TROCHEATA, *Terquem*, 1878. Ibid., p. 28, pl. ii (vii), fig. 18.
ROTALIA PUNCTATO-GRANOSA, *Seguenza*, 1879. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 147, pl. xiii, fig. 37.
— BECCARII, *Carpenter*, 1879. Encyclop. Brit., edit. 9, vol. ix, p. 380, fig. 18.
— — *Nicholson*, 1879. Manual Palæont., vol. i, p. 109, fig. 18°.
— — *Terrigi*, 1880. Atti Acc. Pontif. Nuov. Lincei, vol. xxxiii, p. 208, pl. iii, fig. 62; and pl. iv, figs. 63—66.
— — var. INFLATA, *Terrigi*, 1880. Ibid., p. 210, pl. iv, fig. 67.
— — *Jones*, 1883. Microgr. Dict., edit. 4, p. 668, pl. xxiv, figs. 13, 14.
— BECCARI [RII], *Uhlig*, 1883. Jahrb. k. Geol. Reichsanst., vol. xxxiii, p. 773, pl. viii, figs. 8 *a*, *b*.
— BECCARII, *Brady*, 1884. Report 'Challenger,' pp. 627 and 704, pl. cvii, figs. 2, 3.
— BECCARI [RII], *Gümbel*, 1885. Geol. Bayern., vol. i, part 2, p. 421, fig. 266^{23}.
— (TURBINULINA) TORTUOSA, *Basset*, 1885. Ann. Sci. Char.-Inf., p. 162, fig. 74.
— BECCARII, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 143 and 172.
— — *Wright*, 1886. Proceed. Belfast Field-Club, Appendix ix, p. 332, pl. xxvii, fig. 15.
— — *Brady*, 1887. Journ. Roy. Micr. Soc., p. 923.
— BECCARI [RII], *Malagoli*, 1888. Boll. Soc. Geol. Ital., vol. vi, fasc. 4, p. 522, pl. xiii, fig. 11.
— BECCARII, *Chapman*, 1888. Sci. News, p. 413, fig. 17.
— — *Prestwich*, 1888. Geology, vol. ii, p. 420, figs. 210 *b*, *c*.
— — *Terrigi*, 1891. Mem. Descriz. Cart. Geol. Italia, vol. iv, part 1, p. 108.

Rotalina Beccarii, *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 420, pl. xix, figs. 25—27.
Rotalia Beccarii, *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 455.
— — *Fornasini*, 1894. Foram. Coll. Soldani, Sagg. Oritt., pp. 11, 12, and 19.

Characters.—Shell composed of four or five convolutions. Superior (spiral) surface more or less convex or conical; inferior, convex or flattened. All the chambers are visible on the spiral surface, the last convolution only on the lower. Septal lines usually limbate and hyaline on the spiral surface; irregularly excavated and obscured by granulation on the inferior face. Aperture single, simple, on the inner margin of the terminal chamber.

Our figure of the edge view of *Rotalia Beccarii* (Pl. II, fig. 21) is scarcely characteristic. It appears to have been drawn from a point not exactly perpendicular to the transverse axis of the shell, and in consequence the spiral side is flatter and less distinctly trochoid than is usual in good specimens. Prof. Williamson gives admirable and characteristic figures in his 'Monograph' (pl. iv, figs. 90—92); and to these, as well as to his detailed history of the species, we would refer those who desire fuller information in respect to it.

Occurrence.—*Rotalia Beccarii* is essentially a shallow-water form, of temperate and tropical seas. It is most frequently met with at depths down to 50 fathoms; but specimens were found by the 'Challenger' at depths so great as 2950, and by the 'Gazelle' at 2416 fathoms.

Fossil specimens have been recorded from the Upper Jurassic of Russia (Uhlig, 1883); the Neocomian (Bargate Beds of Surrey); the Chalk of Taplow and Ireland; the Eocene (London Clay and Thanet Sands); the Miocene of Italy, Malaga, and Vienna; the Pliocene of Italy and St. Erth; and the Pleistocene generally. We have also specimens in our own collection from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag it is of very frequent occurrence, and we have specimens from every zone examined. It is also a common form in the Upper Crag, as recorded in the First Part of the Monograph.

2. Rotalia orbicularis, *d'Orbigny*, 1826. Woodcut, figs. 24 *a*, 24 *b*.

Part I, 1866, Appendices I and II, Tables, No. 89.

Pulvis testaceus ex microscopicis testis, &c., *Soldani*, 1780. Saggio Orittogr., p. 110, pl. viii, figs. *aa*, AA, BB (= *Gyroidina lævigata*, d'Orb.).

GYROIDINA ORBICULARIS, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 278, No. 1; Modèle, No. 13.

— LÆVIGATA, *d'Orb.*, 1826. Ibid., p. 278, No. 2.

ROTALIA ORBICULARIS, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 123, Tables.

— — *Reuss*, 1861. Sitzungsb. Akad. Wiss. Wien, vol. xlii, p. 359.

— — — 1863. Bullet. Acad. Roy. Belg., ser. 2, vol. xv, p. 155, No. 54.

— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 470, pl. xlviii, fig. 16.

— — *J. and P.*, 1864. Geologist, vol. vii, p. 86.

— BECCARII, var. ORBICULARIS, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 389, pl. xvi, fig. 34.

— ORBICULARIS, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 20, pl. iii, fig. 85.

— — *J., P., and B.*, 1866. Mon. Crag Foram., Append., No. 89.

— — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 358; Trans. Geol. Soc. Glasgow, vol. iii, p. 125.

— — *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 175, pl. xii, fig. 150.

— — *Terquem*, 1882. Mém. Soc. Géol. France, sér. 3, vol. ii, Mém. III, p. 60, pl. xii, figs. 1—3.

— — *Brady*, 1884. Report 'Challenger,' pp. 627, 706, pl. cvii, fig. 5 ?; pl. cxv, fig. 6.

— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 153.

— — *Brady*, 1887. Journ. R. Micr. Soc., p. 923.

— — *Terrigi*, 1891. Mem. Descriz. Cart. Geol. (R. Com. Geol. Ital.), vol. iv, p. 108, pl. iv, fig. 14.

ROTALINA ORBICULARIS, *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 421, pl. xix, figs. 22—24.

ROTALIA ORBICULARIS, *Fornasini*, 1894. Foram. Coll. Sold., Sagg. Oritt., p. 9.

ROTALINA ORBICULARIS, *Egger*, 1895. Jahresb. Nat. Ver. Passau, vol. xiv, p. 34, pl. v, figs. 11 *a—c*.

Characters.—Shell composed of three or four convolutions; spiral face flat or slightly conical, inferior surface highly convex. All the segments are visible on the spiral surface, those of the latest convolution only on the other face. Septal lines scarcely depressed. Aperture on the inner margin of the terminal chamber, close to its line of contact with the previous whorl.

This minute compact form differs from its type *Rotalia Beccarii* in having its spiral face nearly flat, and its inferior surface much more highly convex. It is also free from granular or other exostoses indicative of free growth of shell-substances.

Occurrence.—*Rotalia orbicularis* appears to be a moderately deep-water form. The depths recorded for the species in the 'Challenger' Report range from 100 to 2400 fathoms, and the 'Gazelle' records extend from 194 to 2991 fathoms. Most of the specimens were taken from moderate depths. The geographical range is extensive, but apparently does not extend to the Arctic or Antarctic regions.

It has been recorded as a fossil from the Eocene (London Clay and Calcaire Grossier); from the Miocene of Italy and Malaga; from the Pliocene of Italy and Antwerp, and the Pleistocene of Norway and Scotland (Kintyre). In the Coralline Crag we have found it sparingly in nearly every zone examined.

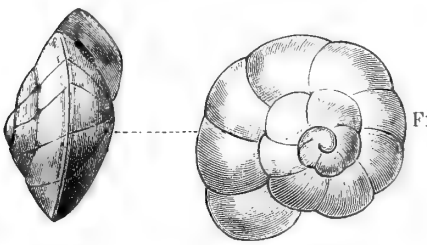


Fig. 24 *b*. Fig. 24 *a*.

Figs. 24 *a*, 24 *b*.—*Rotalia orbicularis*, d'Orbigny. From the 'Trans. Linn. Soc.,' vol. xxiv, pl. xlviii, figs. 16 *a*, *b*. × 100 diam.

3. Rotalia calcar (*d'Orbigny*), 1826. Plate II, figs. 16—18 (*Calcarina rarispina*).

Part I, 1866, Appendices I and II (*Calcarina rarispina*), Tables, No. 90.

Calcarina calcar, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 276, No. 1; Modèle, No. 34.

Rotalia armata, *d'Orb.*, 1826. Ibid., p. 273, No. 22; Modèle, No. 70.

Calcarina rarispina, *Deshayes*, 1833. In Lyell's Principles of Geology, vol. iii, p. 251, pl. iv, figs. 9—11.

— calcar, *d'Orb.*, 1839. Foram. Cuba, p. 93, pl. v, figs. 22—24.

— rarispina, *Brown*, 1843. Elem. Foss. Conch., p. 25, pl. ii, figs. 45, 46.

Rotalia (Calcarina) rarispina, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 124, Tables.

Calcarina calcar, *Carpenter*, 1862. Introd. Foram., p. 223, pl. xiii, fig. 21.

— Spengleri, *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 24, pl. iii, fig. 87.

— armata, *Parker, Jones, and Brady*, 1865. Ibid., p. 30, pl. iii, fig. 88.

— rarispina, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendices, No. 90, pl. ii, figs. 16—18.

Rotalina armata, *Terquem*, 1882. Mém. Soc. Géol. France, sér. 3, vol. ii, Mém. III, p. 67, pl. v (xiii), figs. 14, 15.

ROTALIA CALCAR, *Brady*, 1884. Report 'Challenger,' pp. 627, 709, pl. cviii, figs. 3 and 4 (?).
ROTALINA CALCAR, *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 423, pl. xix, figs. 1—3.

Characters.—Shell biconvex, with a marginal armature arising from the angular or pointed peripheral ends of the chambers, the shell having a pointed or zigzag outline according to the size and shape of the projecting angles.

Occurrence.—*Rotalia calcar* appears to be a shallow-water form, and to be most at home in tropical waters. The 'Challenger' apparently gathered no specimen, but Brady mentions in his Report that the species "is not uncommon in the shallow-water coral-sands of the East and West Indies; it occurs also in the Mediterranean and the Red Sea; on the shores of Madagascar, the Mauritius, and Ceylon; and at the Cape of Good Hope." The 'Gazelle' obtained specimens, but few in number, from the Mauritius and off the south-west of Australia.

The records of the species in a fossil condition extend to the Eocene (Calcaire Grossier—Terquem); it has also been obtained from the Barton Beds (Brady); from the Miocene of Malta (Brady) and Muddy Creek (Howchin); from the Casterlian and Scaldisian of Antwerp (Burrows and Holland); and from St. Erth (Millett). In the Coralline Crag it is not uncommon, and we have specimens from every zone examined. A few minute specimens have also been met with in the Red Crag of Essex, as recorded in the First Part of this Monograph.

Sub-family 3.—TINOPORINÆ.

Brady, 'Challenger' Report, p. 74.

Chambers irregularly heaped; with or without a spiral primordial portion. Usually without any general aperture.

Genus 1.—GYPSINA, *Carter*, 1877.

Brady, Report 'Challenger,' 1884, *pp.* 74 *and* 716.

CERIOPORA, *Reuss.*
ACERVULINA, *Schultze, Marsson.*
ORBITOLINA,[1] *Parker and Jones.*

[1] The little, globular and hemispherical, bead-like fossils from the Chalk, formerly also referred to *Orbitolina* by Parker and Jones ('Ann. Mag. Nat. Hist.,' ser. 3, vol. vi, 1860, p. 37), and by others previously to *Millepora, Tragos*, and *Coscinopora*, have been placed, as being allied to *Hydractinia*, in a new genus, *Porosphæra*, by Steinmann. Von Zittel also refers it to the *Hydrozoa;* but Nicholson thinks it may be a sponge.

TINOPORUS, *Carpenter, Parker and Jones, Brady, Robertson, Wright, Carter, Karrer, Siddall, Terrigi.*
POLYTREMA, *Brady, Carter.*
CELLEPORA, *Parfitt.*
GYPSINA, *Carter, Brady.*

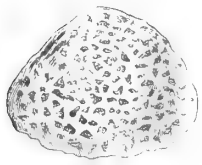
General Characters.—Free or adherent; spherical, subconical, or compressed. Chambers numerous, minute, crowded; rounded, polygonal, or irregular in shape; surface of chambers porous; septa prominent, forming the areolated surface of the shell.

1. GYPSINA VESICULARIS (*Parker and Jones*), 1860. Woodcut, fig. 25.

Part I, 1866 (*Tinoporus lævis*), Appendix I, Table, No. 91; Appendix II, Table, No. 94.

ORBITOLINA VESICULARIS, *Parker and Jones*, 1860. Ann. Mag. Nat. Hist., ser. **3**, vol. vi, p. 31, No. **5**.
— — var. CONGESTA, *P. and J.*, 1860. Ibid., p. 32, No. 6.
— LÆVIS, *Parker and Jones*, 1860. Ibid., p. 33, No. 7.
TINOPORUS LÆVIS, *Carpenter*, 1860. Phil. Trans., p. 559, pl. xxi, figs. 1—3. [Large subconical specimen from the tropics.]
— VESICULARIS, *Carpenter*, 1862. Introd. Foram., p. 224, pl. xv, figs. 1—4.
— LÆVIS, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 470, pl. xlviii, fig. 17. [Small subspheroidal specimen from Shetland.]
— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Appendices, Nos. 91 and 94.
— — *Brady*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 304.
GYPSINA VESICULARIS, *Carter*, 1877. Ibid., ser. 4, vol. xx, p. 173.
TINOPORUS VESICULARIS, *Goës*, 1882. K. Svensk. Vet. Ak. Handl., vol. xix, No. 4, p. 104, pl. vii, figs. 245—247. [A lenticular variety; possibly a compressed *T. globulus*.]
GYPSINA VESICULARIS, *Brady*, 1884. Report 'Challenger,' p. 718, pl. ci, figs. 9—12.
— — — 1887. Journ. R. Micr. Soc., p. 923.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 382, pl. xiv, figs. 20—23.
— — var. INTERMEDIA, *Goës*, 1894. Kongl. Svensk. Vet. Akad. Handl., vol. xxv, No. 9, p. 92, pl. xv, figs. 788 *a, b, c*. [Between *globulus* (Reuss) and *G. vesicularis* (P. and J.).]
— — var. DISCUS, *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, No. 1, p. 74, pl. vi, figs. 4—6. [Flat form.]

Characters.—Shell free (or parasitic ?), subspherical, or shaped like a truncate cone. Chambers very numerous, nearly equal in size; arrangement mostly confused. Surface marked by an angular areolation, due to the external prominence of the limbate septa.



Gypsina vesicularis (Parker and Jones). From Brady's Report 'Challenger,' &c., pl. cii, fig. 10. × 15 diam.

FIG. 25.

Occurrence.—Brady states in the 'Challenger' Report that the geographical and geological distribution of this species is co-extensive with that of *Gypsina globulus* (Reuss); "they occur together in the coral sands of warm latitudes, at depths ranging from the littoral zone to about 400 fathoms. Small examples are occasionally met with on the northern and western shores of the British Islands."

Fossil specimens have been recorded from the Miocene of Austria-Hungary, Malta, and Jamaica, from the Pliocene of Costa Rica, and from Tertiary beds of Palermo, Bordeaux, and San Domingo.

Gypsina vesicularis is rare in the Crag. One specimen was found in the Polyzoan Crag of Sudbourne.

Family 6.—NUMMULINIDÆ, *Brady.*

'*Challenger*' *Report*, 1884, *p.* 74.

Symmetrically spiral, possessing a supplemental skeleton and a canal-system.

Sub-family 1.—POLYSTOMELLINÆ, *Brady.*

'*Challenger*' *Report*, 1884, *p.* 75.

Bilaterally symmetrical, nautiloid. Lower forms without supplemental skeleton or interseptal canals; higher types with canals opening along the external septal depressions.

Genus 1.—Nonionina, *d'Orbigny*, 1826.

Carpenter's Introd. Foram., 1862, *p.* 286; *Brady*, '*Challenger*' *Report*, *p.* 724.

Synonyms:

Nautilus, *Linné, Gmelin, Adams, Walker and Jacob, Soldani, Fichtel and Moll, Montagu, Maton and Rackett, Pennant, Turton, Wood, Fleming, Dillwyn, Brown.*
Nautilites, *Soldani.*
Chrysolus, Florilus, and Nonion, *de Montfort.*
Melonis, *de Montfort, Blainville.*
Pulvinulus, *Lamarck.*
Placentula, *Lamarck, Defrance.*
Cristellaria, *Lamarck.*
Lenticulina, *Defrance, Blainville.*
Polystomella, *Defrance, Blainville, Macgillivray, Thorpe, Parker and Jones.*
Robulina, *d'Orbigny.*
Aristerospira, *Ehrenberg.*
Nonionina, *d'Orbigny, Sander Rang, Menke, Römer, Bronn, Reuss, Czjzek, Alth, Risso, Williamson, Ehrenberg, Costa, Parker and Jones, Egger, Karrer, von Gümbel, Carpenter, Seguenza, Brady, M. Sars, Alcock, Dawson, Millett, Parfitt, Woodward and Thomas, Terrigi, Fornasini, von Hantken, Terquem, Goës, Schwager, Andreae, Balkwill and Wright, A. Silvestri, and others.*

General Characters.—Shell free; spiral, equilateral. Inner convolutions nearly or entirely concealed by the outermost whorl. Septa, in well-developed forms, thickened at and near the umbilicus by a granulate or stellate deposit of exogenous shell-substance. Aperture single, curved, slit (normally simple), on the inner edge of the terminal chamber.

Supplemental skeleton either absent or rudimentary, and confined to the umbilical region. No external septal pores nor bridges, except in some transitional individuals.

Mr. F. W. Millett has kindly supplied the following systematic list or scheme of the *Nonioninæ*, arranged gradationally, and based chiefly upon the condition of the umbilical region (pp. 339—341). It shows how the tendency to exogenous growth increases with the inflation of the chambers, and the consequent lobulation of the periphery characteristic of one of the types, *N. depressula*. The scheme is of course defective, as it refers only to *published figures*. It might be greatly improved by a careful examination of specimens in good collections.

The affinities of the species of the Foraminifera are so complex that it is

impossible to indicate them in their proper order on a plane surface, such as that of a sheet of paper. Varieties radiate in all directions from the type forms; and to properly indicate their relationship we should have to take a series of spiked balls, like that with which the giant in the Guildhall is armed, and attach the different varieties to these spikes at varying distances from the ball. Consequently, in this table such characters as periphery, rounded or angular—chambers, few or many, straight or arched—have not received the consideration due to their importance.

The side lines in the table do not indicate exactly where one type ends and another begins; one might as well try to separate the colours of the rainbow by definite lines. As a rule Mr. Millett has commenced with *thin* forms, gradually working up to the *thicker;* thus, from the thin *communis* to the thick *Labradorica*, from the thin *umbilicatula* to the thick *pompilioides*, and so on.

The particulars given in this list will be sufficient for anyone who has C. D. Sherborn's 'Index to the Genera and Species of the Foraminifera,' except of course for the figures published after a certain date (1888). Figures which are merely copies are not referred to.

The *Nonionina leo* of Karrer, 1868, is not included, as it might be an *Operculina*. Nor are the very doubtful forms given by Zwingli and Kübler referred to, and very sparing use has been made of Ehrenberg's figures of translucent specimens.

Mr. Millett observes that the *Polystomellæ* might also be treated in a similar manner; but he has not found any figure of those in which the two conditions of the umbilical region are combined in one shell, as in the Gomer specimens and in *N. asterizans*.

Mr. Millett is inclined to think that the *Anomalina punctulata*, d'Orbigny ('Ann. Sci. Nat.,' vol. vii, 1826, p. 282, pl. xv, figs. 1—3), is the "unsymmetrical" form of *N. incrassata* (F. and M.). Before the Gomer specimens threw a light on the subject, most of the unsymmetrical *Nonioninæ* were assigned to *Anomalina* or *Truncatulina*;[1] and doubtless if the original specimens were now examined, many species would have to be removed from one genus to the other.

[1] See, for instance, 'Ann. Mag. Nat. Hist., ser. 3, vol. iv, 1859, p. 329, where Walker and Jacob's fig. 69 is referred to *Truncatulina* because "the two faces are decidedly unsymmetrical."

Mr. Millett's Systematic Grouping of the published figures of the Genus NONIONINA.

SHELL ELONGATE.

Shell elongate by the rapid increase in width of the chambers.

Type: *communis*.

Umbilical region exposed on both faces.	*Umbilical region on both faces covered by exogenous or other shell-deposit.*[1]
Nonionina Sloanii, d'Orb., 1839. Woodcut, fig. 26, p. 341.	
— *Grateloupi*, d'Orb., 1839.	
— *communis*, d'Orb., 1846.	
— — Terquem, 1882.	
— — — 1875.	
— — Egger, 1893.	
— *exponens*, B., P., and J., 1888.	
— *Brownii*, d'Orb., 1839.	
— *communis*, Terrigi, 1880.	*Nonionina scapha*, B., P., and J., 1888 (pl. xliii, figs. 20 *b*, *c*).
— *crassula*, var. *scapha*, Goës, 1882.	
— *scapha*, Egger, 1893.	
— *communis*, Terrigi, 1883.	
— *punctulata*, d'Orb., 1839.	
— *asterizans*, var. *turgida*,[2] Williamson, 1858.	

Shell elongate by the later chambers receding from the umbilical axis of the shell.

Type: *scapha*.

Polystomella crispa, var. *Nonionina turgida*, P. and J., 1865.	
Rotalia cristellarioides, Reuss, 1863.	
Nonionina turgida, Goës, 1882.	
— — Brady, 1884.	
— — Terquem, 1886.	
— — Egger, 1893.	
Nautilus faba,[3] F. and M., 1803.	
— *scapha*, F. and M., 1803. Woodcut, fig. 27, p. 341.	
Nonionina scapha, Brady, 1865.	
— — Terrigi, 1883.	*Nonionina communis*, Terrigi, 1883.
— *Labradorica*, Dawson, 1860.	— — Egger, 1857 (pl. xiv, figs. 11, 12).
— — Jones, Parker, and Brady, 1866.	
Polystomella crispa, var. *Nonionina scapha*, P. and J., 1865.	— *pauperata*, Halkyard, 1889.
Nonionina pauper, Egger, 1857.	— *nautiloidea*, Costa, 1856 (pl. xx, fig. 1).
— *faba*, Terrigi, 1883.	
— *latescens*, Schwager, 1883.	— — Costa, 1856 (pl. xxii, fig. 20).
— *Boueana*, Reuss, 1863.	— *pauperata*, Balkwill and Wright, 1885).

SHELL CIRCULAR.

Having the two characters combined, one umbilicus being open and the other covered up.

Nonionina Boueana, var. *Janiformis* (see p. 343).
Nautilus spiralis-umbilicatus, &c., Walker and Jacob, 1784, 'Ann. Mag. Nat. Hist.,' ser. 3, vol. iv, 1859, p. 339, H *a*.

[1] Such as the asterigerine flaps over the sutures of *Nonionina stelligera*, and even supplementary chambers if they be found to exist in any of the *Nonioninæ*.

[2] *N. turgida* is one of the most characteristic, but not the central type of the *N. communis* group.

[3] *N. faba* may be a *Polystomella*, but it has the elongate contour of *N. scapha*, and no published *Polystomella* possesses this form. It is noted in the 'Ann. Mag. Nat. Hist.,' ser. 3, vol. v, 1860, p. 103, that "this may be an oblong form" of *P. striatopunctata*.

TABLE—*continued.*

		Umbilicus open.	*Umbilicus covered.*
Shell circular.	Type: *Boueana.*	*Nonionina umbilicata*, Terquem, 1882. — *Boueana*, d'Orb., 1846. *? Anomalina insecta*, Schwager, 1883. *Nonionina*, cf. *Boueana*, Schwager, 1883. — *Boueana*, Goës, 1894. — — Egger, 1893. — *asterizans*, Terrigi, 1880. — *umbilicatula*, B., P., and J., 1888. — *affinis*, Reuss, 1851. — *Barleeana*, Williamson, 1858. — — Terquem, 1876. — *polystoma*, Costa,[1] 1856.	*Nonionina Boueana*, Brady, 1884. — — var. *armata*, Brady, 1884. — — Terrigi, 1889. *Nonionina*, No. 342, v. Schlicht, 1870.
Shell circular.	Type: *umbilicatula.*	*Aristerospira borealis*, Ehrenberg, 1874. *Polystomella crispa*, var. *Nonionina umbilicatula*, P. and J., 1865. *Nonionina umbilicatula*, Goës, 1894. — *simplex*, Karrer, 1864. — *crassula*, Terquem, 1875. — *rudis*, Costa, 1856. — *formosa*, Seguenza, 1879. — *astræa*, Ehrenberg, 1854. — *umbilicatula*, Brady, 1884. [Not named], Macdonald, 1857. *Nonionina umbilicatula*, Terrigi, 1883. — *Soldani*, Costa, 1856. — *umbilicatula*, Silvestri, 1893. — *Soldanii*, d'Orb., 1846. *Nautilus pompilioides*, F. and M., 1803. — *melo*, Soldani, Test., 1798 (*Nonionina melo*, d'Orb., 1826). *Nonionina umbilicata*, d'Orb., Modèle 86, 1826. *Nautilus*, Soldani, 1780 (p. 100, pl. ii, fig. 16, tt, vv, xx, &c.). *Nonionina attenuata*, Costa, 1856. — *pompilioides*, Terrigi, 1883. — *umbilicata*, d'Orb., 1826. — *pompilioides*, Egger, 1893. — *Soldanii*, Egger, 1895 (fig. 16). *Melonis Etruscus*, Montfort, 1808. *Nonionina pompilioides*, Brady, 1884.	*Nonionina tuberculata*, d'Orb., 1846. — — Terrigi, 1883. — *umbilicatula*, Egger, 1893. — *Soldanii*, Egger, 1895 (fig. 18 . — *asterizans*, Brady, 1884. *Florilus stellatus*, Montfort, 1808. *Nonionina orbicularis*, Brady, 1881. — — — 1884. — *depressula*, var. *orbicularis*, Madsen, 1895.
Shell circular.		*Having the two characters combined.* *Nautilus asterizans*, Fichtel and Moll, 1803.	

[1] Costa gives some figures showing unsymmetrical *Nonioninæ*; but where these occur, his references in the letterpress are usually either erroneous or altogether wanting.

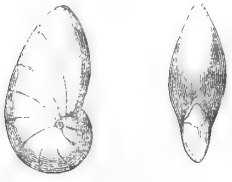
TABLE—*continued.*

SHELL CIRCULAR.

Type: *depressula*.

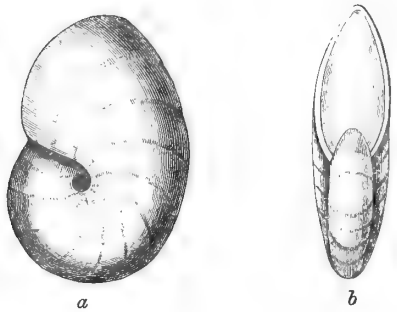
Umbilicus open.

Nonionina scapha [thick *depressula*], J., P., and B., 1866.
— *umbilicata*, Jones, 1895.
— *punctata*, d'Orb., 1846.
— *perforata*, d'Orb., 1846.
— — Terrigi, 1883.
— *depressula*, Terrigi, 1889.
— — Terquem, 1876.
— — B., P., and J., 1888.
— *Buxovillana*, Andreae, 1884.
— *depressula*, Goës, 1894.
— *Jaccardi*,[1] Loriol, 1865.



a *b*

FIGS. 26 *a*, 26 *b*. *Nonionina Sloanii*, d'Orb. From the 'Foram. Cuba,' pl. vi, figs. 18, 18 *bis*. Highly magnified.



a *b*

FIGS. 27 *a*, 27 *b*. *Nonionina scapha*, Fichtel and Moll. From the 'Testac. Microsc.,' pl. xix, figs. *d*, *e*. Very highly magnified.

Umbilicus covered.

Nautilus spiralis, &c., W. and J., pl. iii, figs. 68 and 70, 1784.
Nonionina punctulata, Costa, 1856.
— *crassula*, Williamson, 1856.
— *stelligera*, d'Orb. ("Canaries"), 1839.
— — Brady, 1864.
— — — 1884.
— — Egger, 1893.
Polystomella crispa, var. *Nonionina stelligera*, P. and J., 1865.
— — var. *Nonionina asterizans*, P. and J., 1865.
Nonionina stelligera, Goës, 1894.
— *stellata*, Terquem, 1882.
— *asterizans*, Egger, 1893.
— *granifera*, Terquem, 1882.
— *granosa*, d'Orb., 1846.
— — Terquem, 1882.
— — Terrigi, 1883.
Polystomella crispa, var. *Nonionina depressula*, P. and J., 1865.
Nonionina depressula, Brady, 1884.
— — Terrigi, 1880.
Pulvinulina nonioninoides, Andreae, 1884.
Nonionina subgranosa, Egger, 1857.
— *depressula*, Egger, 1893.
Nonion incrassatus, Montfort, 1808.
Nautilus incrassatus, F. and M., 1803.
Nonionina lævis, d'Orb., Modèle 46, 1826.
— — Terquem, pl. x, figs. 12, 13, 1882.
— *incrassata*, Terrigi, 1883.
Nautilus umbilicatulus, Montagu, 1808.
Nonionina umbilicata, Terquem and Berthelin, 1875.
— *nodulosa*, Terquem, 1886.
— *? Villersensis*,[2] Loriol and Jaccard, 1865.

[1] Together with *N. Villersensis* from the Purbeckian strata at Villers-le-Lac, Doubs, France.

[2] Smaller and thinner than *N. Jaccardi*.

1. Nonionina scapha (*Fichtel and Moll*), 1803; var. Labradorica, *Dawson*, 1860. Plate II, figs. 44, 45 (*N. Labradonica*). Woodcuts, figs. 27 *a*, *b*, p. 341.

Part I, 1866, Appendix I, Table, No. 98 (part); Appendix II, Table, No. 99 (part); *N. scapha*.

Synonyms of N. scapha *and* var. Labradorica:

Nautilus scapha, *Fichtel and Moll*, 1803. Test. Micr., p. 105, pl. xix, figs. *d—f*.
Nonionina Sloanii, *d'Orbigny*, 1839. Foram. Cuba, p. 68, pl. vi, fig. 18.
— communis, *P. and J.*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 287, pl. xi, figs. 7, 8.
— Labradorica, *J. W. Dawson*, 1860. Canad. Nat., vol. v, pp. 191, 192, fig. 4 (thick *N. scapha*).
— — *Parker and Jones*, 1860. A. M. N. H., ser. 3, vol. v, p. 102, No. 4.
— Boueana, *Reuss*, 1863. Bull. Acad. Roy. Belg., ser. 2, vol. xv, p. 156, pl. iii, figs. 47, 48.
Polystomella crispa, var. (Nonionina) scapha, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 404, pl. xiv, figs. 37, 38; pl. xvii, figs. 55, 56.
Nonionina scapha, *Brady*, 1865. Nat. Hist. Trans. Northd. Durham, vol. i, p. 106, pl. xii, figs. 10 *a*, *b*.
— Labradorica, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendices I and II, Nos. 98 and 99, pl. ii, figs. 44, 45 (thick variety of *N. scapha*).
— scapha, var. Labradorica, *J. W. Dawson*, 1869. Canad. Nat., n. s., vol. iv, p. 416, fig. 34; and 1872, ibid., vol. vi, p. 255, pl. iii, fig. 4; and Handbook Zool., 1886, p. 46, fig. 38.
— — — *G. M. Dawson*, 1870. Ibid., n. s., vol. v, p. 177, fig. 5; Amer. Journ. Sci., ser. 3, vol. i, 1871, p. 207, fig. 5; Ann. Mag. Nat. Hist., ser. 4, vol. vii, 1871, p. 86, fig. 5.
Pullenia communis [elongata on the plate], *Hantken*, 1875. Mitth. Jahrb. k. Ung. Geol. Anst., vol. iv, p. 59, pl. x, fig. 10.
Nonionina scapha, *Terrigi*, 1883. Att. Acc. P. N. Lincei, vol. xxxv, p. 202, pl. iv, fig. 47 (thick variety).
— faba, *Idem*, 1883. Ibid., p. 204, pl. ix, fig. 50.
— scapha, *Brady*, 1884. Rep. 'Challenger,' p. 730, pl. cix, figs. 14, 15, and 16?.
— — *Idem*, 1887. Journ. R. Micr. Soc., p. 925.
— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, p. 230, pl. xliii, fig. 20.

NONIONINA SCAPHA, *Terrigi*, 1889. Mem. R. Accad. Lincei, ser, 4 vol. vi, p. 120 pl. x, fig. 7.

— — *Idem*, 1891. Mem. Descriz. Carta Geol., R. Com. Geol. Ital., vol. iv, p. 110, pl. iv, fig. 18.

— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii' p. 424, pl. xix, figs. 42, 43 (elongate).

— COMMUNIS, *Idem*, 1893. Ibid., figs. 40, 41.

— SCAPHA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 104, pl. xvii, fig. 830.

— — *Woodward and Thomas*, 1895. Final Report Geol. Nat. Hist. Survey Minnesota, vol. iii, pt. 1, pp. 48—52, pl. E, figs. 35, 36.

— COMMUNIS, *Egger*, 1895. Jahresb. xvi, Naturh. Vereins Passau, p. 40, pl. iii, fig. 17.

— SCAPHA, *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 79.

Characters.—Shell oblong-ovate, depressed at the umbilicus; margin obtuse, rounded; chambers numerous arcuate, more or less ventricose; aperture crescentic on the inner margin of the terminal chamber.

By the larger growth of the later chambers, the septal face of the last segment varies from oval to more or less cordate, as in the thick variety named *N. Labradorica* by Dawson.

Occurrence.—*Nonionina scapha* is widely diffused. It is frequent in dredgings from 30 to 100 fathoms, and has been taken at various depths down to 1421 fathoms. Taking the records of the 'Challenger' and the 'Gazelle' together, it has been found in nearly every sea.

Its geological range extends to the Neocomian (Bargate Beds) of Surrey, but we are aware of no record in subsequent deposits until the Middle Tertiary is reached. Specimens have been obtained from the Miocene of Italy, Malaga, and Vienna; from the Pliocene of Italy, Antwerp, and St. Erth; and from several Pleistocene deposits. In the Coralline Crag it occurs in every zone examined, and it was recorded in the First Part of the Monograph as rare from the Red Crag.

2. NONIONINA BOUEANA, *d'Orbigny*, 1846; var. JANIFORMIS, nov. J. Woodcuts figs. 28 *a*, *b*, *c*.

Synonyms of the typical form:

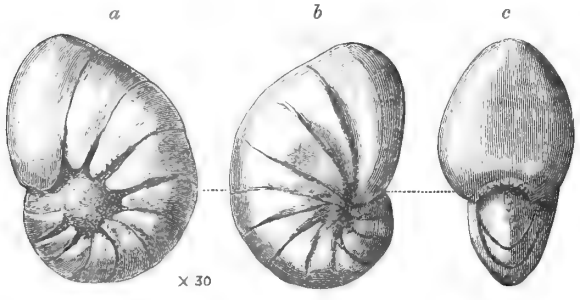
NONIONINA BOUEANA, *d'Orb.*, 1846. Foram. Foss. Vien., p. 108, pl. v, figs. 11, 12.

— — *Pictet*, 1857. Traité Paléont., 2nd edit., vol. iv, p. 498, pl. cix, fig. 17.

Nonionina Boueana, *Brady*, 1884. 'Challenger' Rep., p. 729, pl. cix, figs. 12, 13.
— — *Terrigi*, 1889. Mem. R. Accad. Lincei, ser. 4, vol. vi, p. 119, pl. x, fig. 5.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 426, pl. xix, figs. 34, 35.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xix, p. 104, pl. xvii, figs. 829 *a*, *b*.

Characters.—The varietal form under notice has a nearly circular outline and subacute peripheral edge; it is stoutly made, and the chambers, which are numerous, narrow, falciform, and slightly inflated, increase rather rapidly in size towards the end. Some specimens are rather more oval than others. One umbilicus is exposed, and on this side the sutures are visible from the periphery to the umbilicus, but the other umbilicus is covered with granular shell-substance. Thus the variety under notice has at once the two characters that divide the *Nonioninæ* into two series. Hence it may be called *Janiformis*.

N. asterizans in Fichtel and Moll's figures has the two sides differing in a similar manner; but this new variety is the most pronounced of the unsym-



Figs. 28 *a*, 28 *b*, 28 *c*. *Nonionina Boueana*, d'Orb., var. *Janiformis*, nov. Specimen from the Coralline Crag, Gomer (zone **g** ?). × 30 diameters. 26 *a*, the closed side; 26 *b*, the open side; 26 *c*, the apertural face.

metrical forms of the genus that Mr. Millett has been able to observe. He regards it as more developed in this direction than *N. asterizans*. In its contours it agrees more closely with *N. Boueana*.

Occurrence.—Numerous specimens in good condition were found by Mr. Millet in the Coralline Crag at Gomer, or Gomer Field (now ploughed over), between the Ferry on the River Butley and Gedgrave, Suffolk.

In the recent state *Nonionina Boueana* lives in comparatively shallow water in the Atlantic and the Red Sea; also near Amboyna, Hong Kong, and the west coast of Patagonia. It is found in the Oligocene of Germany, and the Miocene of Austria and South Italy.

3. Nonionina umbilicatula (*Montagu*), 1808; Var. passing into *N. depressula*. Plate V, fig. 32 (*N. umbilicatula*). Woodcuts, figs. 29 *a*, *b* (the zoological type).

Nautilitæ..... minusculæ, &c., *Soldani*, 1789. Testaceogr., vol. i, part 1, p. 66, pl. lx, fig. b.

Lenticulæ minusculæ, *Soldani*, 1798. Testaceogr., vol. ii, p. 110, pl. xxvi, fig. 0.

Nautilus umbilicatulus, *Montagu*, 1803. Test. Brit., p. 191; Supplem., p. 78, pl. xviii, fig. 1.

Nonionina umbilicata, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 293, No. 5.

Robulina Planciana, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 290, No. 20.

Nonionina Soldanii, *d'Orb.*, 1846. For. Foss. Vien., p. 109, pl. v, figs. 15, 16.

— — *Costa*, 1856. Atti Accad. Pontan., vol. vii, p. 201, pl. xvii, fig. 11.

— polystoma, *Costa*, 1856. Ibid., p. 206, pl. xiv, fig. 10.

— Barleeana, *Williamson*, 1858. Rec. For. Brit., p. 32, pl. iii, figs. 68, 69.

— asterizans (*F. and M.*), var. umbilicatula (*Montagu*), *P. and J.*, 1859, Ann. Mag. Nat. Hist., ser. 3, vol. iv, p. 347.

Polystomella crispa, var. (Nonionina) umbilicatula, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 405, pl. xiv, figs. 42 *a*, *b*; pl. xvii, figs. 58, 59.

Nonionina umbilicatula, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 242, pl. xii, fig. 157.

— — *Parker and Jones*, 1872. Ann. Mag. Nat. Hist., ser. 4, vol. ix, p. 218 (Macdonald's pl. v, figs. 18, 19, ibid., 1857).

— — *Brady and Robertson*, 1875. Brit. Assoc. Report for 1874, p. 191.

— — *Siddall*, 1878. Proc. Chester Soc. Nat. Sci., part 2, p. 56.

— formosa, *Seguenza*, 1879. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 63, pl. vii, fig. 6.

— umbilicatula, *Terrigi*, 1883. Att. Acc. P. N. Lincei, vol. xxxv, p. 203, pl. iv, fig. 48.

— — *Brady*, 1884. 'Challenger' Report, p. 726, pl. cix, figs. 8, 9.

— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 239.

— — *Brady*, 1887. Journ. R. Micr. Soc., p. 924.

— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, p. 230, pl. xliii, fig. 19.

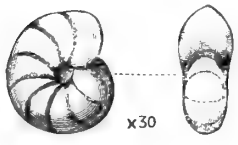
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 458.

— — *A. Silvestri*, 1893. Atti Acc. Zelant. Acireale, vol. v, p. 20, pl. iii, figs. 26, 27.

Nonionina umbilicatula, *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 426, pl. xix, figs. 36, 37.
— — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 103, pl. xvii, fig. 823 (fig. 824, *Haplophragium ?*).
— — *De Amicis*, 1895. Nat. Sicil., Ann., xiv, pp. 55 and 63.
— Soldanii, *Egger*, 1895. Jahresb. xvi, Nat. Ver. Passau, p. 40, pl. iii, figs. 18 *a*, *b*.
— — *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 78.

For a more exact, and not chronological, list of the near allies of *N. umbilicatula* see Mr. Millett's catalogue, p. 340.

Characters.—Small, neat, many-chambered, and nautiloid; compact with flush septa and hollow umbilici.



Figs. 29 *a*, 29 *b*.—*Nonionina umbilicatula* (Montagu).[1] Zoological type. Specimen from the Coralline Crag of Broom Hill; zone **e**. × 30 diam.

Occurrence.—*Nonionina umbilicatula* is a cosmopolitan form, and has a bathymetrical range down to 3125 fathoms. It has been found in a fossil condition in the Eocene (London Clay and Calcaire Grossier); in the Oligocene of Germany; the Miocene of Italy, Vienna, and Muddy Creek, Victoria; the Pliocene of Italy, Antwerp, Garrucha (Spain), and St. Erth; and in the Pleistocene generally. In the Coralline Crag we have specimens from Sudbourne and Broom Hill, zone **d**.

The variety shown by Pl. V, fig. 32, began its growth like *N. umbilicatula*, with neatly compact chambers; but afterwards had inflated chambers with sunken sutures. This varietal condition is illustrated by several published figures, such as (*N. crassula*) by Parker and Jones, 'Ann. Mag. Nat. Hist.,' ser. 2, vol. xix, 1857, p. 286, pl. xi, figs. 5, 6; by Williamson (*N. crassula*), 'Rec. Brit. Foram.,' 1858, pp. 23 (*umbilicatula*, p. 97), pl. iii, figs. 70, 71; by Goës as *N. depressula*, 'K. Svensk. Vet. Selsk. Handb.,' vol. xxv, p. 104, pl. xvii, figs. 825, 826. See also *N. depressula*, Brady, 'Challenger' Rep., p. 725, pl. cix, figs. 6, 7.

According to the view as to whether the earlier or the later stage is to be regarded as characteristic, this form may be either *umbilicatula* becoming *depressula*, or *depressula* beginning as *umbilicatula*. In either case the later stage may be said to be affected by decadence or weakness of growth, resulting in a variation from the compactly built type.

The specimen under notice is one of several rather variable individuals

[1] The specimen figured by Montagu, although the first *published* form, is not so good a real *zoological type* of the "species" as the form here represented. Such specimens as this have been carefully figured by d'Orbigny as *N. Soldanii*, and by Brady and others as *N. umbilicatula*.

(fig. 32), and was probably from the Coralline Crag of Sutton (?). It is in Mr. F. Chapman's Collection.

4. NONIONINA DEPRESSULA (*Walker and Jacob*), 1798. Plate II, figs. 36, 37; Thick Variety.

Part I, Appendix I, No. 98 (*N. scapha*); II, No. 99 (*N. scapha*).

Synonyms of the Type:

Nautilus spiralis utrinque subumbilicatus, geniculis depressis plurimis, *Walker and Jacob*, 1784. Test. Min., p. 19, pl. iii, fig. 68.

NAUTILUS DEPRESSULUS, *Walker and Jacob*, 1798. Adams's Essays, Kanmacher's edition, p. 641, pl. xiv, fig. 33.

NONIONINA DEPRESSULA, *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., ser. 3, vol. iv, pp. 339 and 341.

— ASTERIZANS, var. DEPRESSULA, *P. and J.*, 1862. Carpenter's Introd. Foram., Appendix, p. 310.

— SCAPHA, *J., P., and B.*, 1864. Monogr. Foram. Crag, Appendix i, No. 98; ii, No. 99, pl. ii, figs. 36 and 37 (thick form).

POLYSTOMELLA CRISPA, var. (NONIONINA) DEPRESSULA, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 403, pl. xiv, figs. 39 *a*, *b*.

NONIONINA DEPRESSULA, *Anon.*, 1870. Science Gossip, p. 12, fig. 29.

— — *Terrigi*, 1880. Atti Acc. Pont. Nuov. Lincei, vol. xxxiii, p. 218; vol. iv, fig. 77.

— — *Brady*, 1884. 'Challenger' Report, p. 725, pl. cix, figs. 6, 7.

— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, p. 229, pl. xliii, fig. 25.

— — *Terrigi*, 1889. Mem. R. Accad. Lincei, ser. 4, vol. vi, p. 119, pl. x, fig. 4.

— — *Egger*, 1893. Abhand. k. Bayer. Akad. Wiss., vol. xviii, p. 427, pl. xix, figs. 38, 39.

— — *Goës*, 1894. K. Svensk. Vet.-Selsk. Akad. Handl., vol. xxv, p. 104, pl. xvii, figs. 825, 826.

Some closely allied forms are enumerated by H. B. Brady in the 'Challenger' Report, page 725; and by F. W. Millett in the Table at p. 341.

Characters.—Usually compressed; periphery nearly circular, and somewhat lobulate by the inflation of the chambers; sutures depressed; septal face more or less rounded.

The variety figured in Pl. II, figs. 36, 37, is an extraordinarily thick form; the latest chambers having widened out crosswise, until the face of the last chamber is transversely reniform, instead of being suboval and compressed.

Occurrence.—*N. depressula*, found in the Arctic seas, and abounding in the North Atlantic, occurs also in the South Atlantic, South Pacific, Red Sea, and elsewhere, usually at less than 100 fathoms. "It is the only member of the genus that is common in estuaries and brackish water pools" (H. B. Brady).

Under one name or another this form and its varieties have been described from the Eocene of Paris, the Miocene of Vienna and Calabria, the Pliocene of Rhodes, and the Post-Tertiaries of Norway and the British Islands (H. B. Brady).

The specimen here figured was collected from the Coralline Crag of Sutton by S. V. Wood some years ago.

Genus 2.—Polystomella, *Lamarck*, 1822.

Cornu ammonis, *Plancus.*

Nautilus, *Linné, Favanne, Walker and Jacob, Soldani, Gmelin, Schreibers, Fichtel and Moll, Montagu, Adams, Maton and Rackett, Pennant, Parkinson, Turton, Brown, Fleming.*

Polystomella, *Lamarck, Defrance, Blainville, d'Orbigny, Risso, Sander Rang, Menke, Deshayes, Potiez and Michaud, Michelotti, Egger, Sowerby, Brown, Macgillivray, Thorpe, Williamson, Parker and Jones, Carpenter, Wood, Seguenza, Karrer, Dawson, Brady, von Gümbel, Alcock, Parfitt, Bunzel, von Reuss, Czjzek, Rütimeyer Bronn, d'Eichwald, Schultze, Schwager, Hoernes, Abich, Terrigi, Targioni, A. Silvestri, Costa, Terquem, Reeve, Goës, Steinmann, Crouch, Harvey, Mantell, Gosse, Harting, Greene, Toula, von Zittel, Nicholson, Möbius, Hamilton, West, Hogg, Verworn, Lister, Walther, Prestwich, Mackie, Uhlig, Olszewski, Quenstedt, Bütschli, Schlumberger, Fornasini, Millett, Cooke, Neumayr, and others.*

Elphidium, Geophonus, Pelorus, Chrysolus, Andromedes, Sporilus, Themeon, and Cellanthus, *de Montfort.*

Robulina, *von Münster, d'Orbigny.*

Cristellaria, *Lamarck.*

Vorticialis, *Lamarck, Defrance, Blainville.*

Geoponus, *Ehrenberg.*

Polystomatium, *Ehrenberg.*

Nonionina, *Boll, Egger.*

Helicoza, *Möbius.*

General Characters.—Shell free, equilateral, nautiloid; convolutions numerous, the outermost embracing more or less completely all the preceding whorls; segments numerous in each convolution; their posterior margins marked by crenulations (less definite in those of simpler growth), formed by tubular retral

elongations of the sarcode cavity of the segment; septa narrow and limbate in the more advanced forms; septal apertures numerous, at or near the edge of the segment in contact with the edge of the previous whorl. Supplemental skeleton present; septal bridges and canal-system more or less fully developed; canals opening at the umbilicus, and by pores along the sutures. Aperture a Λ-shaped line of perforations at the base of the septal face of the last chamber.

1. Polystomella faba (*Fichtel and Moll*), 1798. Woodcuts, figs. 30 *a*, *b*.

Part I, 1866, Appendix I, Table No. 99; Appendix II, Table No. 98.

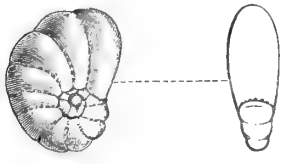
Nautilus faba, *Fichtel and Moll*, 1798. Testac. Microscop., p. 103, pl. xix, figs. *a—c*.

Chrysolus (Chrysole perlé), *Montfort*, 1808. Conch. Systém., vol. i, p. 26, No. 7.

Polystomella faba, *P. and J.*, 1860. Ann. Mag. N. H., ser. 3, vol. vi, pp. 102, 103, No. 5; and ibid., p. 339, No. 5.

Polystomella crispa, var. (Nonionina) faba, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 402, pl. xiv, fig. 36.

Characters.—Nautiloid, somewhat elongate and compressed; chambers numerous, arcuate; sutures more or less distinctly pitted; aperture crescentic, often barred. This form, by its sutural pittings and its foraminate aperture, has passed from *Nonionina* into *Polystomella*.



Figs. 30 *a*, 30 *b*.—*Polystomella faba* (Fichtel and Moll). From the 'Philos. Trans.,' vol. clv, pl. xiv, figs. 36 *a*, *b*. × 12 diameters.

Occurrence.—*Polystomella faba* (usually referred to as a *Nonionina*) is known from the Arctic seas, and from the Adriatic. It occurs fossil in the newer Tertiaries of Italy (Tuscany).

The specimens formerly in S. V. Wood's Collection, and referred to in Part I, Appendices I and II, have been lost sight of. It is stated (in Appendix II) as having been rather common in the Coralline Crag at Sutton, and very rare in the Red Crag.

2. Polystomella striatopunctata (*Fichtel and Moll*), 1798. Plate II, figs. 38, 39.

Part I, 1866, Appendices I and II, Tables, No. 97.

Nautili striati, *Soldani*, 1789. Testaceogr., vol. i, part 1, p. 54, pl. xxxiv, figs. *ee, ff.*

Nautilus striatopunctatus, *Fichtel and Moll*, 1798. Test. Micr., p. 61, pl. ix, figs. *a—c.*

Robulina sulcata, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 289, No. 10.

Polystomella Poeyana, *d'Orb.*, 1839. Foram. Cuba, p. 75, pl. vi, figs. 25, 26.

— articulata, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 30, pl. iii, figs. 9, 10.

Geoponus stella-borealis, *Ehrenberg*, 1839. Abhandl. k. Akad. Wiss. Berlin, p. 132, pl. i, figs. *a—g.*

Polystomella gibba, *Schultze*, 1854. Organ. Polyth., p. 66, pl. vi, figs. 1—4.

— stella-borealis, *Schultze*, 1854. Ibid., p. 67, pl. vi, figs. 5, 6.

— venusta, *Schultze*, 1854. Ibid., figs. 7—9.

Nonionina striatopunctata, *Parker and Jones*, 1857. Ann. Mag. N. H., ser. 2, vol. xix, p. 288, No. 12.

Polystomella crispa, *Parker and Jones*, 1857. Ibid., No. 13, pl. xi, fig. 19.

Nonionina heteropora, *Egger*, 1857. Neues Jahrb. für Min., &c., p. 300, pl. xiv, figs. 19—21.

Polystomella cryptostoma, *Egger*, 1857. Ibid., p. 301, pl. ix, figs. 19, 20.

— subcarinata, *Egger*, 1857. Ibid., p. 301, pl. xiv, figs. 24, 25.

— angulata, *Egger*, 1857. Ibid., p. 302, pl. xv, figs. 5, 6.

— umbilicatula, *Williamson*, 1858. Rec. For. Gt. Br., p. 42, pl. iii, figs. 81, 82.

— — var. incerta, *Williamson*, 1858. Ibid., p. 44, pl. iii, fig. 82 *a*.

— — *J. W. Dawson*, 1859. Canad. Nat., vol. iv, p. 27, fig. 1 ("*striatopunctata*," 1865).

— inflata, *Reuss*, 1860. Sitzungsb. k. Ak. Wiss. Wien, vol. xlii, p. 358, pl. i, figs. 10 *a, b.*

— striatopunctata, *Parker and Jones*, 1860. Ann. Mag. Nat. Hist., ser. 3, vol. v, p. 103, No. 6.

— — *Carpenter*, 1862. Introd. Foram., p. 287.

— — *P. and J.*, 1863. Ann. Mag. Nat. Hist., ser. 3, vol. xii, p. 434, No. 26.

— minuta, *Reuss*, 1864. Sitzungsb. k. Ak. Wiss. Wien, vol. l, p. 478, pl. iv, figs. 6 *a, b.*

— discrepans, *Reuss*, 1864. Ibid., figs. 7 *a, b.*

— latidorsata, *Reuss*, 1864. Denkschr. k. Akad. Wiss. Wien, vol. xxiii, p. 10, pl. i, figs. 16 *a, b.*

POLYSTOMELLA STRIATOPUNCTATA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 89; *Idem*, 1865, Nat. Hist. Trans. Northd. and Durham, vol. i, p. 106, No. 2.

— — *J. W. Dawson*, 1865. Canadian Nat., n. s., vol. ii, p. 86.

— CRISPA, var. (NONIONINA) STRIATOPUNCTATA, *Sars*, 1865. Foss. Dyrelevn. Qvartærperioden, p. 11.

— — — — *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 402, pl. xiv, figs. 31—34; pl. xvii, figs. 60 *a*, *b*.

— STRIATOPUNCTATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendix, Tables, No. 97, pl. ii, figs. 38, 39.

— — *Sars*, 1868. Christiania Vidensk.-Selsk. Forhandl. for 1868, p. 249.

— — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 351; and Trans. Geol. Soc. Glasgow, vol. iii, p. 125.

— CRISPA, *J. W. Dawson*, 1869. Canad. Nat., n. s., vol. iv, 1869, p. 416, fig. 33.

— UMBILICATULA, *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 70.

— CRISPA, var. STRIATOPUNCTATA, *G. M. Dawson*, 1870. Canad. Nat., new ser., vol. v, p. 179.

— STRIATOPUNCTATA, *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, pp. 305, 306.

— — *Parker, Jones, and Brady*, 1871. Ibid., ser. 4, vol. viii, p. 239, No. 101; and p. 241, No. 112, pl. xii, fig. 156.

— CRISPA, var. STRIATOPUNCTATA, *J. W. Dawson*, 1872. Canad. Nat., n. s., vol. vi, p. 255, pl. iii, fig. 2.

— STRIATOPUNCTATA, *Williamson*, 1872. Mem. Lit. Phil. Soc. Manchester, ser. 3, vol. v, p. 134; see also vol. viii, 1847, p. 44, pl. ii, fig. 30.

— EXCAVATA, et var., *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 25, pl. ii, figs. 2 *a—f*.

— UMBILICATULA, *Terquem*, 1875. Ibid., figs. 3 *a*, *b*.

— STRIATOPUNCTATA, *Brady and Robertson*, 1875. Rep. Brit. Assoc. for 1874, p. 191.

— — *Schulze*, 1877. Arch. Mikr. Anat., vol. xiii, p. 9, pl. ii, figs. 4—6.

— — *Siddall*, 1878. Proc. Chester Soc. N. Sci., part 2, p. 56.

— MINIMA, *Seguenza*, 1879. Atti R. Accad. Lincei, ser 3, vol. vi, p. 333, pl. xvii, fig. 38.

Polystomella striatopunctata, *Terrigi*, 1880. Atti Accad. Pontif. N. Linc., ann. xxxiii, p. 216, pl. iv, figs. 73, 74.
— Antonina, *Terquem*, 1882. Mém. Soc. géol. France, sér. 3, vol. ii, p. 47, pl. ii (x), figs. 25 *a*, *b*.
— striatopunctata, *Jones*, 1883. Microgr. Dict., ed. 4, p. 623, pl. xxiv, fig. 19.
— — *Brady*, 1884. Report 'Challenger,' p. 733, pl. cix, figs. 22, 23.
— crispa, *J. W. Dawson*, 1886. Handb. Zool., ed. 3, p. 45, fig. 37.
— striatopunctata, *Brady*, 1887. Journ. Roy. Micr. Soc., p. 926.
— — *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. v, p. 161.
— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 230, pl. xliii, fig. 17.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 433, pl. xix, figs. 49, 50.
— — (partim), *Goës*, 1894. K. Sven. Vet.-Ak. Handl., vol. xxv, No. 9, p. 101, pl. xvii, figs. 815 *c—l*, *o*, *p*, *s*, *t*, 817, 818, 819.
— — *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 78.

Characters.—Shell nautiloid, rather compressed, the outermost convolution concealing the previous whorls; segments numerous, arcuate, somewhat ventricose; margin rounded and more or less lobulated; septal lines and umbilicus generally depressed; septal bridges (retral processes) well developed; aperture variable.

Polystomella striatopunctata differs from the type (*P. crispa*) in the generally smooth condition of the shell and its rounded margin. It is the principal representative of the genus in brackish and shallow waters, under enfeebling external conditions. It seldom attains any considerable size, and has often a very thin and delicate shell.

Occurrence.—This species is practically cosmopolitan, but its habitat is in comparatively shallow water. It is most frequently met with at depths ranging from the shore-line to 100 fathoms. It is, however, not unfrequently found at depths down to 600 fathoms, and occasionally in still deeper water.

Fossil specimens have been recorded from the Eocene (London Clay and Calcaire Grossier); from the Oligocene of Germany; from the Miocene of Vienna, Bavaria, and Malaga; from the Pliocene of Antwerp, Italy, and St. Erth; and from the Pleistocene generally. In the Coralline Crag we have somewhat rare specimens from nearly every zone examined; and it has been found, as stated in the First Part of the Monograph, throughout the Upper Crag.

3. Polystomella crispa (*Linné*), 1767. Plate II, figs. 40—43.

Part I, 1866, Appendices I and II, Tables, No. 95.

Cornu Hammonis minus vulgare, Orbiculatum, &c., *Plancus*, 1739. Conch. minus notis, Edit. Venet. (and Edit. Romæ, 1760), p. 10, pl. i, figs. 2 D, E, F.

Nautilus minimus, &c., *Gaultieri*, 1742. Index Test. Conch., pl. xix, figs. A and D.

Nautilus crispus, *Linné*, 1758. Syst. Nat., ed. 10, p. 709, No. 235; edit. 12, p. 1162, No. 275; edit. 13 (Gmelin's), p. 3370, No. 3.

Cornu Hammonis, *Ledermüller*, 1760. Mikroscopisch. Gemüths, &c., p. 16, pl. viii, fig. *b*.

Nautilus tabulatus, minimus, umbilicatus, marginatus, et granulatus, *Martini*, 1768. N. Syst. Conch.-Cab., p. 250, pl. xx, figs. 172—174.

Nautilo, *Targioni*, 1770. Relaz. Viaggia, vol. iv, p. 8, pl. i, figs. 6—8.

Nautile microscopique granuleux, *D'Argenville* (*Favanne*), 1780. Conchyliologie, vol. i, p. 680, pl. vii, fig. B 1; p. 728, pl. lxix, fig. D 2.

Nautilus crispus, *Spengler*, 1781. Nye Saml. k. Danske Selsk. Skr., vol. i, p. 368 [pl. i], figs. 1 *a—c*.

Nautilus spiralis geniculis crenatis, *Walker and Boys*, 1784. Test. Min. Rar., p. 18, pl. iii, fig. 65.

Nautilus crispus, *Adams*, 1787. Essays Microsc., p. 640, pl. xiv, fig. 30.

Nautili *striati communes* (*crispi*, Linnæi), *Soldani*, 1789. Testaceogr., vol. i, part 1, p. 54, pl. xxxiii, fig. F; and pl. xxxiv, figs. G, H (umbonate *P. crispæ*); and fig. I (impoverished *P. strigillata*, between *crispa* and *macella*).

Hammonia *crispa*, *Soldani*, 1789. Ibid., p. 54, pl. xxxiv, fig. *cc* (an explanate *Polystomella*, near *P. macella*).

Nautilus crispus, *Fichtel and Moll*, 1798. Test. Microsc., p. 40, pl. iv, figs. *d—f*; and pl. v, figs. *a*, *b*.

— *ambiguus*,[1] *F. and M.*, 1798, p. 62, pl. ix, figs. *d—f*.

— crispus, *Kanmacher* (*Walker and Jacob*), 1798. In Adams's Essays Microsc., 2nd edit., p. 640, pl. xiv, fig. 30.

— — *Pulteney*, 1813. Hutchins's Hist. Dorset, 2nd edit., vol. iii, p. 42, pl. xix, fig. 29.

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[1] *Nautilus ambiguus*, F. and M., although possibly a *Peneropolis*, has the angular row of perforations representing the aperture typical of *Polystomella*; and, if it be the latter, *P. ambigua* (F. and M.) is one of the varieties ranging between *striatopunctata* and *crispa*. It is much like *P. Listeri*, d'Orb., 'For. Foss. Vien.,' pl. vi, figs. 19—22. On the same plate d'Orbigny has figured other closely related varieties, as *P. Hauerina*, figs. 1, 2; *rugosa*, figs. 3, 4; *obtusa*, figs. 5, 6; and *Antonina*, figs. 17, 18.

NAUTILUS CRISPUS, *Montagu*, 1803. Test. Brit., p. 187, Suppl., 1808, pl. xviii, fig. 5.

— — *Maton and Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 115.

THEMEON RIGATUS, *Montfort*, 1808. Conchyl. Systém., vol. i, p. 202, 51e genre.

NAUTILUS CRISPUS, *Parkinson*, 1811. Org. Rem. Former World, vol. iii, p. 107, pl. xi, fig. 25.

POLYSTOMELLA CRISPA, *Lamarck*, 1822. Anim. sans Vert., vol. vii, p. 625, No. 1.

VORTICIALIS CRISPA, *Defrance*, 1824. Dict. Sci. Nat., vol. xxxii, p. 181; and *Blainville*, 1825, Malacologie, p. 375.

NAUTILUS CRISPUS, *Wood*, 1825. Index Testac., p. 63, pl. xiii, fig. 8.

— AMBIGUUS, *Wood*, 1825. Ibid., p. 66, pl. xiii, fig. 58.

POLYSTOMELLA CRISPA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 283, No. 1; Modèle, No. 45.

— — *Crouch*, 1827. Introd. Conch., p. 41, pl. xx, fig. 14.

NAUTILUS CRISPUS, *Brown*, 1827. Illustr. Conch. Gt. Brit., fly-leaf, pl. lii, fig. 6.

POLYSTOMELLA OWENIANA, *d'Orbigny*, 1839. Foram. Amér. Mérid., p. 30, pl. iii, figs. 3, 4.

— LANIERI, *d'Orbigny*, 1839. Foram. Cuba, p. 74, pl. vii, figs. 12, 13.

— CRISPA, *Brown*, 1843. Foss. Conch., p. 22, pl. ii, fig. 15.

— — — 1844. Illustr. Conch. Gt. Brit., edit. 2, pp. 1 and 145, pl. i, fig. 6.

— — *Reuss*, 1845. Geinitz's Grundriss, p. 647, pl. xxiv, fig. 43.

— — *d'Orb.*, 1846. For. Foss. Vien., p. 125, pl. vi, figs. 9—14.

— FLEXUOSA, *d'Orb.*, 1846. Ibid., p. 127, pl. vi, figs. 15, 16.

— CRISPA, var., *Williamson*, 1848. Mem. Lit. Phil. Soc. Manchester, vol. viii, p. 44, pl. xxx; *P. striatopunctata*, Ibid., ser. 3, vol. v, 1872, p. 134.

— — *Williamson*, 1848. Trans. Micr. Soc. Lond., vol. ii, p. 159, pl. xxviii, figs. 1—7.

— FLEXUOSA, *Reuss*, 1849. Denksch. k. Akad. Wiss. Wien, vol. i, p. 370, pl. xlviii, fig. 3.

— CRISPA, *Mantell*, 1850. Pictor. Atlas, p. 144, pl. lxii, fig. 25.

— — *Williamson*, 1852. Trans. Micr. Soc., vol. iii, p. 123, pl. xviii, fig. 19.

— — *Bronn*, 1853–6. Lethæa Geogn., edit. 3, vol. iii, p. 204, pl. xxxv², figs. 6 *a*, *b*.

— STRIGILATA, *Schultze*, 1854. Organ. Polythal., p. 64, pl. iv.

— CRISPA, *Gosse*, 1855. Man. Mar. Zool., p. 12, fig. 14.

— — *Costa*, 1856. Atti Accad. Pontan., p. 212, vol. vii, pl. xiv, figs. 11 *a*, A, B.

NONIONINA? HELICINA,[1] *Costa*, 1856. Ibid., pl. xiv, figs. 13 A, B, C (near our Pl. II, figs. 42, 43).

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[1] If this be a true *Polystomella*, it is an example of the combined characters of "covered" and "uncovered" sides. See page 338.

POLYSTOMELLA SPINULOSA, *Costa*, 1856. Atti Accad. Pontan., p. 212, vol. vii, pl. xix, figs. 14 A, B, C.

— ORNATA, *Costa*, 1856. Ibid., p. 215, pl. xix, figs. 16 A, B.

— CRISPA, *Costa*, 1856. Ibid., p. 212, pl. xix, figs. 17 A, B, C.

— STRIOLATA, *Costa*, 1856. Ibid., figs. 15 A, B, and 18 A, B.

— DEPRESSULA, *G. B. Sowerby*, 1856. Foram. Colne River, p. 1, fig. 1.

— CALCAR, *G. B. Sowerby*, 1856. Foram. Colne River, p. 1, fig. 4.

— CRISPA, *Egger*, 1857. Neues Jahrb. für Min., Jahrg. 1857, p. 303, pl. xv, figs. 1, 2.

— — *Parker and Jones*, 1857. Ann. Nat. Hist., ser. 2, vol. xix, p. 288, pl. xi, fig. 19.

— — *Williamson*, 1858. Rec. For. Gt. Br., p. 40, pl. iii, figs. 78—80.

— — *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., ser. 3, vol. iii, p. 479.

— — *Carpenter*, 1860. Phil. Trans., vol. cl, p. 535, pl. xvii, figs. 9, 10.

— — — 1862. Introd. Foram., p. 278, pl. xvi, figs. 4—6.

— — *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 399, pl. xiv, fig. 24; pl. xvii, figs. 61 *a*, *b*.

— — *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 26, No. 45, pl. iii, fig. 96 (aperture wrong).

— — *Hartwig*, 1866. The Sea, edit. 3, p. 381, fig. *c*.

— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Append., Tables, No. 95, pl. ii, figs. 40—43.

— — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vii, p. 351; Trans. Geol. Soc. Glas., vol. iii, p. 125.

— — *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, pp. 239 and 266, No. 102, pl. xii, fig. 155.

— — *Greene*, 1871. Manual Protoz., p. 15, fig. 3 *c*.

— — *Brady and Robertson*, 1875. Brit. Assoc. Rep. for 1874, p. 191.

— — *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 24, pl. i, figs. 19 *a*, *b*.

— — *Toula*, 1875. Mitth. Geogr. Ges. Wien, vol. xviii, p. 165, fig. 20.

— — *Zittel*, 1876. Handb. Palæont., vol. i, p. 101, fig. 41.

— — *Schwager*, 1877. Boll. Soc. Geol. Ital., vol. viii, p. 25, fig. 16.

— — *Siddall*, 1878. Proc. Chester Soc. N. Sci., pt. 2, p. 56.

— — *Nicholson*, 1879. Manual Pal., vol. i, p. 118, fig. 18[a].

— — *Terrigi*, 1880. Att. Acc. P. N. Lincei, vol. xxxiii, p. 214, pl. iv, figs. 71, 72.

— COSTIFERA, *Terquem*, 1882. Mém. Soc. Géol. France, sér. 3, vol. ii, Mém. iii, p. 47, pl. ii (x), fig. 26.

Polystomella crispa, var. Poëyana, *Goës*, 1882. K. Sv. Vet.-Akad. Handl., vol. xix, No. 4, p. 116, pl. viii, figs. 301, 302.
— — *Jones*, 1883. Micr. Dict., edit. 4, p. 623, pl. xxiii, fig. 55; pl. xxiv, figs. 20 *a*, *b*.
— — *West*, 1883. J. Post. M. S., vol. ii [5], p. 41, pl. xxi, figs. 1—3.
— — *Brady*, 1884. 'Challenger' Rep., p. 736, pl. cx, figs. 6, 7.
— — *Basset*, 1884. Ann. Soc. Sci. Nat. Char.-Inf., No. 21, p. 162, fig. 45.
— — *Gümbel*, 1886. Geol. Bayern., vol. i, pt. 2, p. 421, fig. 266[25].
— — *Hogg*, 1886. Microsc., p. 375, fig. 207[3].
— — *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. v, pp. 142, 158—160.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 926.
— — *Steinmann*, 1888. Elem. Pal., vol. i, p. 32, fig. 17 a.
— flexuosa, *Walther*, 1888. Mitth. Zool. Stat. Neapel, vol. viii, pp. 382, 383, pl. xx, fig. 5.
— crispa, *Prestwich*, 1888. Geology, vol. ii, p. 420, fig. 210 *a*.
— — [*Chapman*], 1888. Scient. News, May, p. 413, fig. 18.
— — *Verworn*, 1888. Zeit. Wiss. Zool., vol. xlvi, p. 462, pl. xxxii, figs. 7, 8, 9, and *g*, *h*, *i*; Ann. Mag. Nat. Hist., ser. 6, vol. ii, p. 161, pl. ix, figs. 4—6.
— — *Terrigi*, 1891. Mem. Descriz. Carta Geol. d'Italia, vol. iv, p. 110.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 432, pl. xx, figs. 20, 21.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 460.
— — *A. Silvestri*, 1893. Atti Red. Acc. Zelanti Acireale, vol. v, p. 21, pl. iii, figs. 28, 29.
— — *Goës*, 1894. K. Sven. Vet.-Ak. Handl., vol. xxv, No. 9, p. 102, pl. xvii, figs. 820—822. Fig. 822 is a thick-edged form, like our figs. 42, 43.
— — *Fornasini*, 1894. Foram. Coll. Sold., Sagg. Oritt., pp. 9—11, and 21.

Characters.—Shell lenticular, spiral, showing only the outermost convolution, which consists of numerous narrow, arcuate, flexuose segments. Anterior border of each segment prominent, smooth, forming a raised septal line—the central portion and posterior border more depressed, sometimes concave; sculptured into numerous transverse crenulations, most conspicuous near their junction with the preceding segment. Peripheral margin thin, sometimes carinate, occasionally furnished with tubercular or spinous processes projecting from the septal ridges. Apertures numerous, arranged in a Λ-shaped series, close to the surface of the antecedent convolution.

Pl. II, figs. 40 and 41, represent the typical form of *P. crispa;* in figs. 42 and 43 we have a smaller and relatively thicker form, more compressed, and retaining more of the characters of *P. striatopunctata.*

Occurrence.—*Polystomella crispa* is very common, and has practically a world-wide range, but is confined to comparatively shallow waters. The bathymetrical range extends from the littoral zone to 355 fathoms; it is one of the most common species on our own coasts.

Fossil specimens have been recorded from the Eocene of the Paris Basin; from the Oligocene of Germany; from the Miocene of Malaga, Italy, Vienna, and elsewhere; from the Pliocene of Italy, Spain (Garrucha), and St. Erth; and from the Pleistocene generally. We have met with the species in every zone of the Coralline Crag examined; and, as recorded in the First Part of the Monograph, it occurs throughout the Upper Crag.

4. Polystomella macella (*Fichtel and Moll*), 1803. Plate VII, figs. 35 *a*, *b*.

Part I, 1866, Appendices I and II, Tables, No. 96.

Ammonia seu Nautilus, &c., *Soldani*, 1780. Saggio Oritt., p. 104, pl. iii, fig. 8.
Nautilus *striatus communis*, *Soldani*, 1789. Testaceographia, vol. i, pt. i, p. 54, pl. 34, fig. *cc*.
— macellus, *Fichtel and Moll*, 1798. Test. Micr., p. 66, var. *α*, pl. x, figs. *e—g*; var. *β*, pl. x, figs. *h—k*.
Elphidium (L'Elphide soufflé), *Montfort*, 1808. Conchyl. Systém., vol. i, p. 14, genre 4.
Geophonus (Le Géopone jaune), *Montfort*, 1808. Ibid., p. 18, genre 5.
Polystomella planulata, *Lamarck*, 1822. Anim. sans Vert., vol. vii, p. 625, No. 3.
— macella, *Blainville*, 1824. Dict. Sci. Nat., vol. xxxii, p. 183.
— planulata, *Blainville*, 1824. Ibid., Atlas Conch., pl. xv, fig. 8.
— macella, *Blainville*, 1825. Malac., p. 388.
— planulata, *Blainville*, 1825. Ibid., pl. vii, fig. 8.
Nautilus macellus, *Wood*, 1825. Index Testac., p. 63, pl. xiv, fig. 45.
Polystomella strigilata (in part), *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 284, No. 4.
— Lessonii, *d'Orb.*, 1826. Ibid., No. 6.
— — — 1840. Foram. Amér. Mérid., p. 29, pl. iii, figs. 1, 2.
— Fichteliana, *d'Orb.*, 1846. For. Foss. Vien., p. 125, pl. vi, figs. 7, 8.
— Ortenburgensis, *Egger*, 1857. Neues Jahrb. für Min., &c., p. 302, pl. xv, figs. 7, 9.

POLYSTOMELLA MACELLA, *Parker and Jones*, 1860. Ann. Mag. Nat. Hist., ser. 3, vol. v, p. 104, No. 8; p. 290, No. 70; vol. vi, p. 339, Nos. 2, 3.

— TENUISSIMA, *Karrer*, 1864. Novara-Exped. geol. Theil, vol. i, p. 83, pl. xvi, fig. 16.

— MACELLA, *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 239, No. 101, pl. xii, fig. 154.

— LAMINATA, *Terquem*, 1878. Mém. Soc. Géol. France, sér. 3, vol. i, Mém. iii, p. 16, pl. i (vi), figs. 8 *a*, *b*.

— — — 1882. Ibid., vol. ii, Mém. iii, p. 47, pl. ii (x), figs. 24 *a*, *b*.

— MACELLA, *Brady*, 1884. 'Challenger' Report, p. 737, pl. cx, figs. 8—11.

— — *B., S., and B.*, 1890. Journ. R. Micr. Soc., p. 563, pl. xi, figs. 26 *a*, *b*.

— — *Egger*, 1883. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 432, pl. xx, figs. 22, 23.

Characters.—Compressed, explanate, umbilicus depressed; margin more or less acute; chambers narrow, curved.

So far as essential particulars are concerned, the description of *Polystomella crispa* would apply equally to *P. macella*. There are, however, distinctions which tend to place *P. macella* in the light of a starved modification of the type. *P. macella*, whilst having a lateral surface as large as that of *P. crispa*, is much thinner than the typical form, and is subject, as shown in Fichtel and Moll's figures, to lateral deviations from the symmetrical plan of growth. The peripheral margin is generally even, and not tubercular or spinose as in *P. crispa*, *P. regina*, &c.

Occurrence.—*Polystomella macella* is stated by Brady in the 'Challenger' Report to be "not common in the Northern Temperate Zone; the Mediterranean and the Adriatic being apparently its boreal limit." We have, however, well-marked specimens in our own collection from the southern coast of England. The published records show that it is very generally distributed as a shallow-water form as far south as Kerguelen.

Its geological range, so far as is at present known, extends to the Middle Jurassic of Russia. It has also been recorded from the Red Chalk of Speeton; from the Eocene of the Paris Basin; from the Miocene of Vienna, Bavaria, and Muddy Creek, Victoria; from the Pliocene of Italy, Kar Nicobar, Isle of Rhodes, and St. Erth. It is not uncommon as a Pleistocene fossil. In the Coralline Crag we have found specimens in every zone examined; but, unlike *P. crispa*, the species has not been found in the Upper Crag.

Sub-family 2.—NUMMULITINÆ.

Brady, '*Challenger*' *Report*, 1884, *p.* 75.

Test lenticular or complanate; lower forms with thickened and finely tubulated shell-wall, but no intermediate skeleton; higher forms with interseptal skeleton and complex canal-system.

Genus 1.—AMPHISTEGINA, *d'Orbigny*, 1826.

Carpenter, *Phil. Trans.*, *vol. cxlix*, 1859, *pp.* 30—35; *Introd. Foram.*, 1862, *pp.* 241—247, *pl. xciii*, *figs.* 22—29; *Brady*, *Report* '*Challenger*,' 1884, *pp.* 75 *and* 739.

AMPHISTEGINA, *d'Orbigny, Bronn, von Reuss, Roemer, Cuvier, Pictet, Suess, Williamson, Ehrenberg, Carpenter, Parker and Jones, Karrer, Pourtales, Kaufmann, Möbius, Brady, Abich, von Gümbel, Terquem, Harting, Bunzel (?), von Zittel, Schwager, Credner, de Lapparent, de Amicis, Nicholson, Bütschli, Steinmann, Terrigi, Smedley, Bassett, Kölliker, Chapman, and others.*

HETEROSTEGINA, NONIONINA, *Ehrenberg.*

HEMISTEGINA, *Kaufmann.*

General Characters.—Shell free, lenticular, umbonate, inequilateral, more convex on one side than the other; consisting of a turbinoid spire, each convolution completely embracing the previous whorl. Chambers saddle-shaped (equitant), the alar prolongations on the upper side simple (as in *Nummulites*), on the lower divided each into two portions by the constriction of the sarcode; the secondary lobes being directed backwards and radially, and being intercalated have the appearance externally of an independent whorl of chambers. Aperture on the lower side of the ultimate chamber (as in the Rotalinæ).

The structural peculiarities of the genus *Amphistegina* are treated at length in Dr. Carpenter's 'Introduction,' &c., p. 241, *et seq.*

AMPHISTEGINA VULGARIS, *d'Orbigny*, 1823. Plate II, figs. 46—48.

Part I, 1866, Appendix I, Table, No. 92; Appendix II, Table, No. 91.

Lenticula, *Soldani*, 1780. Sagg. Oritt., p. 106, pl. iv, figs. 32 *e*, *E*; and pl. vii, figs. *zz*, *ZZ* (?); Testaceogr., vol. ii, App., p. 140 (Ammonia), and p. 141 (same pl. and figs.).

AMPHISTEGINA VULGARIS, *d'Orbigny*, 1823. Modèles, Livraison 2e, No. 40; Annales Sci. Nat., vol. vii, 1826, p. 305, No. 8.
ROBULINA NITIDA (?), *d'Orb.*, 1826. Ibid., p. 290, No. 22.
AMPHISTEGINA GIBBOSA, *d'Orb.*, 1839. Foram. Cuba, p. 120, pl. viii, figs. 1—3.
— — *Williamson*, 1852. Trans. Micr. Soc. Lond., vol. iii, p. 105, pl. xvii, figs. 1, 2.
— VULGARIS, *Parker and Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 147 (Table); and Ann. Mag. Nat. Hist., ser. 3, vol. xii, 1863, pp. 430, 438, No. 1.
— — *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 25, No. 40, pl. iii, fig. 91; and p. 34, No. 98, pl. iii, fig. 92.

Amphistegina vulgaris, d'Orb., was adopted by Parker and Jones as the natural type of the genus (see references given above); and, moreover, it has priority as a *published* form (Modèle, No. 40 in livraison 2) over *A. Lessonii* (Modèle, No. 98 in livraison 4), although the latter comes first in d'Orbigny's catalogue in the 'Annales Sci. Nat.,' vol. vii, p. 304, and has therefore been regarded as the "type" by various writers. Besides *A. Lessonii* several other varieties are enumerated in Brady's list of synonyms in the 'Challenger' Report, pp. 740, 741. All of these and others can be grouped around *A. vulgaris* as indicated by Parker and Jones in 1863 and 1865 on zoological grounds.

The following are the most important references to *Amphistegina* since the publication of the 'Challenger' Report, 1884, or not included in it.

AMPHISTEGINA VULGARIS, *J., P., and B.*, 1866. Monogr. For. Crag, Appendices, pl. ii, figs. 46—48.
— (?), *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 243, No. 118, pl. xii, fig. 152.
— VULGARIS, *Terquem*, 1875. Plage Dunk., p. 36, pl. v, figs. 8 *a*, *b*.
— — *Jones*, 1882. Catal. Foss. Foram. B. Mus., pp. 44, 67, 73, 74, 79, 94.
— LESSONII (including *vulgaris*, &c.), *Brady*, 1884. Report 'Challenger,' pp. 740, 741, pl. cxi, figs. 1—7.
— HAUERI, *Gümbel*, 1885. Geol. Bayer., vol. i, pt. 2, p. 423.
— (?), *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 152, No. 43.
— LESSONII, *De Amicis*, 1893. Ibid., vol. xii, p. 462.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 431, pl. xx, figs. 18, 19.
— — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 55 and 63.
— — *Chapman*, 1895. Proceed. Zool. Soc. for 1895, p. 45.
AMPHISTEGINA VULGARIS, *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 79.

Characters.—Shell lenticular, unequally biconvex, umbonate; chambers numerous; septal lines sinuous on the upper, curved and astral on the lower surface; margin acute; surface smooth.

Distribution.—*Amphistegina vulgaris* (including *Lessonii*) is mostly confined to tropical and subtropical seas; and, as a rule, does not extend to depths beyond 400 fathoms, and is most common at depths of less than 30 fathoms. Rare specimens have, nevertheless, been recorded from much greater depths—1750 fathoms by the 'Challenger,' and 2714 fathoms (*A. Hauerina*) by the 'Gazelle.'

Dr. A. Goës found this species at 20, 100, 300, and 1000 fathoms in the Caribbean Sea.

The genus in the fossil condition has been recorded from the Carboniferous of Bristol (H. B. Brady); the species from the Eocene of France (Calcaire Grossier); of Bavaria (Nummulitic beds of the Traunstein, Ehrenberg); and (?) of Java (Orbitoidal Limestone, Ehrenberg).

It is, perhaps, the most characteristic Foraminifer of the Miocene deposits generally; and it has been found in the Pliocene of many localities, especially in Italy, also at St. Erth. We include *Amphistegina vulgaris* as a constituent of the Crag rhizopodal fauna with some reservation. The specimens from Sudbourne found by Mr. S. V. Wood seem to carry evidence of having been washed from some earlier formation.

Genus 2.—Operculina, *d'Orbigny*, 1826.

Carpenter, Introd. Foram., 1862, *pp.* 247—262, *pl. xvii; Brady, Report 'Challenger,'* 1884, *pp.* 76, 742.

Nautilus, *Gronovius, Schroeter, Gmelin.*
Lenticulites, *Defrance, Basterot.*
Operculina, *d'Orbigny, Bronn, Michelotti, von Reuss, Leymerie, Cornuel, Rütimeyer, d'Archiac and Haime, Carter, Parker and Jones, Carpenter, Brady, M. Sars, Kaufmann, von Hantken, Vine, Quenstedt, Schafhäutl, Schauroth, von Gümbel, Schwager, Michelotti, Brown, T. Wright, von Zittel, Locard, Steinmann, Pictet, Mayer, M. Chalmas, Galeotti, Terquem, Ansted, Kölliker, Williamson, Figuier, Bütschli, Woodward and Thomas, &c.*
Amphistegina, *d'Orbigny, von Reuss.*
Nonionina, *Williamson, Fischer.*
Nummulina, *Parker and Jones.*

General Characters.—Shell free, equilateral, plano-spiral; formed of a regular spire, the successive convolutions of which are in close contact without over-

lapping, and are equally visible on both sides of the shell. Chambers numerous, rapidly increasing in size. Aperture simple at the inner margin of the chamber, as in *Nummulites*, from which genus *Operculina* differs in its delicate and more explanate shell, and more rapid increase of size in successive whorls. Canal system well developed.

1. Operculina complanata, *Defrance*, 1822. Plate II, figs. 49, 50.

Part I, 1866, Appendix I, Table No. 94; Appendix II, Table No. 93.

Lenticulites complanata, *Defrance*, 1822. Dict. Sci. Nat., vol. xxv, p. 453.
— — *Basterot*, 1825. Mém. Géol. Env. Bordeaux, pt. 1, p. 18.
Operculina complanata, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 281, pl. xiv, figs. 7—10; Modèle, No. 80.
— — *Michelotti*, 1841. Mem. Soc. Ital. Sci., vol. xxii, p. 285, pl. ii, figs. 1 *a*, *b*.
— — *Reuss*, 1845. In Geinitz's Grundriss, p. 665, pl. xxiv, fig. 41.
— ammonea, *Leymerie*, 1846. Mém. Soc. Géol. France, sér. 2, vol. i, p. 359, pl. xiii, figs. 11 *a*, *b*.
— complanata, *Rütimeyer*, 1850. Nouv. Mém. Soc. Helvet. Sci. Nat., vol. xi, Mém. 2, p. 108, pl. iv, fig. 56.
— arabica, *Carter*, 1852. Ann. Mag. Nat. Hist., ser. 2, vol. x, pp. 161—176, pl. iv, figs. 1—9.
— — — 1853. Journ. Bombay Branch R. Asiatic Soc., vol. iv, p. 437, pl. xviii.
— Hardiei, *d'Archiac and Haime*, 1854. Foss. Nummulit. Inde, livr. 2, p. 346, pl. xxxv, figs. 6, 6 *a—c*, granulose.
— complanata, *Bronn*, 1853–6. Lethæa Geogn., edit. 3, vol. iii, p. 208, pl. xxxv^2, figs. 7 *a—d*.
— — *T. Wright*, 1855. Ann. Mag. Nat. Hist., ser. 2, vol. xv, p. 75, pl. vii, figs. 4 *a*, *b*.
— — *Carpenter*, 1859. Phil. Trans., vol. cxlix, pp. 12—30, pl. iv; pl. v, figs. 1—12; pl. vi, figs. 1—4.
— — *Parker and Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 149, Tables.
— arabica, *Carter*, 1861. Ann. Mag. Nat. Hist., ser. 3, vol. viii, pp. 309—320, pl. xvii, figs. 10—14.
— complanata, *Parker and Jones*, 1861. Ibid., ser. 3, vol. viii, p. 229.
— — *Michelotti*, 1861. Nat. Verh. Holl. Maatsch-wet., ser. 2, vol. xv, p. 20, pl. i, figs. 14, 15.
— — *Carpenter*, 1862. Introd. Foram., p. 247, pl. xvii.

OPERCULINA COMPLANATA, *Parker and Jones*, 1863. Ann. Nat. Hist., ser. 3, vol. xii, p. 207, No. 36; p. 435, No. 36; and p. 440, No. 15.
— — *Parker, Jones, and Brady*, 1865. Ibid., vol. xvi, p. 32, pl. iii, fig. 93.
— — *Jones, Parker, and Brady*, 1866. Monogr. For. Crag, Append. i and ii, Tables, Nos. 93, 94, pl. ii, figs. 49, 50.
— STUDERI, *Kaufmann*, 1867. Geol. Beschreib. Pilatus, p. 151, pl. ix, figs. 1, 2.
— MARGINATA, *Kaufmann*, 1867. Ibid., p. 152, pl. ix, fig. 4.
— COMPLANATA, *Zittel*, 1876. Handb. Pal., vol. i, p. 96, fig. 36.
— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 25, fig. 22.
— — *Locard*, 1877. Ann. Agric. Lyon, ser. 4, vol. ix, p. 231, pl. v, figs. 6, 7.
— — *Jones*, 1882. Catal. Foss. Foram. Brit. Mus., pp. 22, 36, 40, 53, 69, 73, 80, 94.
— — *Möbius*, 1880. Foram. Mauritius, p. 104.
— ARABICA, *Jones*, 1883. Microgr. Dict., p. 555, pl. xxiv, figs. 23—26.
— COMPLANATA, *Brady*, 1884. 'Challenger' Report, p. 743, pl. cxii, figs. 3—5, 8.
— — *Basset*, 1885. Ann. Soc. Sci. Nat. Charente-Inf., No. 21, p. 162, fig. 80.
— — *Woodward and Thomas*, 1885. Thirteenth Rep. Geol. Surv. Minnesota, p. 175, pl. iv, fig. 35.
— — *Gümbel*, 1885. Geol. Bayer., vol. i, part 2, p. 421, fig. 266[28].
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 435, pl. xx, figs. 40—42.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 464.
— — *Woodward and Thomas*, 1895. Final Report Geol. Surv. Minnesota, vol. iii, part 1, p. 45, pl. E, figs. 37 and 39.
— — *Chapman*, 1895. Proc. Zool. Soc. for 1895, p. 47.

Characters.—Shell discoidal, complanate, subumbonate; consisting of three or four revolutions, rapidly increasing in breadth; chambers numerous, radial or arcuate; septa subtranslucent, sometimes limbate.

Distribution.—*Operculina complanata* is essentially a shallow-water form, and is confined to tropical and subtropical seas. No specimens have been obtained from the Atlantic. *O. ammonoides* represents it in the North Atlantic.

Fossil in the Chalk of Maestrichtand Minnesota; in the Eocene of Central Europe and India; in the Miocene of Italy and of Muddy Creek (Victoria); and in great profusion in the Langhian of the Bordeaux area. So far as the

Crag is concerned *Operculina complanata* was found in company with the *Nummulites Boucheri* and *Amphistegina vulgaris* in the Coralline Crag of Sudbourne. We have reason to believe that none of the three are proper to the Crag, but that all have been derived from earlier Tertiary beds; so also probably the *Alveolina*, *Peneroplis*, *Dendritina*, *Orbitolites*, and *Orbiculina* already described in the foregoing Parts I and II, and the *Orbitoides* that follows.

2. Operculina ammonoides (*Gronovius*), 1781. Plate VII, figs. 34 *a*, *b*.

Nautilus ammonoides, *Gronovius*, 1781. Zooph. Gron., p. 282, No. 1220, and p. v (expl. Tab.).

— Balthicus, *Schroeter*, 1782. Naturforscher, vol. xvii, p. 120; and 1783, Einleitung, vol. i, p. 20, pl. i, fig. 2.

Operculina complanata, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 285, pl. xi, figs. 3, 4.

Nonionina elegans, *Williamson*, 1858. Rec. For. Gt. Br., p. 35, pl. iii, figs. 74, 75.

Operculina ammonoides, *P. and J.*, 1861. Ann. Mag. Nat. Hist., ser. 3, vol. viii, pp. 229, 230.

— — *Carpenter, Parker, and Jones*, 1862. Introd. Foram., pp. 252, 310.

Nummulina perforata, var. (Operculina) ammonoides, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 398; pl. xiv, figs. 44 *a*, *b*; pl. xvii, figs. 62, 63.

Nonionina elegans, *Fischer*, 1870. Actes Soc. Linn. Bordeaux, vol. xxvii, p. 396 No. 45.

Operculina ammonoides, *B. and R.*, 1875. Brit. Assoc. Rep. for 1874, p. 191.

— — *Vine*, 1878. Sci. Goss., vol. xiv, p. 52, fig. 31.

— — *Brady*, 1884. 'Challenger' Report, p. 745, pl. cxii, figs. 1 and 2.

— — — 1887. Journ. R. Micr. Soc., p. 926.

— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 434, pl. xx, figs, 38, 39. (Approaches our fig. 33, pl. v, in want of septal limbation.)

— — *A. Silvestri*, 1893. Mem. Pontif. Accad. N. Lincei, vol. ix, p. 217, pl. vi, fig. 5.

— — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 105, pl. xvii, figs. 833, 833 *a*, and 833 *a—c*. (In fig. 833 [*bis*] the septa are rather more curved, and the chambers fuller and thinner at edge, than in the type.)

Anomalina ammonoides (?), *Woodward and Thomas*, 1895. Final Rep. Geol. Survey Minnesota, pl. d, fig. 30.

Characters.—Discoidal, compressed, compact; chambers fewer than in *Op. complanata*, and subquadrate; the limbation of the septa gives the surface a rotiform aspect.

Occurrence.—*Operculina ammonoides* has a wide geographical range, but is for the most part confined to comparatively shallow waters. It has been met with in the North Atlantic, including the Baltic, Gulf of Gascony, and Mediterranean; Gulf of Suez, off the Mauritius, Cape of Good Hope, and Australia; Malay Archipelago, the Philippines, Hong Kong, and south of Japan.

Fossil specimens have been recorded from the Pliocene of Calabria (Seguenza), and from the Pleistocene of Norway (Sars). In the Coralline Crag we have specimens from Broom Hill, zone **d**, Sutton and Gedgrave, zone **f**.

2*. Operculina ammonoides (*Gronovius*), 1781; var. curvicamerata, nov., *Jones*.
Plate V, fig. 33.

This differs from *Op. ammonoides, vera*, in not having a septate limbation, in the narrowness and curvature of the chambers, and in its distinct margin. It is proposed to distinguish this as a variety under the name of *curvicamerata*. Probably from the Crag at Sutton.

Dr. A. Goës in 1894, 'Trans. Roy. Swed. Acad.,' figured a form intermediate to this and *Op. ammonoides* in his pl. xvii, figs. 833 *a*—*c*.

Genus 3.—Nummulites,[1] *Lamarck*, 1801.

The following are references to some of the most important memoirs treating of the history and particulars of this genus:

D'Archiac et Haime, 'Description des Animaux fossiles du Groupe Nummulitique de l'Inde,' livr. i, 1853; livr. ii, 1854.

Parker and Jones, 'Annals and Magazine of Natural History,' ser. 3, vol. v, 1860, pp. 106—111; pp. 289—294; vol. viii, 1861, pp. 230—238.

Carpenter, 'Introduction to the Study of Foraminifera,' Ray Soc., 1862, pp. 262—276.

Philippe de la Harpe, 'Bullet. Soc. Géol. France,' ser. 3, vol. v, 1877, pp. 817—835; 'Bullet. de la Société de Borda à Dax,' année iv, 1879, pp. 137—

[1] This name has priority over *Nummulina*, Lamarck. It was at first intended to distinguish fossil from living forms by making the names of the former end in *ites*, and those of the latter in *ina*. As fossil specimens were first recognised Lamarck named them *Nummulites;* d'Orbigny published some recent examples with the name *Nummulina*, but this is of use only as a synonym (see 'Catal. Foss. Foraminifera Brit. Mus.,' 1882, pp. 90, 91).

150; and in the 'Mém. Soc. Paléont. Suisse,' vol. vii, 1880, pp. 1—104; vol. viii, 1881, pp. 105—149; vol. x, 1883, pp. 141—180; and 'Palæontographica,' vol. xxx, 1883.

H. B. Brady, Report 'Challenger' Foram., 1884, pp. 747—749.

Synonyms :

Nummi lapidei,[1] *Mercati.*
Nummularius lapis, *Gesner.*
Nummalis lapis, *Brückmann, Fortis.*
Numismales lapides, &c., *Deluc, Scheuchzer, Clusius.*
Nummulus, *Stobæus, Bromell, Fortis.*
Numulus, *Lhuyd.*
Nummulaires, *Saussure.*
Porpitæ, *Stobæus.*
Salices, *Scheuchzer.*
Phacites, *Gesner, Blumenbach.*
Phacolites, *Sage.*
Phyllites, *Scheuchzer.*
Helicites, *Gesner, Guettard, Burtin, Bosc, Defrance, Blainville.*
Nautilus, *Forskål, von Fichtel and von Moll.*
Camerina, *Bruguière, Bosc, Cuvier, Hericart de Thury.*
Discolithus, *Fortis.*
Lenticulites, *Lamarck, von Schlotheim, Defrance, Blainville, Bronn, d'Archiac, Rütimeyer.*
Lenticulina, *Lamarck, Defrance, Blainville, von Reuss.*
Amphistegina, *von Reuss, Carpenter.*
Numulites, Lycophris, Rotalites, Egeon, *de Montfort.*
Nummularia, *Sowerby, Parkinson, Carter, Brown, Dixon, Rütimeyer.*
Nummulina, *d'Orbigny, Risso, Sander Rang, Menke, Rouillier, Rütimeyer, d'Archiac, Ehrenberg, Savi, Meneghini, Lamarck, Boubée, Pusch, Martin, Carter, von Schlotheim, Michelotti, Joly, Leymerie, von Gümbel, Bornemann, Hoernes, Carpenter, Parker and Jones, Steinmann, Bronn, Schafhäutl, Seguenza, Karrer, Costa, Kaufmann, Buvignier, Galeotti, Mantell, Nicholson, Schauroth, Rouault, Brunner, Williamson, Cooke, Terquem, Deshayes, Brady, Römer, Potiez and Michaud, Heilprin, Macdonald, &c.*
Nummulites, *Defrance, Blainville, de Roissy, d'Orbigny, Lamarck, Alberti, Schafhäutl, De la Harpe, Kutorga, Conrad, Catullo, Leymerie, Joly, Emmons, d'Archiac and Haime, Bellardi, Gemmellaro, von Reuss, Carter, Rütimeyer, Meneghini, Parkinson, Crouch, Bronn, Mantell, Quenstedt, Fritel, Deshayes, Vutskits, Fraas, Brady, Morton, von Schlotheim, Sowerby, Ehrenberg, Prestwich, Parker and Jones, von Zittel, Abich, Michelotti, Heilprin, Pilla, Pictet, Medlicott and Blanford, Lartet, Tellini, Schlumberger, Parkinson,*

[1] Nature's money; also Saint Peter's, Saint Boniface's, and the devil's pence.

Blainville, Cuvier, Bütschli, Credner, Hartwig, Greene, Catullo, Boubée, Brunner, Cailliaud, Verbeek, Tchihatcheff, Uhlig, von Fritsch, Alth, Brown, Bowdich, Ure, Bakewell, Moxon, Ansted, Prevost, Lyell, Cornuel, von Hantken and Madarász, Brocklesby, Beudant, Hitchcock, Semper, Hahn, Neumayr, &c.

General Characters.—Shell free, lenticular or discoidal, spiral, equilateral, biconvex; convolutions numerous, embracing, the later usually hiding the preceding whorls by the extension of the alar flaps of its saddle-like chambers towards each umbilicus; segments numerous, short and narrow, with their lateral prolongations either *straight, curved, sinuous,* or *interlacing;* the latest chambers in matured shells contracted at their peripheral margin, so that they ultimately close in the shell; septal orifice single at the inner border of the septum.

1. Nummulites Boucheri, *De la Harpe*, 1879. Plate II, figs. 51, 52 (*Nummulina planulata*).

Part I, 1866 (*Nummulina planulata*), Appendix I, Table No. 93; Appendix II, Table No. 92.

Nummulites vasca, *Joly et Leymeric*, pars, *d'Archiac et Haime*, 1853. Foss. de l'Inde, p. 145, pl. ix, fig. 12.

Nummulina Germanica, pars, *Bornemann*, 1860. Zeitsch. Deutsch. Geol. Ges., vol. xii, p. 158, pl. vi, figs. 5—9.

Nummulites striatus (*d'Orb.*), *d'Arch.*, var., *Hantken*, 1875. Mittheil. Jahrb. kön. Ungar. Geol. Anstalt., vol. iv, p. 85, pl. xii, fig. 5.

— Boucheri, *De la Harpe*, 1879. Bullet. Soc. Borda à Dax, année iv, p. 146, pl. i, figs. iv, 1—10; vol. vi, pp. 240 and 243.

— — — 1883. Mém. Soc. Paléont. Suisse, vol. x, p. 179, pl. vii, figs. 33—59.

— — *Uhlig*, 1886. Jahrb. k. k. Geol. Reichsanst, vol. xxxvi, p. 205, pl. ii, figs. 7, 8, and 10 (var.); woodcuts (fig. 12), p. 206.

Characters.—A small lenticular Nummulite. Chambers relatively large, obliquely subquadrate; alar flaps rather broad, with strong septa, partially bent and slightly irregular, but giving a distinctly radiate pattern to the surface. This form belongs to the *radiate* group, and is thus related to *Nummulites striatus, variolarius, radiatus, Guettardi, Ramondi,* and others. Dr. Philippe de la Harpe's figures of *N. Boucheri* most resemble this Nummulite from the Crag. *N. Boucheri*

has been described as having a breadth of 2—3 mm. The Crag specimen here figured is 2·5 mm. broad and ·83 mm. thick.

The specimens of *Nummulites Boucheri* from Sudbourne are, there can be little doubt, "derived" from earlier beds, though in the absence of any positive indication it seems necessary to give it a provisional place in this Monograph.

Occurrence.—We have no record of the occurrence of this species in the recent condition. It occurs in the Eocene of Biarritz and in the Miocene or Oligocene at Magdeburg and in Hungary. So far as the Coralline Crag is concerned we have nothing to add to the record given in the First Part of the Monograph.

Sub-family 3.—Cycloclypeinæ.

Brady, 'Challenger' Report, 1884, *p.* 76.

Complanate with thickened centre, or lenticular, consisting of a disc of chambers arranged in concentric annuli, with more or less lateral thickening of laminated shell-substance or acervuline layers of chamberlets. Septa double, and furnished with a system of interseptal canals.

Genus 1.—Orbitoides, *d'Orbigny*, 1847.

Carpenter, 'Introd. Study Foram.,' 1862, *pp.* 298—304.

Discolithus, *Fortis.*
Lycophris, *Defrance, Sowerby, Carter.*
Lenticulina, *von Schlotheim.*
Asteriacites, *von Schlotheim.*
Nummulites, *Boubée.*
Orbitolites, *d'Archiac, Conrad, Michelin.*
Orbitulites, *Michelin, Bronn, Rütimeyer, Catullo, Rouault, Carter, von Gümbel.*
Orbitoides, *d'Orbigny, Carpenter, Carter, d'Archiac, Mayer, von Fritsch, Michelotti, Sowerby, Abich, Terquem, Ehrenberg, von Reuss, Kaufmann, Parker and Jones, Medlicott and Blanford, Bütschli, von Zittel, Carpenter, Morton, Seguenza, Karrer, von Gümbel, von Hantken, Jennings, Schwager, Martin, Brady, Stoliczka, Steinmann, and others.*
Calcarina, *d'Archiac, von Gümbel.*
Hymenocyclus, *Bronn, von Gümbel, Schafhäutl, von Schauroth, d'Eichwald.*
Cyclosiphon, *Ehrenberg.*
Asterodiscus, *Schafhäutl.*

Discocyclina, Rhipidocyclina, Aktinocyclina, Asterocyclina, Lepidocyclina, *von Gümbel.*
Nummulina, *Bronn, Rütimeyer, d'Archiac.*
Numismale, *Faujas de St. Fond.*
Lenticulites, *von Schlotheim.*

General Characters.—Shell lenticular, consisting (firstly) of numerous chambers arranged in concentric annuli, in one plane round a central primordial chamber (large or small); and (secondly) of numerous layers of flattened chamberlets disposed more or less regularly on each face of this median plane.

1. Orbitoides aspera, *Gümbel*, 1868. Plate III, fig. 25 (*O. Faujasii*).

Part I, 1866 (*Orbitoides Faujasii*), Appendices I and II, Tables, No. 100.

Orbitolites submedia (part), *d'Archiac*, 1846.	Mém. Soc. Géol. France, ser. 2, vol. ii, mém. No. iv, pl. B (vi), figs. 6, 6*a*. Named on the plate only. According to von Gümbel.
— Pratti (part), *Michelin*, 1840–47.	Iconograph. Zooph., p. 278, pl. lxiii, fig. 14. According to von Gümbel.
Orbitulites convexo-convexa (?), *Catullo*, 1857.	Terr. Sedim. Super. Venezia, p. 25, pl. i, fig. 7. According to von Gümbel.
Orbitoides (Discocyclina) aspera, *Gümbel*, 1868.	Abhandl. k. Bayern. Akad. Wiss., vol. x, p. 698, pl. iii, figs. 13, 14, 32—34.
— aspera, *Hantken*, 1875 (1881).	Mitth. Jahrb. k. Ung. Geol. Anst., vol. iv, p. 82, pl. xi, fig. 4.
— — *Schwager*, 1877.	Boll. R. Com. Geol. Ital., vol. viii, p. 26, fig. 77.
— — *Jones*, 1882.	Catal. Foss. Foram. Brit. Mus., pp. 34, 41, 42.

Characters.—Lenticular, biconvex, surface very rough and warty; median chambers almost square in section. The Bavarian specimens range to 8 and 12 mm. in breadth. Our figured specimen is 4 mm. broad.

Occurrence.—The genus may be said to be characteristic of the Upper Cretaceous and of the Lower and Middle Tertiaries. Professor von Gümbel refers to this species as having been found at Hammer, Götzreuth, Kressenberg, and Schöneck in the Bavarian Alps; near Biarritz in South France; near Mosciano,

not far from Florence; at the Pretora Majella and the Consuma in the Apennines; and at Caldiero, Granella, and Brendola, not far from Verona. Our figured specimen is from Sudbourne; and, together with some others previously mentioned, pp. 364, 368, was probably derived from some older Tertiary strata.

INCERTÆ SEDIS. Plate III, figs. 23 and 24.

1. RADIOLARIAN? Plate III, figs. 23 *a*, 23 *b*.

The small orbicular fossil, Pl. III, figs. 23 *a*, 23 *b*, is of uncertain alliance. In 1862 the explanation of these figures was "hemispherical shell of an organism possibly allied to *Dactylopora*; a 'derived' fossil (?). Sutton."

As figured, it appears to be thick-shelled, perforate, and spherical, much like an *Orbulina*, but more like a *Cenosphæra*, a simple, lattice-shelled Radiolarian, common in both the recent and fossil condition. Where a piece of the outer shell had been broken away, the figure shows what seems like an internal mass with a few short pillar-like rods.

The specimen is unfortunately lost. Mr. S. V. Wood, who collected it, has left a memorandum to the effect that it was "hyaline," and possibly this may have had reference to a *siliceous* condition.

Mr. F. W. Millett has lent us a MS. book by Mr. S. V. Wood, written about 1845, containing notes and drawings of Foraminifera from the Crag, and in it this little fossil is sketched in outline, and thus described:

"1. ORBULINA PERFORATA, *mihi*.

"T[esta] orbicula[ris], sphærica, lævigata, perforata, perforationi[bu]s magnis, apertura—.

"Shell globular, spheroidal, smooth and hyaline; strong, with very large and regular perforations; aperture ——. Diameter $\frac{1}{40}$ of an inch [= 0·6 mm.]. *Locality*.—Coralline Crag, Gedgrave.

"I have only one specimen of this species, which I have ventured to place in this genus. It does not fully correspond in its generic characters, as the openings are few and very large, and as wide as the spaces between them. They stand in irregular quincunx, and are not more that eight in the half-circle [across the hemisphere]."

Thus, although the figures are referred to in the explanation of the Plate III (1866) as "hemispherical," one was evidently intended to represent a spherical

body; and, according to the measurements there given of the two magnified aspects of this little fossil, fig. 23 *a* × 50 gives 0·48 mm., and fig. 23 *b* × 8 gives only 0·35 mm.

Several published, small, spherical, more or less reticulate bodies, figured as *Orbulinæ*, which have a diameter of about 0·35 to 0·72 mm., and relatively large perforations, eight to eleven in number across the shell, might at first sight be referred to as analogues of this little organism, especially if the roughnesses on some of them were supposed to have been worn off. Compare—

(1) *Globulina porosa*, Terquem, 1858; *Orbulina porosa*, Brady, 1884; *O. porosa*, Haeusler, 1890; Terrigi, 1890; Egger, 1893. (2) *Orbulina liassica*, Terquem, 1862. (3) *Orbulina punctata*, Terquem, 1862; Terquem and Berthelin, 1874. (4) *Orbulina neojurensis*, Karrer, 1867; Terrigi, 1880; Uhlig, 1883. (5) *Orbulina millepora*, Terquem. (6) *O. macropora*, Terquem, 1876, 1883. (7) *O. Argoviensis*, Haeusler, 1881. (8) *Orbulina nitida*, Terquem, 1886.

Two of these in particular closely resemble our fig. 23 *a*, and are far more likely to be Radiolarian than Foraminiferal according to the figures and descriptions of them given by M. Terquem, thus:

Orbulina macropora, Terquem (from the Bajocian of the Moselle), 'Bulletin Soc. Géol. France,' ser. 3, vol. iv, 1876, p. 481, pl. xv, fig. 1: "Coquille blanchâtre, translucide, munie des pores très-grands et espacés; fort rare. Diamètre, 0·29 mm."

Orbulina nitida, Terquem (recent from Christiansand), 'Bulletin Soc. Zoolog. France,' vol. xi, 1886, p. 330, pl. xi, fig. 1: "Coquille subsphérique, lisse, brillante et transparente; fort rare. Diamètre, 0·31 mm."

The figure (Pl. III, 23 *a*) given in 1866 shows, however, that the little sphere is not hollow. Whether a Foraminiferal *Orbulina* or a Radiolarian *Cenosphæra*, perhaps it had been filled with matrix, some of which, entering small holes in the shell, still remains as short rods. If these little rod-like bodies had been more equally proportioned, we might look to the Radiolarian *Actinomma* (*Thecosphæra*) for an analogue. In this case the short pillar-like rods may have been the "beams" connecting the inner mass with the outer shell by passing into its substance at the narrow spaces between the round holes of the surface. Their relative positions, however, scarcely permit of this interpretation.

Our fossil is very much larger than the majority of Radiolaria. The perforations of the shell, however, are about the same in number as in some forms of *Ethmosphæra* and *Thecosphæra*, and are not relatively larger.

Of course we have here evidence only of analogy, and not identity. Supposing the little fossil to have been coated or thickened with mineral matter, and

if the structural analogy be true, we may see its Radiolarian nature beneath the mask.

Numerous minute, subglobular, pitted, white, calcareous organisms found in the Calcaire Grossier of Grignon, &c., belong to the Calciferous Algæ (*Siphoneæ verticillatæ*), being equivalent to the calcified segments of the jointed branches of *Cymopolia* (*Corallina*), &c. These and other Dactyloporoid débris were probably in the mind's eye when the Explanation of Plate III was written in 1866.

2. Dactyloporoid ? Plate III, fig. 24.

This little hemispherical, subglobular (or beehive-shaped), reticulate body, shown obliquely, measures 0·3 mm. according to the magnified figure. Unfortunately it is lost.

It somewhat resembles the subconical and rounded ends of some forms of *Polytrypa*, *Dactyloporella*, *Haploporella*, and *Gyroporella*. Hence probably its presumed relationship to *Dactylopora* in the Explanation of Plate III (1866).

We may also note that, excepting in its relatively small size, it may be distantly compared with some *Polyzoa*, such as *Cerioporæ* and *Dianulites*.

TABLE OF THE DISTRIBUTION OF THE FORAMINIFERA IN THE CRAG AND SOME CONTEMPORANEOUS FORMATIONS IN EUROPE.

TABLE OF THE DISTRIBUTION OF THE FORAMINIFERA IN TH

By H. W. Burrows, A.R.I.B.A

vl. Very large. l. Large. m. Middle-sized. s. Small. rs. Rather small. vs. Very smal

	Genera, Species, and Varieties.	Coralline Crag.									English
		Zone d.			Zone e.		Zone f.		Zone f		
		Tattingstone.	Sudbourne Hall.	Broom Hill.	Broom Hill.	Sutton.	Sutton.	Gedgrave.	Aldborough.		
		1	2	3	4	5	6	7	8		
1	Biloculina ringens (*Lamarck*)		m. VR.	l. VR.	s. VR.	...	vl. RC.	m. RC.	s. VR.	vs. R	
2	— elongata, *d'Orbigny*	...	vl. VR.	vl. VR.	...	...	...	vs. VR.	...		
3	— depressa, *d'Orbigny*		...	s. R.	...	..	..	...	..		
4	— *depressa*, var. *murrhyna*, Schwager	...	...		...		...	...	...		
5	— *bulloides*, d'Orbigny	...	...	...	...	...	...	...	...		
6	— bulloides, var. inornata, *d'Orb*	...	s. VR.	...	...	s. R.	rs. VR.	...	...	v R	
7	Spiroloculina planulata (*Lamarck*)		..	...	m. VR.	...		...	..		
8	— excavata, *d'Orb.*	..	m. RC.	s. VR.	s. VR.	s. VR.	...	...	...		
9	— canaliculata, *d'Orb*	...	m. R.		...		...	...	...		
10	— dorsata, *Reuss*	s. VR.	m. C.	m. C.	m. VC.	s RR.	m. RR.	s. RR.		C.	
11	— nitida, *d'Orb.*				...			...			
12	— *grata*, Terquem				...			...			
13	— *tenuimargo*, Brady							...			
14	— *arenaria*, Brady						...				
15	— — var. *perlonga*, de Amicis										
16	Miliolina seminulum (*Linné*)	s. VR.	s. RC.	vs. VC.	s. VC.	m. C.	l. VC.	s. VC.	s. VR.	VC	
17	— triangularis (*d'Orb.*)	...			...		...	...			
18	— Cuvieriana (*d'Orb.*)	...			...	m. VR.	...	...	...		
19	— tricarinata (*d'Orb.*)	...			...						
20	— oblonga (*Montagu*)	s. R.	m. RC.	s. VC.	s. VC.	..	m. RC.	s. VC.	s. R.	VC	
21	— subrotunda (*Montagu*)				...	...	m. VR.	vs. VR.	...		
22	— circularis (*Bornemann*)				s. VR.	..		...			
23	— bicornis (*W. and J.*)				s. VR.	..	...	...	...	VR	
24	— (*M.*), var. Brongniartii (*d'O.*)	...			...	...	...	...	...		
25	— pulchella (*d'Orb.*)	...	s. RR.	l. RR.	vs. VR.	...	...	vs. VR.	...		
26	— Ferussacii (*d'Orb.*)		s. VR.	s. RR.	...	...	...	s. RR.	...		
27	— *agglutinans* (d'Orb.)	...	...	...	...	...	...	...	...		
28	— *Auberiana* (d'Orb.)	...	...	...			...	...	...		
29	— *Linnæana* (d'Orb.)		..	...	..	..	...	..	...		
30	— *reticulata* (d'Orb.)	...	..	...	...	...	...	...	...		
31	— *sclerotica* (Karrer)		...	...	...		...	...	...		
32	— *secans* (d'Orb.)	...	...	...	...		...	...	...		
33	— *trigonula* (Lamarck)	...		...	...	..	...	...	...		
34	— *undosa* (Karrer)	...	..	...	...	...	...	...	...		
35	— *valvularis* (Reuss)	...	...	...	...		...	...	...		
36	— *venusta*, Karrer	...		...		...	...	...	...		
37	Sigmoilina tenuis (*Czjzek*)	...	..		..	s. VR.	...	...	...		

CRAG AND IN SOME CONTEMPORANEOUS FORMATIONS IN EUROPE.

AND RICHARD HOLLAND.

V. Very common. C. Common. RC. Rather common. R. Rare. RR. Rather rare. VR. Very rare.

CENE.

		Upper Crag.			Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
								Plaisancian.				Astian.		
Zones undetermined.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Sutton...	...	m. VR.	.	vs. R.	...	..	..	l. RC.	l. C.	RC.	×	...	...	1
	...	m. VR	...	...	...	...		s. VR.	rs. VR.	VR.	×	s. VR.	.	2
	...	..	...	...	VR.	s. VR.	...	s. VR	s. VR.	R.	×	..	...	3
	...	.	...	rs. VR.	...	...	...	...	..	..	...	...	..	4
	...	...	...	...	...	...	vs. VR.	vs. VR.	...		×	..	.	5
	...	.	...	...	VR.		s. VR.	...	...		.	..		6
	s. R.	...	...	...	...	...	.		..	VR.	...	...		7
	...	...	...	vs. RR	...	...	...	m. VR.	m. VR.	VR.	...	rs. VR.	...	8
	...	..	...	...	..	...	...	s. VR.	s. VR.	...	×		...	9
	...	...	...	s. RR.	...	m. RC.	rs. VR		...	VR.	..	.	×	10
V.	...	..	...	...	...	...	...	...	...	...	..	...	...	11
	...	...	.	..	...	...	...	m. VR.	...	.	...	...		12
	...	...	...	...		m. R.		...	...	...		..	...	13
	..	...	...		...	...	...			VR.		..	...	14
	...	...	...	..	...	...	...	...	...	VR.		.	...	15
	s. VR.	×	...	l. C.	VR	vs. VR.	vs. RR.	rs. VC.	rs. RR.	C.	×	...		16
	s. RC.	...	...	..		...		...	..	...	..	.		17
	rs. R.	...	..	...	...	...	...	vs. VR.	...	..		rs. R.	...	18
	...	..	..	vs. C.	...	..	...	...	rs. VR.	VR.		...	...	19
	s. VR.	..		s. C.		..	rs. RC	s. VR.	...	VR.	...	vs. VR.	.	20
	...		..	vs. RR.		..	...	...	..	.	...		...	21
	s. VR.	...	...	rs. R.	.			...	.	.	...	.	..	22
	...	...	...	vl. RC	..	...		s. VR.	rs. VR	VR.	...	rs. RR.		23
LL	...	...	...	...	.	..		...	...	...	..	..	...	24
VR	...	...	...	...	...	...	...	vl. VR.	vl. VC.	...	...	rs. R.	...	25
	l. R.	...	...	rl. RC.	...	...	...	...	...	VR.	...	...	.	26
	...	..	...	s. R.	...	...	...	...	...	VR.	...	...	...	27
	..	...	...	...	VR.	...	...	...	...	VR.	...	...	...	28
	...	..	...	...	...	...	...	...	rs. VR.	VR.	...	...	...	29
	...	...	...	...	...	...	...	rs. VR.	rs. VR.	VR.	...	...	...	30
	...	...	...	m. C.	...	...	...	...	...	...	...	...	...	31
	...	...	...	s. VR.	..	...	...	...	...	...	...	...	...	32
	..	...	..	s. RR.	...	...		...	...	...	×	...	...	33
	...	...		s. R.	...	...	...	...	...	VR.	...	...	...	34
	..	...	...	...	...	...		...	...	VR.	...	...		35
	...	...	...	...	...	...	...	...	...	...	...	rs. VR.	.	36
	s. VR.	...	...	...	R.	...	...	...	...	VR.	...	...	×	37

	Genera, Species, and Varieties.	Coralline Crag.								
		Zone **d.**			Zone **e.**		Zone **f.**		Zone	
		Tattingstone.	Sudbourne Hall.	Broom Hill.	Broom Hill.	Sutton.	Sutton.	Gedgrave.	Aldborough.	Gedgrave.
		1	2	3	4	5	6	7	8	9
38	*Planispirina celata* (Costa)	...	...	...	...	.	...	...	...	...
39	Cornuspira foliacea (*Philippi*)	...	...	...	...	...	...	...	...	...
40	— involvens (*Reuss*)	...	...	l. VR.	...	...	vl. VR.	m. VR.	...	...
41	Peneroplis planatus (*F. & M.*)	...	..	s. VR.	...	...	...	...	...	...
42	— (Dendritina) arbuscula (*d'Orb.*)	...	...	...	..	.	...	...	...	...
43	— cylindraceus (*Lamarck*)	...	...	...	...	...	.	..	...	...
44	Orbiculina adunca (*F. & M.*)	...	...	...	...	vs. VR.	...	...	...	...
45	Orbitolites complanatus, *Lamarck*	...	...	...	...	...	.	...	...	...
46	Alveolina Boscii (*Defrance*) ?	..	...	...	...	...	...	...	...	...
47	*Pelosina apiculata*, Schrodt	...	..	...	...	...	..	...	...	..
48	*Psammosphæra fusca*, Schultze	.	...	...	.	.	...	..	...	..
49	*Saccammina sphærica*, Sars	...	...	...	.	...	...	...	...	..
50	*Rhabdammina irregularis*, Carpenter	...	...	...	...	...	...	...	...	...
51	Haplophragmium glomeratum (*Brady*) ?	vs. VR.	s. RC.	s. RC.	s. VR.	...	...	...	s. C.	VR
52	— *Canariense* (d'Orb.)	..	...	...	..	...	...	...	...	...
53	— *Fornasinii*, De Amicis	.	...	...	.	...	...	...	...	...
54	*Haplostiche Soldanii* (Jones & Parker)	...	...	...			...	...	...	...
55	*Hippocrepina constricta*, Schrodt	...	...	...	...	...	...	...	...	...
56	Webbina hemisphærica, *J., P., & B*	...	...	...	...	...	...	...	...	...
57	Textilaria sagittula, *Defrance*	s. RC.	m. VC.	rl. RC.	s. VC.	s. C.	l. VC.	s. RC.	s. RR.	VC
58	— — var. jugosa, *Brady*	s. VR.	l. VC.	rl. VR.	l. RC.	...	l. RC.	l. RR.	s. VR.	...
59	— sulcata, *Jones*	...	...	...	...	...	...	...	...	...
60	— subflabelliformis, *Hantken*	...	...	...	...	...	...	...	...	...
61	— agglutinans, *d'Orb.*	..	vl. C.	m. R.	s. VC.	m. C.	l. R.	s. RC.	m. RR.	RC
62	— — var. *porrecta*, Brady	...	...	...	...	...	...	...	...	...
63	— — var. densa, *Jones*	...	...	m. R.	...	...	...	...	...	...
64	— trochus, *d'Orb.*	vs. VR.	rl. VC.	m. R.	s. R.	n. VR.	...	...	m. RR.	VR
65	— conica, *d'Orb.*	s. RC.	m. C.	m. R.	s. R.	s. R.	..	s. RC.	s. RR.	VR
66	— gibbosa, *d'Orb.*	...	l. VC.	l. RC.	rl. RC.	m. C.	vl. VC.	l. RC.	m. VC.	...
67	— tuberosa, *d'Orb.*	...	...	...	...	...	...	...	...	...
68	— globulosa, *Ehrenberg*	...	...	...	...	...	...	...	...	...
69	— *abbreviata*, d'Orb	...	...	...	...	...	...	...	...	...
70	— *aciculata*, d'Orb.	...	...	...	...	...	...	...	...	...
71	— *aspera*, Ehr.	...	...	...	...	...	...	...	...	...
72	— *carinata*, d'Orb	...	.	...			...	...	...	...
73	— — var. *minor*, Seg	...	...	...	...		...	...	...	...
74	— *concava* (Karrer)	...	...	...	...	...	...	...	...	...
75	— *gramen*, d'Orb	...	...	...	...	..	...	.	...	...
76	— (*Bolivina ?*) *quadrilatera*, Schwager	...	...	...	...	...	..	...	...	...
77	*Verneuilina spinulosa*, Reuss	...	...	.	.	..	..	...	...	...
78	*Tritaxia lepida*, Brady	...	...	...	...	...	...		...	...
79	Bigenerina nodosaria, *d'Orb.*		...	..	..	...		...	...	...
80	— *capreolus*, d'Orb	...	...	...	...	.	...		...	...
81	Spiroplecta rosula, *Ehr.*[1]	...	...		...	...	..	..	...	VR
82	— *Americana*, Ehr.	..	...	...	..	...	...	...	...	...

[1] In the text (p. 160) this is said erroneously to occur in Zone **f.**

NE.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
	Upper Crag.							Plaisancian.				Astian.		
ones ermined.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
	11	12	13	14	15	16	17	18	19	20	21	22	23	
	...	...	...	...	..	m. VR.	m. RC.	m. VR.	...	C.	...		×	38
	..	...	...	s. R.	...	...	...	rl. VR.	s. VR.	.	...			39
	...	...	...	s. RC.	...	...	...	.	..	...	...			40
	...	...		...	...	...	...	...	.	.		..		41
	s. VR.	...	...	...	...	...	...	...	...			.	..	42
	s. VR.	...	...	...	...	..	...	...	..		..		...	43
	...	...	...		...	...	...	..	..		..		...	44
	...	...	...	...	..	...	...	...		..	..	.		45
	m. VR	..	...	...	.	...	...	...	..	..	..			46
	...	...	.	...	...	...	...	...	..		...	.	×	47
	...	...	...	...	...	...	...	..	...	..	..		×	48
	...	...	...	...	...	...	...	...	...	...	...		×	49
	...	..	..	...	...	...	...	...	...				×	50
	...	...	...	...	...	...	...	...	...	...	...	...	..	51
	...	...	...	vs. VR.		...	...	...	...	...		...		52
	...	...	...	...	...	...	...	..	.	VR.	...	..		53
	...	...	...	...	..	.	...	...	l. RC.	...	..	...	.	54
	...	...	...	...	...	...	...	...	...	...	..		×	55
	...	...	..	...	...	...	...	...	...	...	..	...		56
	s. C.	m. RR.		m. RC.	...	rs. VR.	vs. VR.	s. VR.	rs. VR	VR.	..	s. VR.	×	57
	...	.	..	...	...	...	m. VR.	rl. RC.	l. C.			.	.	58
	...	...		..		...		..	..		...	..	..	59
	...	...	...		.	..	...	..	...		...	.	..	60
	m. RC.	..	...	.	...		..	..	rs. VR.	..	×	rs. RC.	...	61
	...	...		..	...	.	...	..	rl. VR.	...		...	.	62
	..	...		...	...			...	..	...	...	...	.	63
	m. RR.	...	..		..	...	...	...	..	VR.		vs. R.	^	64
	...	...	...	..	...	vs. VR.	s. VR.	s. VR.	m. VR.	VR.	..	vs. R.		65
	m. RC.	...		...	..	...		rs. VC.	rs. VR.	RC.	×	×	×	66
	..	...	...		..	.	...	...	...	RR.				67
	..	..	s. VR.	rs. R.	..	...	...			...	..	..		68
	...	.	...		...	...	...		..	RC.	×	...	×	69
	...	.	...	..	...	...		..	..	RR.	...	...	..	70
	...	...	..	...	...	...	...	.	...	VR.	..	...	...	71
	...	...	...	...	C.	...	...		...	...	...	...	...	72
	...	...	...	...		...				VR.	.	.	..	73
	...	...	...	rs. VR.	...		...	...	...	VR.	...	..	..	74
	...	...	...	rs. R.	...	...	s. RR.	...	m. C.	C.	...	..	...	75
	..	...	...	m. VR.	...	.	...	...	...	..	...	...	...	76
	..	...	...	m. R.	.	...		s. RR.	s. VR.		×	s. VR.	...	77
	...	...	...	..	...	...	...	.		...	..	...	×	78
	...	...	...	vs. VR.	...	...	...	...	.	VR.	×	..	×	79
	...	...	...	...	...		..				...	..	×	80
	...	...	...	m. VR.	...	...		...		...	..	...	..	81
	...	...	..	m. RC.	...			...	.	..	..	...	.	82

	Genera, Species, and Varieties.	Coralline Crag.								
		Zone **d.**			Zone **e.**		Zone **f.**		Zone **g.**	
		Tuttingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
83	*Gaudryina pupoides*, d'Orb.	...	..	...	...	...	...	...	...	..
84	*Clavulina angularis*, d'Orb.	...	..	...	..	..	...	...	...	.
85	— *communis*, d'Orb.	..	...	...	...	...	...	...	...	..
86	— *cylindrica*, Hantken	...	...	...	...	...	...	...	...	..
87	— *gaudryinoides*, Fornasini	...	...	..	...	...	...	...	...	.
88	— *Parisiensis*, d'Orb.	...	...	...	.	...	.	...	...	..
89	— *rudis*, Costa	.	..	...	...	...	...	...	...	..
90	Bulimina elegans, *d'Orb.*	...	s. R.	s. VR.	...	...	...	vs. VR.	s. VR.	vs. V.
91	— *elegans*, var. *exilis*, Brady	...	..	...	...	...	.	...	...	..
92	— aculeata, *d'Orb.*	...	...		.	...	...	...	...	vs. V.
93	— marginata, *d'Orb.*	..	...	...	...	...			...	..
94	— *affinis*, d'Orb.	.	...	...	...		...	...	...	..
95	— *Buchiana*, d'Orb.	..		...	...	...	...	..	...	..
96	— *elegantissima*, d'Orb		...	...	...	...	.	...	...	..
97	— *inflata*, Seguenza	...	...	..	...	...		..	...	.
98	— *ovata*, d'Orb.	...		...	...	...	...	...	...	.
99	— *pyrula*, d'Orb.	...	...	...	...	...	.	...	...	.
100	— *pupoides*, d'Orb.	...		...	...	...	...	..	...	.
101	— *scabriuscula*, Reuss		...	...	...	...	.	...	...	.
102	— *subteres*, Brady	...	...	...	...	.	...	...	...	.
103	*Virgulina Schreibersiana*, Czjzek		...	...	...	...	..	...	...	.
104	— — var. obesa, *Jones*	...	vl. VR.	...	...	...	...	...	...	.
105	Bolivina punctata, *d'Orb.*	s. R.	rl. C.	rl. C.	...	...	s. RC.	vs. VR.	s. RC.	
106	— Ænariensis (*Costa*)	s. C.	rl. C.	rl. C.	...	s. RC.	s. RC.	vs. VR.	s. RC.	s. R.
107	— *Beyrichi*, Reuss	...	...		...	.	..	...	...	.
108	— — var. *alata*, Seguenza	...	...	...	...			...	..	
109	— *dilatata*, Reuss	...		...	...	..	..		...	
110	— *gibbera*, Millett	...	...	...			...	...	...	
111	— *lævigata* (Williamson)	...		...	...	...	...	...	...	
112	— *nobilis*, Hantken	...	...	...	...	...	...	.	...	
113	— *obsoleta*, Eley	...	...	..	...	...	...	...	...	
114	— *plicata*, d'Orb.	...	...	...		...	...	..	...	
115	— *robusta*, Brady	...	...	...	...	...	...	...	...	
116	— *textilarioides*, Reuss	.	...		.	...	...	.	...	
117	— *tortuosa*, Brady			...		...	...		...	
118	*Pleurostomella alternans*, Schwager	...	...	...	...	...	...	...	...	
119	Cassidulina lævigata, *d'Orb.*	m. C.	...	l. RR.	...	s. RC.	m. C.	vs. RR.	vs. VR.	vs. R.
120	— crassa, *d'Orb.*	...	...	m. VR.	...	s. VR.	...	...	...	
121	— — var. oblonga, *Reuss*	...	.	...	...	...	...	..	...	
122	— *Bradyi*, Norman	...	...	...	...	...	...	...	..	
123	Lagena globosa (*Montagu*)	m. VR.	m. C.	m. VR.	m. RR.	...	l. C.	m. RC.	s. VR.	vs. R.
124	— apiculata, *Reuss*	...	...	...	...	...	...	s. VR.	...	
125	— lævis (*Montagu*)	s. VR.	m. R.	s. VR.	s. VR.	s. VR.	m. VR.	s. VR.	s. VR.	s. R.
126	— clavata (*d'Orb.*)	...	...	...	...	...	m. VR.	...	...	
127	— gracillima, *Seguenza*	...	...	...	...	...	...	...	...	

Pliocene.		Upper Crag.			Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
Zones undetermined.								Plaisancian.				Astian.		
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
...	...	...	...	...	...	...	...	...	...	..	...	...	×	83
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	84
...	...	...	...	...	...	...	...	rl. R.	m. RC.	VC.	..	..	×	85
...	...	...	...	...	...	...	...	...	...	...	...	..	×	86
...	...	...	...	...	...	...	..	...	...	VR.	...	...	...	87
...	...	...	...	m. VR.	..	...	...	m. VR.	m. VR.	VR.	.	m. VR.	...	88
...	...	...	...	...	..	...	...	...	...	VR.	..	..	...	89
...	...	...	vs. R.	...	...	vs. VR.	vs. VR.	...	vs. VR.	...	...	...	...	90
...	...	...	...	...	...	...	...	s. VR.	...	...	...	...	...	91
...	...	...	vs. VR.	rs. R.	...	...	...	...	...	...	×	...	×	92
...	s. R.	...	...	s. R.	...	...	...	...	...	...	...	...	...	93
...	...	...	...	m. RC.	...	...	...	s. VR.	vs. VR.	...	...	...	...	94
..	...	...	...	...	...	...	...	...	...	VR.	×	...	...	95
...	...	...	...	s. RR.	...	...	...	...	...	...	...	..	...	96
...	...	...	...	...	...	...	...	m. VR.	...	.	×	...	×	97
...	...	...	...	...	...	...	...	...	vs. VR.	VR.	...	...	...	98
...	...	...	...	...	...	...	...	s. VR.	...	VR.	×	...	×	99
...	...	...	...	m. RR.	...	...	...	...	...	...	×	...	×	100
...	...	...	...	...	R.	...	...	...	...	...	...	...	...	101
...	...	...	...	s. VR.	..	...	...	...	...	...	...	...	...	102
...	...	...	...	m. C.	C.	...	vs. VR.	...	vs. VR	...	...	...	...	103
...	...	...	...	...	...	...	...	...	...	...	...	...	...	104
..	s. R.	...	...	s. RC.	...	...	...	m. R.	s. VR.	VR.	×	...	×	105
...	...	...	...	...	...	s. RR.	s. RR.	s. VR.	rs. VR	...	×	...	...	106
...	...	...	..	m. R.	...	...	...	...	...	...	×	...	×	107
...	...	...	...	...	...	...	...	m. R.	...	...	...	...	×	108
..	...	...	...	s. RC.	...	...	...	...	...	...	...	...	×	109
..	...	...	...	m. RC.	...	...	...	.	..	..	...	.	...	110
..	...	...	...	m. RC.	...	...	...	...	...	...	...	.	...	111
..	...	...	...	...	...	...	...	.	...	...	.	rs. VR.	...	112
..	...	...	...	m. VR.	...	...	...	...	...	...	...	...	...	113
.	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	114
..	...	...	...	m. VC.	...	...	...	...	...	...	...	...	×	115
..	...	...	...	s. R.	...	...	vs. VR.	...	...	...	..	...	...	116
..	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	117
..	...	...	...	...	...	..	...	s. VR.	...	...	...	...	×	118
..	m. VR.	...	...	rs. VC.	...	...	vs. VR.	s. RR.	s. VR.	...	×	...	..	119
..	m. VR.	...	...	rs. RR.	...	vs. VR.	...	...	...	...	...	...	...	120
R.	m. VR.	...	...	rs. C.	...	...	...	...	...	...	...	...	×	121
..	...	...	...	rs. RC.	...	...	...	...	...	...	×	...	...	122
R.	l. RC.	...	...	rs. RC.	VR.	s. RR.	s. RR.	...	...	...	×	...	...	123
...	s. R.	...	...	s. RR.	..	...	...	...	...	VR.	...	...	...	124
r VR.	...	...	...	rs. VC.	R.	vs. VR.	vs. VR.	...	...	...	×	...	×	125
...	...	...	...	m. RC.	VR.	...	...	...	...	...	...	...	×	126
v. VR.	...	...	...	m. RC.	...	...	...	...	s. VR.	...	...	...	...	127

	Genera, Species, and Varieties.	English Coralline Crag.								
		Zone d.			Zone e.		Zone f.		Zone g.	
		Tattingstone.	Sudbourne Hall.	Broom Hill.	Broom Hill.	Sutton.	Sutton.	Gedgrave.	Aldborough.	Gedgrave.
		1	2	3	4	5	6	7	8	9
128	Lagena striata (*d'Orb.*)	...	...	m. VR.	m. VR	...	rl. VR.	s. VR.	...	s. VR
129	— sulcata (*W. & J.*)	...	rl. C.	s. VR.	m. C.	...	s. R.	s. RC.	s. VR.	vs. VF
130	— acuticosta, *Reuss*	...	l. VC.	l. VC.	m. VC.	s. RR.	rl. C.	m. VC.	l. RC.	vs. RC
131	— gracilis, *Williamson*	s. VR.	...	...	...	...	...	...	...	...
132	— semistriata, *Will.*	...	...	...	...	...	...	s. VR.	...	...
133	— melo (*d'Orb.*)	s. RC.	rs. R.	s. VR.	s. VR.	s. RR.	s. VR.	s. VR.	...	vs. VF
134	— hexagona (*Will.*)	...	...	s. VR.	...	s. VR.	s. VR.	s. VR.	...	...
135	— seminuda, *Brady*	...	...	m. VR.	...	s. R.	s. VC.	s. RR.	vs. VR.	vs. VF
136	— reticulata (*Macgillivray*)	m. VR.	...	s. VR.	...	...	...	s. VR.	...	vs. RF
137	— lævigata (*Reuss*)	m. VR.	...	m. R.	m. RR.	s. VR.	s. VR.	s. RR.	...	...
138	— quadrata (*Will.*)	m. VR.	vs. VR.	s. VR.	s. VR.	s. VR.	m. R.	s. VR.	...	vs. VF
139	— marginata (*W. & J.*)	s. RR.	m. VC.	m. C.	s. VR.	s VR.	m. RC.	s. VR.	s. C.	s. VC
140	— — var. *inæquilateralis*, Wright	...	...	...	...	...	...	...	...	...
141	— seminiformis, *Schwager*	...	...	vs. VR.	...	...	...	...	...	...
142	— lagenoides (*Williamson*)	...	...	...	...	...	...	...	...	...
143	— formosa, *Schwager*	m. RR.	m. R.	rl. RR.	s. VR.	m. VR.	m. VR.	s. VR.	...	vs. VF
144	— — var. comata, *Brady*	...	m. VR.	...	...	...	m. VR.	...	...	...
145	— annectens, *B. & H.*	m. VR.	...	...	...	...	...	...	...	...
146	— Orbignyana (*Seguenza*)	m. RR.	m. RR.	m. RC.	...	s. RR.	m. RR.	s. VR.	...	...
147	— lacunata, *B. & H*	m. RC.	rl. RR.	s. VR.	...	s. VR.	...	s. VR.	...	s. VF
148	— *acuta* (Reuss)	...	...	...	...	...	...	...	...	...
149	— *aspera*, Reuss	...	...	...	...	...	...	...	...	...
150	— *bicarinata* (Terquem)	...	...	...	...	...	..	...	...	...
151	— *clathrata*, Brady	...	...	...	...	...	...	...	...	...
152	— *Cornubiensis*, Millett	...	...	...	...	...	...	...	...	...
153	— *cymbæformis*, Millett	...	...	...	...	...	...	...	...	...
154	— *fimbriata*, Brady	...	...	...	...	...	...	...	...	...
155	— *hispida*, Reuss	...	...	...	...	...	...	...	...	...
156	— *lineata* (Will.)	...	...	...	...	...	...	...	...	...
157	— *longispina*, Brady	...	...	...	...	...	...	...	...	...
158	— *lucida* (Will.)	...	...	...	...	...	...	...	...	...
159	— *Lyellii* (Seguenza)	...	...	...	...	...	...	...	...	...
160	— *ornata* (Will.)	...	...	...	...	...	...	...	...	...
161	— *quadrata*, var. *semialata*, Balk. & Mill.	...	...	...	...	...	...	...	...	...
162	— *quadricostulata*, Reuss	...	...	...	...	...	...	...	...	...
163	— *rudis*, Reuss	...	...	...	...	...	...	...	...	...
164	— *squamosa* (Montagu)	...	...	...	...	...	...	...	...	...
165	— *Staphyllearia*, Schw	...	...	...	...	...	...	...	...	...
166	— *sulcata*, var. *interrupta*, Will.	...	...	...	...	...	...	...	...	...
167	— *trigono-marginata*, P. & J.	...	...	...	...	...	...	...	...	...
168	— *trigono-oblonga*, Seg. & Sid.	...	...	...	...	...	...	...	...	...
169	— *Yokoyamæ*, Millett	...	...	...	...	...	...	...	...	...
170	Glaudulina lævigata, *d'Orb.*	...	...	...	...	...	...	...	...	...
171	— *rotundata*, Reuss	...	...	...	...	...	...	...	...	...
172	Nodosaria ambigua, *Neugeboren*	...	s. VR.	...	...	...	...	...	...	...

Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
		Upper Crag.						Plaisancian.				Astian.		
Zones undetermined.														
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
...	m. VR.	...	...	m. VC.	C.	...	...	...	...	...	×	...	...	128
vl. C.	l. RC.	m. VR.	s. R.	s. RR.	R.	...	s. VR.	...	s. VR.	...	×	...	×	129
...	...	...	...	...	. .	s. RR.	m. RR.	...	...	...	...	...	..	130
...	...	...	...	...	...	...	...	...	...	...	...	...	...	131
s. R.	...	...	...	s. RR.	C.	...	..	...	...	...	...	...	...	132
...	m. R.	...	...	s. VR.	...	s. VR.	s. VR.	...	...	...	...	...	...	133
...	...	...	...	m. RC.	...	...	s. VR.	...	...	...	×	...	×	134
...	...	...	...	rs. R.	...	...	s. VR.	...	...	...	...	...	...	135
...	...	...	...	...	VR.	...	s. VR.	s. VR.	...	...	...	...	...	136
...	...	...	...	l. C.	...	s. VR.	s. VR.	.	...	...	...	...	...	137
...	...	...	...	m. C.	...	vs. VR.	vs. VR.	...	...	...	...	...	...	138
s. VR.	m. RC.	m. VR.	...	s. RC.	...	vs. VR.	vs. VR.	vs. VR.	...	...	...	...	...	139
...	...	...	...	m. RR.	...	...	...	...	...	...	...	...	...	140
...	...	...	...	s. VR,	...	...	...	...	...	...	...	...	...	141
n. VR.	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	142
...	...	...	..	...	...	l. VR.	l. C.	...	...	...	...	...	..	143
...	...	...	...	...	..	...	m. VR.	...	...	...	...	...	...	144
...	...	...	...	...	...	m. VR.	...	...	...	...	...	...	...	145
...	...	...	...	m. C.	...	...	s. RC.	...	vs. VR.	...	×	...	...	146
...	...	...	...	...	...	s. VR	s. RC.	...	...	...	...	...	...	147
...	...	...	...	s. RC.	...	...	...	...	..	...	...	...	...	148
...	...	...	..	...	...	.	...	...	.	.	.	...	×	149
...	...	...	...	m. VR.	...	...	...	...	...	..	...	...	...	150
...	...	...	...	...	...	...	s. VC.	...	...	...	..	...	...	151
...	...	...	...	m. R	...	...	...	...	...	...	...	...	...	152
...	...	...	...	vs. RC	...	...	...	...	..	...	...	...	..	153
...	...	...	...	vs. RR.	...	...	...	...	...	...	...	...	...	154
...	...	...	...	...	...	...	...	...	...	...	×	...	×	155
...	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	156
...	...	...	...	vs. VR.	...	...	...	...	...	...	...	...	...	157
...	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	158
...	...	...	...	m. VR.	...	...	...	...	...	...	...	...	...	159
...	...	...	...	l. VR.	...	...	...	...	...	...	...	...	...	160
...	...	...	...	s. R.	...	...	...	...	...	...	...	...	...	161
...	...	...	...	rs. C.	...	...	...	...	...	...	...	...	...	162
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	163
...	...	...	...	m. VC.	...	s. VR	...	...	...	...	...	...	...	164
...	...	...	...	vs. VR.	...	...	...	...	...	...	...	...	...	165
...	...	...	...	m. R.	..	...	...	...	...	...	...	...	...	166
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	167
...	...	...	...	m. RR.	.	...	...	...	...	...	...	...	...	168
...	...	...	..	m. R.	...	...	...	...	...	...	...	...	...	169
RC.	...	...	...	vs. R.	VR.	...	...	m. VR.	rl. VR.	VR.	...	...	×	170
...	...	...	...	...	× ?	...	...	...	...	...	...	...	...	171
VR.	...	...	..	...		...	...	...	...	VR.	...	...	...	172

	Genera, Species, and Varieties.	English Coralline Crag.								
		Zone **d.**			Zone **e.**		Zion **f.**		Zone **g.**	
		Tattingstone.	Sudbourne Hall.	Broom Hill.	Broom Hill.	Sutton.	Sutton.	Gedgrave.	Aldborough.	Gedgrave.
		1	2	3	4	5	6	7	8	9
173	Nodosaria raphanus (*Linné*)	...	s. R.	s. VR.	...	...	...	...	...	...
174	— raphanistrum (*Linné*)	...	...	...	...	...	...	...	...	...
175	— proxima, *Silvestri*	...	s. VR.	s. VR.	...	...	s. VR.	s. VR.	...	vs. VR
176	— (Dentalina) obliqua (*Linné*)	...	...	s. VR.	...	...	vl. VR.	...	s. VR.	...
177	— — obliquestriata, *Reuss*	...	...	...	...	...	...	...	...	...
178	— — pauperata, *d'Orb.*	...	...	...	...	...	vl. R.	...	...	...
179	— *acuminata*, Hantken	...	...	...	...	...	...	...	...	...
180	— (*Dentalina*) *Adolphina*, d'Orb.	...	...	...	...	...	...	...	...	...
181	— *æqualis*, Reuss	...	...	...	...	..	...	...	...	...
182	— *bacillum*, Defrance	...	...	...	...	...	...	...	...	...
183	— (*Dentalina*) *brevis*, d'Orb.	...	...	...	...	...	...	...	...	...
184	— *calomorpha*, Reuss	...	...	...	...	...	...	...	...	...
185	— (*Dentalina*) *catenulata*, Brady	...	...	...	...	...	...	...	...	...
186	— — *communis*, d'Orb.	...	...	...	...	...	...	...	...	...
187	— — *consobrina*, d'Orb.	...	...	...	...	...	...	...	...	...
188	— — *costulata*, Reuss	...	...	...	...	...	...	...	...	...
189	— *elegantissima*, Hantken	...	...	...	...	...	...	...	...	...
190	— *farcimen*, Reuss, after Soldani	...	...	...	...	...	...	...	...	...
191	— *filiformis*, d'Orb.	...	...	...	...	...	...	...	...	...
192	— (*Dentalina*) *guttifera*, d'Orb.	...	...	...	...	...	...	...	...	...
193	— *hispida*, d'Orb	...	...	...	...	...	...	...	...	...
194	— — var. *sublineata*, Brady	...	...	...	...	...	...	...	...	...
195	— *longiscata*, d'Orb	...	...	...	...	...	...	...	...	...
196	— (*Dentalina*) *mucronata*, Neugeboren	...	...	...	...	...	...	...	...	...
197	— *perversa*, Schwager	...	...	...	...	...	...	...	...	...
198	— *pirula*, d'Orb.	...	...	...	...	...	...	...	...	...
199	— *plebeia* (Reuss)	...	...	...	...	...	...	...	...	...
200	— *radicula* (Linné)	...	...	...	...	...	...	...	...	...
201	— *rudis*, d'Orb	...	...	...	...	...	...	...	...	...
202	— *scabra*, de Amicis	...	...	...	...	...	...	...	...	...
203	— *scalaris* (Batsch)	...	...	...	...	...	...	...	...	...
204	— *simplex*, Silvestri	...	...	...	...	...	...	...	...	...
205	— *soluta*, Reuss	...	...	...	...	...	...	...	...	...
206	— *subtertenuata*, Schwager	...	...	...	...	...	...	...	...	...
207	— (*Dentalina*) *subtilis*, Neugeboren	...	...	...	...	...	...	...	...	...
208	— *verruculosa*, Neugeboren	...	...	...	...	...	...	...	...	...
209	— (*Dentalina*) *vertebralis* (Batsch)	...	...	...	...	...	...	...	...	...
210	*Lingulina alata*, Schrodt	...	...	...	...	...	...	...	...	...
211	— *carinata*, d'Orb	...	...	...	...	...	...	...	...	...
212	— *costata*, d'Orb.	...	...	...	...	...	...	...	...	...
213	*Frondicularia alata*, d'Orb.	...	...	...	...	...	...	...	...	...
214	— *annularis*, d'Orb	...	...	...	...	...	...	...	...	...
215	— *Dumontana*, Reuss	...	...	...	...	...	...	...	...	...
216	— *Guestphalica*, Reuss	...	...	...	...	...	...	...	...	...
217	— *Hosiusi*, Reuss	...	...	...	...	...	...	...	...	...

Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
		Upper Crag.						Plaisancian.				Astian.		
Zones undetermined.														
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
s. R.	...	...	s. R.	..	...	...	...	rs. RC.	...	R.	×	×	...	173
s. R.	...	...	...	...	...	vs. VR.	...	vl. RR.	vl. VR.	RC.	×	×	...	174
...	...	...	...	...	...	vs. VR.	s. VR.	s. VR.	s. VR.	...	...	...	...	175
l. C.	...	...		...	VC.	...	...	...	m. RR	RC.	...	×	×	176
l. R.	...	...	..	...	...	rl. VR.	...	...	...	...	...	...	...	177
l. C.	...	...	...	rs. R.	...	...	...	...	...	VR.	×	...	×	178
...	...	...	.	...	...	...	...	...	...	...	...	...	×	179
...	...	...	..	...	...	...	...	...	s. RR.	...	...	...	...	180
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	181
...	...	...	...	...	...	...	...	...	...	...	...	...	×	182
...	...	...	...	s. VR.	...	...	...	...	...	...	...	...	...	183
...	...	...	...	s. VR.	...	...	...	...	...	...	...	...	...	184
...	...	...	...	...	...	...	...	...	rl. VR	VR.	...	...	×	185
...	...	...	...	...	...	...	...	rs. VR.	...	R.	×	...	×	186
...	...	...	...	...	...	vs. VR.	...	rl. RC.	s. VR.	RR.	...	...	×	187
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	188
...	...	...	...	...	...	...	...	...	...	...	×	...	×	189
...	...	...	...	...	VR.	...	...	...	...	VR.	...	...	...	190
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	191
...	...	...	...	m. RR.	...	...	...	...	...	...	×	...	...	192
...	...	...	...	...	...	...	...	m. VR.	m. RR.	RR	×	...	×	193
...	...	...	...	...	...	...	...	...	s. VR.	...	...	...	...	194
...	...	...	...	...	...	...	...	rl. RR.	rl. C.	VR.	...	...	...	195
...	...	...	...	...	...	...	...	...	...	...	...	...	×	196
...	...	...	...	...	...	...	...	...	...	RR.	...	...	...	197
...	...	...	...	m. RC.	...	...	...	...	...	...	×	...	...	198
...	...	...	...	...	...	...	...	...	...	...	...	...	×	199
...	...	...	...	rs. R.	...	...	...	...	...	RR.	×	×	×	200
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	201
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	202
s. VR.	s. VR	...	...	s. R.	VR.	...	...	rl. VC	rs. R.	VC.	×	...	×	203
...	...	...	...	m. C.	...	...	...	...	...	...	...	...	...	204
...	...	...	...	...	...	vs. VR.	...	vs. VR.	vl. VR	...	...	...	×	205
...	...	...	...	...	...	...	...	...	...	...	...	...	×	206
...	...	...	...	...	...	...	...	...	...	...	...	...	×	207
...	...	...	...	...	...	...	...	...	...	...	...	...	×	208
...	...	...	...	...	...	...	...	l. RR.	...	RR.	...	...	×	209
...	...	...	...	...	...	...	...	...	...	...	...	...	×	210
...	...	...	...	rs. R.	...	...	...	...	...	...	...	...	...	211
...	...	...	...	...	...	...	...	...	...	VR.	×	...	×	212
...	...	...	...	...	...	...	...	...	...	...	...	×	×	213
...	...	...	...	...	...	...	...	...	vl. VR	...	...	...	...	214
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	215
...	...	...	...	...	...	...	...	m. R.	s. VR.	...	...	...	...	216
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	217

	Genera, Species, and Varieties.	English								
		Coralline Crag.								
		Zone d.			Zone e.		Zone f.		Zone g.	
		1 Tattingstone.	2 Sudbourne Hall.	3 Broom Hill.	4 Broom Hill.	5 Sutton.	6 Sutton.	7 Gedgrave.	8 Aldborough.	9 Gedgrave.
218	*Frondicularia inæqualis*, Costa	...	...	...	...	...	...	...	...	...
219	— *interrupta*, Costa	...	...	...	...	...	...	...	...	...
220	— *Nysti*, Reuss	...	...	...	...	...	...	...	...	...
221	Vaginulina lævigata, *Roemer*	...	...	...	...	...	...	...	...	...
222	— linearis (*Montagu*)	...	...	...	...	...	...	...	...	...
223	— obliquestriata, *Jones*	...	...	...	...	...	...	...	...	...
224	— *cymba* (d'Orb.)	...	...	...	...	...	...	...	...	...
225	— *legumen* (Linné)	...	...	...	...	...	...	...	...	...
226	— *margaritifera* (Batsch)	...	...	...	...	...	...	...	...	...
227	Rhabdogonium tricarinatum (*d'Orb.*)	s. VC.	m. C.	m. VC.	...	s. RC.	m. VC.	s. RR.	s. VR.	vs. RC
228	Marginulina glabra, *d'Orb.*	...	...	...	...	...	...	...	...	...
229	— costata (*Batsch*)	...	...	s. VR.	...	...	...	...	...	...
230	— *hirsuta*, d'Orb	...	...	...	...	...	...	...	...	...
231	— *striatissima*, Schrodt	...	...	...	...	...	...	...	...	...
232	Cristellaria cultrata (*Montfort*)	...	...	...	...	...	s. VR.	...	...	...
233	— gibba, *d'Orb.*	...	...	...	...	...	m. RR.	...	...	vs. VR.
234	— reniformis, *d'Orb.*	...	...	s. VR.	...	...	l. VR.	...	...	...
235	— *aculeata*, d'Orb	...	...	...	...	...	...	...	...	...
236	— *acutauricularis* (F. & M.)	...	...	...	...	...	...	...	...	...
237	— *Ariminensis* (d'Orb.)	...	...	...	...	...	...	...	...	...
238	— *calcar* (Linné)	...	...	...	...	...	...	...	...	...
239	— *cassis* (F. & M.)	...	...	...	...	...	...	...	...	...
240	— *confusa*, Seguenza	...	...	...	...	...	...	...	...	...
241	— *convergens*, Bornemann	...	...	...	...	...	...	...	...	...
242	— *costata* (F. & M.)	...	...	...	...	...	...	...	...	...
243	— *crassa*, d'Orb.	...	...	...	...	...	...	...	...	...
244	— *crepidula* (F. & M.)	...	...	...	...	...	...	...	...	...
245	— *dentata*, Karrer	...	...	...	...	...	...	...	...	...
246	— *echinata* (d'Orb.)	...	...	...	...	...	...	...	...	...
247	— *elongata*, Montfort	...	...	...	...	...	...	...	...	...
248	— *inornata*, d'Orb.	...	...	...	...	...	...	...	...	...
249	— *Italica* (Defrance)	...	...	...	...	...	...	...	...	...
250	— *latifrons*, Brady	...	...	...	...	...	...	...	...	...
251	— *mammiligera*, Karrer	...	...	...	...	...	...	...	...	...
252	— *nitida*, d'Orb	...	...	...	...	...	...	...	...	...
253	— *orbicularis* (d'Orb.)	...	...	...	...	...	...	...	...	...
254	— *rotulata* (Lamarck)	...	...	...	...	...	...	...	...	...
255	— *semi-impressa*, Reuss	...	...	...	...	...	...	...	...	...
256	— *tangentialis*, Reuss	...	...	...	...	...	...	...	...	...
257	— *tricarinella*, Reuss	...	...	...	...	...	...	...	...	...
258	— *variabilis*, Reuss	...	...	...	...	...	...	...	...	...
259	— *vortex* (F. & M.)	...	...	...	...	...	...	...	...	...
260	Polymorphina lactea (*W. & J.*)	s. VR.	rl. RC.	rl. RC.	m. VC.	m. RR	l. RC.	m. RC.	s. R.	vs. VC
261	— — &c. (fistulose)	s. VR.	l. R.	vl. RR.	m. R.	...	vl. RR.	...	m. VR.	...
262	— gibba, *d'Orb.*	rl. C.	l. C.	l. VC.	rl. VC.	rl. C.	vl. VC.	m. RR.	s. RC.	...

Pliocene.		Upper Crag.			Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
Zones undetermined.								Plaisancian.				Astian.		
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
...	...	...	...	...	...	...	...	m. VR	...	...	×	...	...	218
...	...	...	...	..	...	...	...	...	...	...	...	...	×	219
...	...	...	...	...	R.	...	...	...	...	...	...	..	...	220
...	l. VR.	...	...	...	...	...	...	...	...	...	...	..	...	221
. VR.	...	...	...	...	...	...	...	...	...	VR.	..	...	×	222
n. VR.	...	...	...	..	...	...	...	...	...	...	...	...	...	223
...	...	...	...	...	..	...	...	...	...	...	..	..	×	224
...	...	...	...	...	...	...	...	...	m. VR.	RC.	×	...	×	225
...	...	...	...	...	...	...	...	...	...	...	...	...	×	226
...	...	...	...	s. C.	...	s. RR.	s. VR.	m. R.	s. VR.	VR.	...	...	×	227
. VR.	...	...	...	...	...	...	...	m. RR.	...	R.	×	...	×	228
n. R.	...	...	...	...	...	...	...	vl. VC.	vl. VC.	VC.	...	...	×	229
...	...	...	...	...	...	...	...	...	...	VR.	...	...	×	230
...	...	...	...	...	...	...	...	...	...	...	...	...	×	231
n. VR.	...	...	s. VR.	...	...	...	...	l. C.	rl. RR.	VC.	...	...	×	232
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	233
...	...	...	...	...	...	...	...	...	...	...	...	...	×	234
...	...	...	...	...	...	...	...	...	...	...	...	...	×	235
...	...	...	...	...	...	...	...	...	...	VR.	×	...	...	236
...	...	...	...	...	...	...	...	...	l. VR.	...	×	...	×	237
...	...	...	...	...	...	vs. VR.	...	rl. C.	l. VC.	VC.	×	×	×	238
...	...	...	...	...	...	...	...	vl. R.	vl. RR.	RC.	×	×	×	239
...	...	...	...	...	...	...	...	...	...	...	×	...	...	240
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	241
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	242
...	...	...	...	...	...	...	...	...	...	VR.	...	...	×	243
...	...	...	...	s. RR.	...	...	...	...	...	...	×	...	×	244
...	...	...	...	...	...	...	...	...	...	...	...	...	×	245
...	...	...	...	...	...	...	...	rl. R.	...	RC.	...	...	×	246
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	247
...	...	...	...	...	...	...	...	...	...	...	...	...	×	248
...	...	...	...	...	...	...	...	rs. VR.	...	RR.	...	...	×	249
...	...	...	...	...	VR.	...	...	rs. VR.	...	...	×	...	...	250
...	...	...	...	...	...	...	...	...	...	...	...	...	×	251
...	...	...	...	...	...	...	...	...	...	R.	...	...	...	252
...	...	...	...	...	...	...	...	...	...	RC.	...	...	×	253
...	...	...	...	s. RR.	...	...	...	m. RC.	rl. RR.	VC.	...	...	×	254
...	...	...	...	...	...	...	...	...	...	...	×	...	...	255
...	...	...	...	...	...	...	...	...	...	...	...	...	×	256
...	...	...	...	...	...	...	...	...	...	...	...	...	×	257
...	...	...	...	...	...	...	...	s. VR.	...	...	×	...	...	258
...	...	...	...	...	...	...	...	...	...	RR.	...	...	×	259
VC.	l. C.	×	s. R.	s. R.	...	rs. VC.	s. RR.	...	...	...	...	...	...	260
VC.	m. RC.	...	...	s. VR.	...	...	...	...	...	...	...	...	...	261
VC.	m. RC.	s. VR.	...	rs. R.	VR.	rs. VR.	rs. VR.	...	...	VR.	×	...	×	262

	Genera, Species, and Varieties.	English Coralline Crag.								
		Zone d.			Zone e.		Zone f.		Zone g.	
		Tattingstone.	Sudbourne Hall.	Broom Hill.	Broom Hill.	Sutton.	Sutton.	Gedgrave.	Aldborough.	Gedgrave.
		1	2	3	4	5	6	7	8	9
263	Polymorphina gutta, *d'Orb.*	...	...	...	...	...	...	...	...	...
264	— sororia, *Reuss*	...	...	m. VR.	...	...	...	m. VR.	rl. VR.	...
265	— compressa, *d'Orb.*	rl. C.	l. R.	vl. C.	l. VC.	...	vl. VC.	m. RR.	m. R.	...
266	— Thouini, *d'Orb.*	...	l. VR.	m. R.	m. VR.	...	...	...	...	...
267	— nodosaria, *Reuss*	...	...	...	...	...	vl. R.	...	...	...
268	— cylindroides, *Roemer*	...	...	...	rl. RR.	...	...	rl. VR.	...	...
269	— concava, *Williamson*	...	...	...	...	...	...	vs. VR.	...	...
270	— communis, *d'Orb.*	rl. C.	m. C.	l. VC.	m. C.	m. RR.	vl. VC.	m. C.	s. VR.	vs. VC
271	— problema, *d'Orb.*	...	rl. VR.	vl. RR.	...	...	vl. VC	m. RR.	...	...
272	— turgida, *Reuss*	...	...	...	...	...	...	...	...	...
273	— complanata, *d'Orb.*	s. R.	l. RC.	m. C.	...	m. C.	vl. C.	l. C.	m. C.	vs. R.
274	— frondiformis, *S. V. Wood*	m. R.	vl. C.	m. VC.	m. C.	...	vl. VC.	m. RC.	m. C.	...
275	— — var. brevis, *Jones*	...	...	...	...	...	...	s. VR.	...	...
276	— — var. lineata, *Jones*	...	...	...	...	...	...	...	...	...
277	— variata, *J., P., & B.*	m. VR.	l. C.	m. RC.	m. R.	m. R.	vl. VC.	rl. VC.	m. VC.	...
278	— tuberculata, *d'Orb*	...	m. R.	rl. VR.	...	...	...	...	...	...
279	— hirsuta, *B., P., & J.*	...	m. RC.	rl. VR.	m. VR.	s. VR.	m. RC.	m. RC.	...	...
280	— rugosa, *d'Orb.*	...	...	...	...	...	...	...	...	...
281	— *acuta*, Römer	...	...	...	...	...	...	...	...	...
282	— *æqualis*, d'Orb.	...	...	...	...	...	...	...	...	...
283	— *amygdaloides*, Reuss	...	...	...	...	...	...	..	...	...
284	— *angusta*, Egger	...	...	...	...	...	...	...	...	...
285	— *decora*, Reuss	...	...	...	...	...	...	...	...	...
286	— *fusiformis*, Roemer	...	...	...	...	...	..	...	...	...
287	— *inæqualis*, d'Orb.	...	...	...	...	...	...	..	...	...
288	— *lanceolata*, Reuss	...	...	...	...	...	...	...	...	...
289	— *minuta*, Reuss	...	...	...	...	...	...	...	...	...
290	— *oblonga*, d'Orb.	...	...	...	...	...	...	..	...	...
291	— *proteiformis*, Reuss	...	...	...	...	...	...	...	...	...
292	— *regina*, B., P., & J.	...	...	...	...	...	...	s. VR.	...	...
293	— *regularis*, Münst.	...	...	...	...	...	..	...	...	...
294	— — var. *parallela*, Millett	...	...	...	...	...	...	...	...	...
295	— *spinosa*, d'Orb.	...	...	..	...	...	...	...	...	...
296	— *subnodosa*, Reuss	...	...	...	...	...	...	...	...	...
297	Dimorphina tuberosa, *d'Orb.*	...	...	...	...	...	l. VR.	...	...	...
298	— compacta, *B., P., & J.*	...	...	...	...	...	...	vs. VR.	...	...
299	Uvigerina angulosa, *Will*	s. RR.	s. RR.	m. R.	..	vs. VR.	vs. VR.	...	s. VR.	...
300	— Canariensis, *d'Orb.*	...	..	...	s. VR.	vs. R.	...	...	...	...
301	— — var. farinosa, *Hantken*	s. VR.	...	...	...	...	...	...	...	...
302	— *aculeata*, d'Orb.	...	...	...	...	...	...	...	...	...
303	— *asperula*, Czjzek	...	...	...	...	...	.	...	...	...
304	— *pygmæa*, d'Orb.	...	...	...	...	...	...	...	...	...
305	*Sagrina columellaris*, Brady	...	...	...	...	...	...	...	...	...
306	— *nodosa*, P. & J.	...	...	...	...	...	...	...	...	...
307	— *striata*, Schwager	...	...	...	...	...	...	...	...	...

LIOCENE.		UPPER CRAG.			BELGIAN PLIOCENE.			ITALIAN PLIOCENE.					SPANISH PLIOCENE.	
Zones undetermined.								Plaisancian.				Astian.		
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
l. VC.	l. VC.	...	...	...	...	...	...	...	...	...	...	...	...	263
...	...	...	...	rs. VR.	C.	...	...	...	...	...	...	...	...	264
l. VC.	l. VC.	...	s. VC.	m. C.	VR.	...	...	...	...	...	...	...	...	265
l. C.	m. RC.	...	...	...	...	...	...	...	...	...	...	...	...	266
...	...	...	...	...	×	...	...	...	...	...	...	...	...	267
...	...	...	...	...	...	...	...	...	...	...	...	...	...	268
...	vs. VR.	...	...	m. VR.	...	m. VR.	...	...	...	...	...	...	...	269
...	...	...	...	s. VR.	...	rl. VR.	vs. VR.	rl. R.	s. VR.	...	...	s. VR.	×	270
. VR.	...	...	...	...	VR.	...	...	...	...	...	...	...	...	271
. VR.	...	...	...	...	...	...	...	...	...	...	...	...	...	272
l. VC.	l. C.	×	...	rs. VR.	...	rl. RC.	vs. VR.	s. VR.	...	...	...	...	...	273
l. VC.	...	...	...	...	...	...	...	...	...	...	...	...	...	274
...	...	...	...	...	...	...	...	...	...	...	...	...	...	275
...	s. VR.	...	...	...	...	...	...	...	...	...	...	...	...	276
l. R.	...	...	...	...	...	...	...	...	...	...	...	...	...	277
s. VR.	...	...	m. VR.	...	...	s. VR.	...	...	...	...	...	...	...	278
...	...	...	...	m. RC.	...	...	...	...	...	...	...	...	...	279
. RR.	...	...	...	...	...	...	...	...	...	...	...	...	...	280
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	281
...	...	...	...	m. VR.	VR.	...	...	...	...	...	...	...	...	282
...	...	...	...	s. VR.	...	...	...	...	...	...	...	...	...	283
...	...	...	...	m. R.	...	...	s. VR.	...	...	...	...	...	...	284
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	285
...	...	...	...	rs. R.	...	...	...	...	...	...	...	...	...	286
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	287
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	288
...	...	...	...	...	R.	...	...	...	...	...	...	...	...	289
...	...	...	...	...	...	m. VR.	...	...	...	...	...	...	...	290
...	...	...	...	...	C.	...	...	...	...	...	...	...	...	291
...	...	...	...	rs. RR.	...	...	...	...	...	...	...	...	...	292
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	293
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	294
...	...	...	...	...	...	...	...	m. R.	...	...	...	...	...	295
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	296
. R.	...	...	...	...	...	vs. VR.	...	...	...	...	...	...	×	297
. R.	...	...	...	rs. R.	...	...	...	...	...	...	...	...	...	298
...	...	...	...	s. RC.	...	vs. VR.	...	...	...	...	...	...	...	299
...	...	m. VR.	...	...	...	rs VR	...	s. VR.	...	...	×	...	...	300
...	...	...	...	...	...	...	...	...	...	...	...	...	...	301
...	...	...	...	...	...	...	...	...	...	...	×	...	...	302
...	...	...	...	...	...	...	...	...	...	...	×	...	×	303
...	...	...	...	...	VR.	rs. VR.	...	m. C.	...	RC.	×	...	×	304
...	...	...	...	...	...	...	...	...	s. VR.	...	...	...	...	305
...	...	...	...	...	...	...	...	...	...	...	...	...	×	306
...	...	...	...	...	...	...	...	...	s. VR.	...	×	...	...	307

	Genera, Species, and Varieties.	Coralline Crag.								English
		Zone d.			Zone e.		Zone f.		Zone g.	
		Tattingstone.	Sudbourne Hall.	Broom Hill.	Broom Hill.	Sutton.	Sutton.	Gedgrave.	Aldborough.	Gedgrave.
		1	2	3	4	5	6	7	8	9
308	*Sagrina virgula*, Brady	...	...	...	...	...	...	...	...	...
309	Globigerina bulloides, *d'Orb.*	s. VC.	s. RC.	m. VC.	vs. RC.	s. RC.	s. C.	s. VC.	vs. R.	vs. RC
310	— Linnæana (*d'Orb.*)	...	vs. VR.	vs. VR.	...	...	...	...	...	...
311	— *æquilateralis*, Brady	..	...	...	...	..	.	...	...	...
312	— *cretacea*, d'Orb	..	..	...	...	...	..	..	...	...
313	— *inflata*, d'Orb.	...	...				...	...	...	...
314	— *regularis*, d'Orb.	...		...	...	.	...	...	...	...
315	— *triloba*, Reuss	...	...	...	...	..	...	...	...	...
316	Orbulina perforata, *Searles Wood*	...	.	...	...	...	...	...	...	...
317	— *porosa*, Terquem		...	...		...	...	...	...	...
318	— *tuberculata*, Costa	..			..	...	...	...	...	...
319	— *universa*, d'Orb		...	...	...	...	...	...	...	...
320	Pullenia sphæroides (*d'Orb.*)	..	rl. VR	...	...	...	m. VR.	...	m. VR.	...
321	— *quinqueloba*, Reuss	...	...	...	...	...	l. VR.	...	...	...
322	*Sphæroidina bulloides*, d'Orb.	...	...	...	...	...	..	...	...	...
323	Spirillina vivipara, *Ehr.*, including	vs. VR.	...	rl. RC.	rs. VR.	...	...	vs. RR.	...	vs. RC
324	— — var. minima, *Schacko*									
325	— — var. complanata, *Jones*									
326	— *limbata*, var. *denticulata*, Brady	...	.	.	...	...	...	...	...	...
327	*Patellina corrugata*, Williamson	...	...	.	...	...	...	...	...	...
328	Discorbina turbo (*d'Orb.*)	m. RC.	s. VR.	...	...	s. VR.	s. VR.	s. VR.	...	...
329	— globularis (*d'Orb.*)	s. VR.			...	...	...	vs. VR.	...	...
330	— rosacea (*d'Orb.*)	m. RC.	s. R.	s. VR.	vs. VR.	s. RC.	s. R.	vs. VR.	...	vs. V
331	— orbicularis (*d'Orb.*)	m. RC.	s. RR.	s. VR.	...	s. RR.	m. C.	vs. VR	vs. VR.	vs. V
332	— Parisiensis (*d'Orb.*)	rl. RC.	m. C.	m. RC.	s. C.	s. VR.	rl. VC.	s. RC.	s. VR.	vs.
333	— lingulata, *B. & H.*	...	...	...	...	...	rs. VR.	..	...	...
334	— *Araucana* (d'Orb.)		...	..		...		..	...	...
335	— *Bertheloti* (d'Orb.)	..	...	...	...	.	...	..	...	...
336	— *obtusa* (d'Orb.)	...	..		...	...	...	.	..	..
337	— *patelliformis*, Brady	.	.			...	..	...	...	...
338	— *pileolus* (d'Orb.)	...	...			...	...	.		...
339	— *rugosa* (d'Orb.)	...	...	...	...	..	...	..	..	...
340	— *Vilardeboana* (d'Orb.)	...	..	..	...	...	...	...	...	...
341	— *Wrighti*, Brady	.	...	...	...	...	...	...	...	...
342	Planorbulina Mediterranensis (d'Orb.)	..	m. RC.	m. C.	m. RR.	s. RC.	s. RC.	s. RC.	s. VR.	vs. R
343	Truncatulina refulgens (*Montfort*)	s. VR.	s. RC.	s. R.	...	...	...	..	s. VR.	...
344	— lobatula (*W. & J.*)	rl. C.	m. VC.	l. VC.	m. VC.	s. RC.	m. C.	s. VC.	m. VC.	s. V
345	— variabilis (*d'Orb.*)	...	m. RR.	...	m. RR.	s. VR.	m. VR.	s. VR.	s. VR.	...
346	— Haidingeri (*d'Orb.*)	...	...	l. R.	vs. VR.	...	m. RR.	...	m. R.	...
347	— Ungeriana (*d'Orb.*)	s. VC.	m. VC.	m. VC.	vs. VC.	s. RC.	m. C.	s. VC.	s. VC.	vs. R
348	— *Akneriana* (d'Orb.)	...	...	...	...	...	...	..	...	...
349	— *Dutemplei* (d'Orb.)	.		..	...	..	...	...	...	...
350	— *humilis*, Brady	...	..	...	...	...	...	.	...	...
351	— *Kalembergensis* (d'Orb.)	...	..		...	...	...	...	...	...
352	— *Wuellerstorfi* (Schwager)	...		...	...	...	...	...	...	...

LIOCENE.

Zones undetermined.		Upper Crag.		Belgian Pliocene.				Italian Pliocene.					Spanish Pliocene.	
								Plaisancian.				Astian.		
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
...	...	...	...	...	...	...	...	...	...	...	...	...	×	308
RR.	m. RR.	...	vs. VR.	vs. RC.	C.	s. RR.	vs. RR.	s. RR.	rs. R.	VR.	×	rs. VR	×	309
...	...	...	...	...	...	...	...	...	...	...	...	...	...	310
...	...	...	...	...	...	...	...	...	vs. VR	...	...	vs. VR.	...	311
...	...	...	...	vs. VR.	...	...	...	...	...	...	...	...	...	312
...	...	...	...	rs. R.	...	...	...	...	...	VR.	...	...	...	313
...	...	...	...	...	...	...	...	...	...	...	×	...	...	314
...	...	...	...	...	VR.	...	...	...	...	VR.	...	...	...	315
...	rs. VR.	...	...	...	...	...	...	...	...	...	...	...	...	316
...	...	...	...	...	...	...	...	...	...	...	×	...	...	317
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	318
...	...	...	...	...	VR.	...	...	m. VC.	rs. VR	VC.	×	×	×	319
RC.	m. RR.	s. VR.	...	...	...	...	...	m. RC.	s. VR.	...	×	...	×	320
...	...	...	...	...	VR.	rs. VR.	...	...	...	...	...	...	...	321
...	...	...	...	...	VR.	...	...	vs. VR.	rs. R	VR	...	rs. VR.	×	322
														323
VR.	...	...	...	s. R.	...	vs. VR.	...	...	...	...	...	...	...	324
														325
...	...	...	...	m. RC.	...	..	...	...	...	...	...	..	...	326
...	...	...	...	s. VC.	...	m. VR.	...	...	...	...	...	...	...	327
...	...	...	...	l. VC.	...	...	...	...	...	...	×	×	...	328
...	...	...	...	s. RR.	.	vs. VR	...	...	...	...	...	...	...	329
...	s. VR.	...	vs. VR.	s. R.	...	s. VR.	s. VR.	..	...	...	...	s. VR.	...	330
...	...	...	..	s. RR.	...	s. VR.	...	rs. R.	m. VR.	...	×	s. VR.	...	331
RR.	s. RC.	s. R.	...	l. VC.	...	vs. VR.	vs. VR.	...	...	...	...	...	...	332
...	...	...	...	m. RC.	...	...	...	...	...	...	...	...	...	333
...	...	...	...	m. RR.	...	...	...	...	...	...	...	...	...	334
...	...	...	...	m. R.	...	...	...	...	...	...	...	rs. VR.	...	335
...	...	...	...	...	...	...	vs. VR.	...	...	.	...	...	...	336
...	...	...	...	s. R.	...	...	...	...	...	...	...	...	...	337
...	...	...	...	...	...	s. VR.	s. VR.	...	...	VR.	...	...	...	338
...	...	...	...	...	...	...	...	rs. R.	s. VR.	VR.	...	...	...	339
...	...	...	...	...	...	...	...	...	s. VR.	...	...	...	×	340
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	341
RR.	...	...	m. VR.	m. VR.	...	vs. VR.	vs. VR.	s. VR.	...	...	...	...	...	342
...	...	m. R.	...	...	...	..	s. VR.	...	...	...	...	...	...	343
VC.	m. C.	s. C.	m. RC.	s. VC.	C.	s. C.	s. RR.	s. RC.	rs. RR.	RC.	...	m. RC.	...	344
...	...	...	...	s. RR.	...	rs. VR.	...	...	...	...	...	rs. VR.	...	345
. C.	s. R.	...	...	vs. VR.	...	...	vs. R.	m. VR.	rs. VR.	RC.	...	m. RR.	×	346
. C.	...	...	...	s. RC.	...	rs. RR.	vs. VR.	rs. VR.	m. R.	RC.	×	vs. VR..	×	347
...	...	...	...	m. RR.	...	s. RR.	...	...	...	VR.	...	...	...	348
...	...	...	...	...	...	...	...	.	...	VR.	...	...	×	349
...	...	...	...	...	...	s. VR.	...	...	..	...	...	...	...	350
...	...	...	...	...	VR.	...		...	...	...	...	.	...	351
...	...	...	...	...	...	rs. VR.	.	..	..	...	...	.	...	352

	Genera, Species, and Varieties.	English Coralline Crag.								
		Zone d.			Zone e.		Zone f.		Zone g.	
		Tattingstone.	Sudbourne Hall.	Broom Hill.	Broom Hill.	Sutton.	Sutton.	Gedgrave.	Aldborough.	Gedgrave.
		1	2	3	4	5	6	7	8	9
353	*Truncatulina præcincta* (Karrer)	...	...	...	...	...	...	...	...	...
354	— *pygmæa*, Hantken	...	...	...	..	...	..	...	...	...
355	— *reticulata* (Czjzek)	...	...	...	..	...	...	...	...	...
356	— *tenuimargo*, Brady	...	...	...	...	...	...	...	...	...
357	Anomalina grosserugosa (*Gümbel*)	...	m. VR.	...	...	...	...	...	...	...
358	— *ammonoides* (Reuss)	...	...	...	...	...	...	...	..	...
359	— *Ariminensis* (d'Orb.)	...	...	...	...	...	...	...	...	...
360	Pulvinulina repanda (*F. & M.*)	vs. VR.	m. RC.	rs. R.	m. C.	...	m. VR.	m. C.	s. VR.	vs. VF
361	— — var. *concamerata* (Montagu)	...	...	...	...	...	...	...	...	...
362	— punctulata (*d'Orb.*)	...	l. RR.	l. RR.	...	...	s. RR.	m. C.	rl. RC.	vs. VF
363	— auricula (*F. & M.*)	s. VR.	m. VR.	...	...	...	s. VR.	s. VR.	...	...
364	— Karsteni (*Reuss*)	s. VR.	...	...	...	...	...	...	...	...
365	— elegans (*d'Orb.*)	vs. VR.	m. VR.	...	...	s. VR.	...	...	vs. VR.	...
366	— Berthelotiana (*d'Orb.*)	...	...	...	rs. VR.	...	...	...	...	...
367	— *Canariensis* (d'Orb.)	...	...	...	...	...	...	...	...	...
368	— *crassa* (d'Orb.)	...	..	..	...	...	...	...	...	...
369	— *Hauerii* (d'Orb.)	...	.	...	...	...	...	...	...	...
370	— *nitidula*, Chaster	...	..	...	..	...	...	...	...	...
371	— *oblonga* (Williamson)	...	...	...	...	...	...	...	..	..
372	— *Partschiana* (d'Orb.)	...	...	...	...	...	...	...	..	...
373	— *Patagonica* (d'Orb)	...	...	...	...	...	...	...	...	...
374	— *procera*, Brady	...	...	...	...	..	...	...	...	...
375	— *Schreibersii* (d'Orb.)		...	...	...	...	..	...	...	...
376	— *umbonata*, Reuss	...	...	...	...	...	...	...	...	...
377	Rotalia Beccarii (*Linné*)	rl. VC.	rl. RC.	l. RC.	m. VC.	m. R.	rs. C.	rl. VC.	rl. RR.	vs. R
378	— orbicularis, *d'Orb.*	...	...	s. VR.	...	s. VR.	s. VR.	...	...	...
379	— calcar (*d'Orb.*)	vs. VR.	...	m. VC.	s. C.	s. RC.	rl. RR.	s. VC.	m. VC.	vs. R.
380	— *dentata*, P. & J.	...	...	...	...	...	...	...	...	...
381	— (*Discorbina*, Wr.) *nitida* (Will.)	...	...	...	...	...	...	...	...	...
382	— *punctato-granulosa*, Seguenza	...	...	...	...	...	...	...	...	...
383	— *Soldanii* (d'Orb.) ..	...	...	...	...	...	...	...	...	...
384	Gypsina vesicularis (*P. & J.*)	...	...	...	...	...	...	...	...	...
385	Nonionina scapha (*F. & M.*), including	m. C.	m. VC.	m. VC.	m. RC.	m. C.	l. VC.	m. VC.	m. RC.	m. C
386	— — var. *labradorica*, Dawson									
387	— Boueana (*d'Orb.*)	..	...	...	...	..	...	..	...	...
388	— — var. Janiformis, *Jones*	...	...	...	...	...	l. VR.	..	..	...
389	— umbilicatula (*Montagu*)	...	...	...	vs. VR.	vs. VR.	s. R.	...	...	...
390	— depressula (*W. & J.*)	s. VR.	s. RC.	...	rs. VR.	...	...	vs. VR.	...	vs. V.
391	— *affinis*, Reuss	...	...	...	...	...	...	...	...	...
392	— *communis*, d'Orb.	..	...	...	...	...	...	...	..	...
393	— *pompilioides* (F. & M.)		...	...	...	...	...	...	...	...
394	— *stelligera*, d'Orb.	...	...	...	...	...	...	...	...	...
395	— *turgida* (Williamson)	...	...	...	...	...	...	...	...	...
396	Polystomella faba (*F. & M.*)	...	...	...	...	...	...	...	...	...
397	— striato-punctata (*F. & M.*)	s. VR.	s. RC.	...	s. RC.	...	s. RR.	s. C.	s. VR.	vs. R

PLIOCENE.					BELGIAN PLIOCENE.			ITALIAN PLIOCENE.					SPANISH PLIOCENE.	
		UPPER CRAG.						Plaisancian.				Astian.		
Zones undetermined.														
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
...	...	...	...	...	...	...	...	...	...	C.	...	...	×	353
...	...	...	...	rs. R.	...	...	...	...	...	...	...	...	×	354
...	...	...	...	...	...	...	...	...	...	...	...	...	×	355
...	...	...	...	s. RR.	VR.	...	...	...	...	...	...	...	...	356
...	...	...	...	...	...	s. VR.	...	m. RR.	vs. VR.	VR.	...	...	...	357
...	...	...	...	...	...	...	vs. VR.	...	...	RR.	...	...	×	358
...	...	...	...	...	...	...	...	...	rl. R.	...	...	...	×	359
l. RC.	m. R.	...	...	...	...	vs. VR.	...	...	...	...	...	...	...	360
...	...	...	...	...	...	...	...	...	m. VR.	...	×	×	...	361
vl. C.	...	...	...	...	...	...	...	...	...	...	...	...	...	362
m. R.	...	...	...	s. R.	VC.	...	vs. VR.	rs. RR.	rs. VR.	...	...	...	×	363
...	...	...	s. R.	rs. RC.	...	rs. VC.	vs. RC.	...	...	VR.	...	...	...	364
. VR.	...	...	...	s. R.	...	...	s. VR.	l. RC.	vs. VR	VC.	...	rs. VR.	...	365
...	...	...	...	...	...	...	...	m. RC.	rl. VC.	R.	...	...	...	366
...	...	...	...	s. VR.	...	...	...	s. VR.	...	...	...	...	...	367
...	...	...	...	rs. VR	...	...	...	...	...	...	...	...	...	368
...	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	369
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	370
...	...	...	...	s. VR.	...	...	...	...	...	VR.	×	...	...	371
...	...	...	...	...	...	...	...	...	...	...	...	...	×	372
...	...	...	...	...	...	...	...	...	...	...	×	...	...	373
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	374
...	...	...	...	...	...	...	...	...	...	VC.	...	...	×	375
...	...	...	...	...	...	...	...	...	s. VR.	...	×	...	×	376
. RC.	m. C.	m. C.	m. C.	l. C.	...	m. C.	rl. C.	rs. VR.	m. C.	RC.	...	m. RC	...	377
s. R.	...	...	...	rs. R.	VR.	...	...	...	vs. VR.	...	...	...	...	378
. RR.	m. C.	s. R.	...	s. C.	...	vs. VR.	vs. VR	...	...	...	...	...	...	379
...	...	...	...	s. VR.	...	...	...	...	...	...	...	...	...	380
...	...	...	...	m. RC.	...	...	...	...	...	...	...	...	...	381
...	...	...	...	vl. C.	...	...	...	...	...	...	...	...	...	382
...	...	...	...	...	...	...	...	rs. VR.	...	...	×	...	×	383
...	m. VR.	...	...	...	...	...	...	...	...	...	...	...	...	384
VC.	l. C.	s. R.	...	s. RC.	...	s. VR.	rs. RC.	s. RC.	rs. VR.	VR.	...	...	...	385
...	...	...	...	...	VC.	vs. RR.	s. VR.	...	...	...	×	...	...	386
...	l. C.	...	...	...	...	vs. VR.	...	...	...	...	...	...	...	387
. RR.	...	...	...	s. R.	...	...	...	rs. C.	vs. VR.	VR.	...	...	×	388
s. R.	...	...	...	m. R.	...	s. VR.	...	...	...	...	...	...	...	389
...	...	...	...	...	C.	...	...	...	...	...	...	...	...	390
...	...	...	...	s. R.	...	...	...	...	...	...	...	...	...	391
...	...	...	...	...	...	...	...	...	...	...	×	...	...	392
...	...	...	...	s. R.	...	...	...	...	...	VR.	×	...	×	393
...	...	...	...	...	...	...	...	...	...	...	...	...	...	394
. RC.	l. R.	l. VR.	...	...	VR.	...	...	...	s. VR.	...	...	...	...	395
s. R.	m. C.	s. C.	m. VC.	m. RC.	...	s. VC.	rs. VC.	...	...	...	...	...	...	396
														397

	Genera, Species, and Varieties.	English Coralline Crag.								
		Zone **d.**			Zone **e.**		Zone **f.**		Zone **g.**	
		Tattingstone.	Sudbourne Hall.	Broom Hill.	Broom Hill.	Sutton.	Sutton.	Gedgrave.	Aldborough.	Gedgrave.
		1	2	3	4	5	6	7	8	9
398	Polystomella crispa (*Linné*)	l. VR.	rs. C.	l. VC.	rl. VC.	m RC.	rl. C.	s. VC.	s. RR.	vs. RC
399	— macella (*F. and M.*)	s. VC.	s. VC.	l. C.	rs. VC.	m. R.	rl. R.	s. VC.	s. VR.	vs. RC
400	— *Josephina*, d'Orb.	...	...	...		...	...	...	...	...
401	— *subnodosa* (Münster)	...	...	...		...	...	...	...	...
402	*Faujasina carinata*, d'Orb.	...	...	...	...	...	...	...	...	...
403	— *Orbignyi*, Terquem	...	...	...	...	...	...	...	...	...
404	Amphistegina vulgaris, *d'Orb.*	...	...	...	...	...	...	...	...	...
405	Operculina complanata, *Defrance*	...	...	...	...	...	...	...	...	...
406	— ammonoides (*Gronovius*)	...	...	vs. VR.	...	...	...	vs. VR.	...	...
407	— — var. curvicamerata, *Jones*	...	...	...	...	...	...	...	...	...
408	*Heterostegina depressa*, d'Orb.	...	...	...	...		...	...	...	...
409	Nummulites Boucheri, *de la Harpe*	...	...	...	...	...		...	...	...
410	Orbitoides aspera, *Gümbel*	...	...	...	...	...	...	...	...	...

In the foregoing Table those species which occur in the Crag Beds of East Anglia, as described in the Monograph, are printed in ordinary type. The species which have not been found in the Crag, but which occur in the St. Erth Beds, or in other Pliocene Formations of Europe, are printed in *italics*. It will be noticed that additional occurrences are recorded in the Table for some of the Crag Species. These have been met with since the earlier pages were printed off.

The information contained in the Table is based upon our own work, supplemented in some instances, as mentioned below, by published records.

Coralline Crag.—The records for the distribution of Foraminifera in the zones of the Coralline Crag are the result of our examination of material specially collected by ourselves at various times from the several zones now open, and at the sections described in the earlier part of this Monograph. The only exception is the Tattingstone material. This was given to us by the late Sir Joseph Prestwich; and we had further the kind assistance of Mr. Frederic Chapman with respect to that particular locality.

The Columns for the "Zones undetermined" are summarised from the Table given in Appendix II of the First Part of this Monograph, with the addition of a few species described in the later parts of the Monograph, and of which it is now impossible to ascertain the exact zone whence they were derived.

Red Crag and Beds above the Red Crag.—With the few unimportant additions already recorded at p. 78, the original list of Foraminifera from the Red Crag and the Beds above it remains the same as in the Table already referred to.

LIOCENE.														
		Upper Crag.			Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
Zones undetermined.								Plaisancian.				Astian.		
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
. RC.	m. RC.	m. R.	s. R.	m. C.	...	...	m. VC.	rl. RR.	rl. VC.	C.	×	m. VC.	×	398
. RR.	m. C.	...	...	l. VC.	...	vs. VR.	s. VR	s. VR.	...	...	...	rs. VR.	...	399
...	...	...	...	...	...	...	...	...	...	...	...	...	×	400
...	...	...	...	rs. RC.	...	...	...	...	...	...	...	...	...	401
...	...	...	...	l. VC.	...	...	..	...	...	...	...	...	...	402
...	...	...	...	l. RR.	...	...	...	...	...	...	...	...	...	403
×	× ?	...	...	s. VR.	...	vs. VR.	...	l. VC.	s. VR.	VR.	×	×	...	404
...	× ?	...	...	...	...	...	...	...	...	VR.	...	...	...	405
...	...	...	...	...	...	...	...	...	...	...	...	...	...	406
VR.	...	...	...	...	...	...	...	...	...	...	...	...	...	407
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	408
...	× ?	...	...	...	...	s. VR.	...	...	...	...	...	...	...	409
...	× ?	...	...	...	...	...	...	...	...	...	...	...	...	410

St. Erth Beds.—The column referring to the St. Erth Beds is prepared from the lists published by Mr. Fortescue W. Millett in his papers (1885, 1894, &c.) already quoted (*antea*, p. 80), supplemented by notes of additional species kindly supplied to us by Mr. Millett, who has further added to our obligations to him by very kindly furnishing the records of "size" and "frequency" of the species met with in this rich deposit. Mr. Millett wishes us to state that, although *Lagena Lyellii* remains in the St. Erth list in this Table, he is of opinion that it should probably be omitted as not being a good "species."

Belgian Pliocene.—The records for the Scaldisian and Casterlian Beds are the result of our examination of material selected by one of us in company with M. E. Vanden Broeck during the summer of 1886, at which time the excavations for the dry docks at Kattendyk, Antwerp, were in progress. The Scaldisian fossiliferous beds were divided by M. Vanden Broeck into two principal bands, a "banc coquillier inférieur" and a "banc coquillier supérieur." The difference between the Foraminifera obtained from these bands is inconsiderable, and we have therefore given but one column for the two bands.

The Diestian (of Edeghem) list is prepared from that published by M. Mourlon ('Géol. de la Belgique (1880), vol. ii, pp. 235 *et seq.*). The list is an old one founded on that by H. Nyst in Dewalque's 'Prodrome d'une description géol. de la Belgique' (1868), which again appears to be based upon Reuss's work on the Crag of Antwerp. We have carefully examined the published figures and descriptions, and have referred the species recorded to their synonymic position wherever practicable. A few still included in the list under the names given by Reuss are doubtful species.

Italian Pliocene.—The Foraminifera of the Plaisancian Beds of Bordighera and Albenga, here recorded for the first time, were obtained from material kindly supplied to us by Mr. Edward

E. Berry, of Bordighera. For the other Italian records we have laid under contribution the list published by Prof. F. Sacco ('Il Bacino Terziario e Quaternario del Piemonte,' 1889, pp. 24—33) for the Plaisancian Beds of Piedmont; but, as that list records "occurrences" merely, we are unable to give any account of the "size" and "frequency" of the specimens. The Plaisancian Beds of Trinité-Victor are ably dealt with by Dr. de Amicis ("I foraminiferi del Pliocene Inf. di Trinité-Victor," 'Boll. Soc. Geol. Ital.,' vol. xii, 1893, fasc. 3, pp. 293 *et seq.*), and the list given is taken from that work. In his Table Dr. de Amicis records always the number of specimens; and in the text, for some of the species, if not for all, the size of the specimens is recorded in millimètres. This rigidly exact method of noting size has unfortunately not been generally adopted, and we have excused ourselves the labour of picking out the information from the text for the purposes of this Table, because general symbols are used in the rest of the columns.

The Astian list is based principally upon an examination of some material in our own collections from Monte Pellegrino, supplemented by the records of a few species given by Prof. Sacco in the work already referred to. Prof. Sacco's list, however, is meagre, fourteen species only being therein recorded.

In some few cases our Table does not contain a note of the occurrence of some Italian Pliocene species, which are referred to in the notes on "Occurrences" given in the text of the Monograph. Such omissions from the Table are due to the fact that the exact horizon in those cases is not known to us.

Spanish Pliocene.—The list of species met with in the Pliocene Beds of Garrucha, South Spain, is prepared from the list appended to the paper on the fauna of that locality by Dr. Franz Schrodt ('Zeitschr. d. D. Geol. Ges.,' vol. xlii, 1890, pp. 386 *et seq.*).

INDEX.

Synonyms are printed in italics.

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A MONOGRAPH

OF THE

BRITISH CARBONIFEROUS LAMELLIBRANCHIATA.

BY

WHEELTON HIND, M.D., B.S.Lond., F.R.C.S., F.G.S.

PART II.

MYTILIDÆ, ARCIDÆ, NUCULIDÆ.

Pages 81—208; Plates III—XV.

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Genus Posidoniella, *de Koninck*, 1885.

Inoceramus, *J. de C. Sowerby*, 1829. Mineral Conchology, vol. vi, p. 162, pl. dlxxxiv, fig. 2.
— *Goldfuss*, 1836. Petref. Germ., vol. ii, p. 107, pl. cviii, fig. 5 *a*.
— vel Posidonia, *Phillips*, 1836. Geol. Yorks., vol. ii, p. 211, pl. vi, figs. 3 and 4.
Modiola, *Phillips*, 1836. Ibid., p. 210, pl. v, fig. 24.
Perna? *Phillips*, 1836. Ibid., p. 247, pl. vi, fig. 14.
Catillus, *Capt. Brown*, 1841. Trans. Manchester Geol. Soc., vol. i, p. 225.
Posidonia, *de Koninck*, 1843. Ann. Musée R. Hist. Nat. Belge, vol. xi, p. 141, pl. vi, figs. 1 *a* and 1 *b*.
Inoceramus, *Portlock*, 1843. Report Geol. Londonderry, p. 423, pl. xxxiii, figs. 1—3.
Posidonomya, *Morris*, 1843. Cat. Brit. Foss., p. 118.
Modiola, *Morris*, 1843. Ibid., p. 91.
Inoceramus, *McCoy*, 1844. Synop. Carbonif. Fossils Ireland, p. 77.
Posidonomya, *Bronn*, 1848. Nomencl. Palæont., p. 1034.
Posidonia, *Brown*, 1849. Illustr. Fossil Conchology Great Britain, p. 168, pl. lxvii, fig. 15.
Avicula, *Brown*, 1849. Ibid., p. 160, pl. lxvi*, figs. 9 and 10.
Catillus, *Brown*, 1849. Ibid., p. 166, pl. lxvii, fig. 5.
Posidonomya, *d'Orbigny*, 1850. Prodrome de paléontologie stratigraphique, p. 138.
? Mytilus, *de Ryckholt*, 1847. Mélanges paléontologiques, part i, p. 132.
Posidonomya, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 181.
Ambonychia, *S. P. Woodward*, 1854. Manual Mollusca, Part II, p. 261.
— *M'Coy*, 1855. British Palæozoic Fossils, p. 482.
Posidonomya, *Eichwald*, 1860. Lethæa Rossica, pt. i, p. 943.
Ambonychia, *Owen*, 1860. Palæontology, p. 57, fig. 3.
Inoceramus, *Griffith*, 1862. Journ. Geol. Soc. Dublin, vol. iv, p. 93.
Ambonychia, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 45.
Posidonomya, *Armstrong and Young*, 1876. Catal. Western-Scottish Fossils, p. 52.
— *Meek*, 1875. Palæontology of Ohio, vol. ii, p. 333.
— *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 293.
— *Etheridge*, 1885. British Fossils, vol. i, Palæozoic, p. 275.
Posidoniella, *de Koninck*, 1885. Ann. Musée d'Hist. Nat. Belgique, vol. xi, p. 184.
? Myalina, pars, *de Koninck*, 1885. Ibid., p. 169.

Generic Description.—Shell mytiliform, obliquely subquadrate, the posterior portion expanded in the form of a wing. Very inequilateral, the anterior portion of the shell being obsolete; the umbones are pointed, directed forwards, and

frequently terminal. The shell is expanded from side to side in front, and acutely bent at the anterior border to form a somewhat concave and depressed anterior surface, marked off on either side by a decided curved line, which arises above at the apex of the umbo. The hinge-line is straight, narrow, edentulous, and shorter than the greatest transverse diameter of the shell.

The anterior adductor muscle-scar is small, single, pit-like, and terminal; the posterior adductor scar is oval, large, situated somewhat more in the upper than the lower part of the shell, and not marginal. The mantle-line is entire and linear, and situated at some distance from the edge of the valve.

Surface marked with coarse striæ or large concentric folds. Shell thin. No evidence of a periostracum.

Observations.—Considered originally to belong to Inoceramus, the type of this genus has been referred to Posidonomya, Bronn, by most observers, until de Koninck pointed out the very distinct characters which separate it from *Posidonomya Becheri*, the typical species of that genus.

De Koninck, however, still retained the genus in the family Aviculidæ, having been unable to obtain a view of the interior and its muscle-scars. He recognised only one species of the genus, but Captain Brown had described six Carboniferous forms under the name "Catillus" as early as 1841 (*op. supra cit.*). Four of these are stated to occur at High Green Wood, Vale of Todmorden. Phillips describes one form as *Modiola elongata*, and figures another as Perna? in his 'Geology of Yorkshire.' I believe that Brown's *Avicula tenera* and *A. squamula* also belonged to the same genus. Unfortunately it is impossible to trace the types of many of these species, and they can be no longer retained.

All the other forms, while possessing the characteristic general shape, differ from the type *Posidoniella vetusta* in the surface-markings. It is from specimens of these new species that I have been able to elucidate the arrangement and position of muscle-scars and mantle-line. I have removed the genus from the Aviculidæ and placed it under the Mytilidæ on the following grounds.

The general shape is Mytiloid rather than Aviculoid. The shell appears to be equivalve; the posterior adductor scar is situated nearer the posterior margin than in Avicula. There is an absence of ears, and the hinge-line is not elongated, but shorter than the other diameters of the shell; the pallial line is linear and not dotted, and there is no evidence of cartilage pits or grooves at the hinge. In addition, the species are, as a rule, gibbose and obliquely inflated; the umbones terminal; the hinges non-striated and edentulous.

This genus appears to have been identified with Inoceramus on account of the close resemblance between the markings of the surface of *P. vetusta*, the type, and of many Mesozoic Inocerami. A knowledge of the hinge-characters serves to separate the two genera. Woodward separated the genus from Inoceramus

and referred it to Ambonychia of Hall; but the latter genus is stated to have two cardinal teeth and many lamellar, oblique, diverging, posterior, lateral teeth.

De Koninck, in giving the diagnosis of the genus for the first time, lays stress on the presence of a "fossette" on the anterior surface below the umbones. This I have termed the "anterior surface" in my description.

Except in the possession of concentric folds externally, Posidoniella of de Koninck has no real affinity with Posidonomya of Bronn. The latter genus, the type of which is *P. Becheri*, is characterised by the flatness of its valves, subcentral, inconspicuous umbones, and subcircular form. When Phillips (*op. sup. cit.*) described the type of this genus he preserved Sowerby's generic appellation, but remarked, "It probably does not belong to Inoceramus, but to Posidonia, Bronn." It was de Koninck, however, who first substituted that name for the genus. Portlock, M'Coy, and Griffith, however, retained the name Inoceramus, M'Coy describing four species from the Carboniferous Limestone of Ireland. Brown retained the name Posidonia, first given by Bronn, who, finding the name in use for a genus of plants, thought it inadmissible for a genus of shells, and substituted Posidonomya.

I think it very probable that the original of Salter's *Anthracoptera Browniana*, which he stated to be synonymous with *Avicula tenera* of Brown (why the specific name was changed is unaccountable), must have belonged to Posidoniella ('Geology of the Country round Wigan,' p. 37, fig. 3). This figure, evidently complete and typical anteriorly, has an outline dotted in to make the shell conform to the type of the then new genus Anthracoptera.

Whether or no all the members of this genus were byssiferous cannot now be stated, but probably they were. One species, which occurs in the Lower Coal-measures of Lancashire, is known to be so. In such a case the byssal orifice is high up and close under the umbones, at the deepest part of the concavity on the anterior surface.

It seems to me quite probable that certain of the shells described as Myalina by de Koninck may belong more properly to this genus, but this question must be left until much more material is available for examination. Externally, certain shells of both genera resemble each other closely, and it is necessary to be aware of the hinge-plate and interior to determine certain of the species.

The genus does not seem to have been limited to the limestone of Carboniferous age; but some species, smaller, it is true, than those of the limestones, occur in the marine shales of the Coal-measures, and in those which occur below the Millstone-grit of Yorkshire and Lancashire.

A shell belonging to this genus is described by Meek in the 'Report Geol. Ohio,' vol. ii, "Palæontology," pl. xix, figs. 7 *a*, *b*. The description agrees very

thoroughly, but whether or no the species is identical with those from Lancashire and Yorkshire I am unable to say. The shape of *Posidonomya fracta*, Meek, reminds one of *Posidoniella lævis*, but in the figure the shell has more marked undulations and intermediate striæ; in this character it agrees more with *P. vetusta*.

Posidoniella vetusta, *Sowerby*, sp., 1829. Plate V, figs. 9, 10, 10 *a*, 11, 11 *b*; Plate VII, figs. 2, 2 *a*.

Inoceramus vetustus, *J. and J. de C. Sowerby*, 1829. Min. Conch., vol. vi, p. 162, pl. dlxxxiv, fig. 2.
— — *S. Woodward*, 1830. Synop. Table Brit. Organ. Remains, p. 17.
— — *J. Phillips*, 1836. Illustr. Geol. Yorkshire, vol. ii, p. 211, pl. vi, figs. 3, 4.
— — *A. Goldfuss*, 1836. Petref. Germ., vol. ii, p. 107, pl. cviii, fig. 5 *a*.
Posidonomya vetusta, *de Koninck*, 1843. Anim. Foss. Carbonif. Belgique, p. 141, pl. vi, figs. 1 *a*, 1 *b*.
— — *Morris*, 1843. Catalogue British Fossils, p. 118.
Inoceramus vetustus, *M'Coy*, 1844. Synops. Carbonif. Fossils Ireland, p. 77.
Posidonomya vetusta, *Bronn*, 1848. Nomenclat. Palæont., p. 1034.
Posidonia vetusta, *Brown*, 1849. Illustr. Fossil Conch. Gt. Britain and Ireland, p. 168, pl. lxvii, fig. 15.
Posidonomya vetusta, *d'Orbigny*, 1850. Prodr. Paléont. Stratigr., p. 138.
— — *Morris*, 1854. Catal. Brit. Foss., edit. 2, p. 181.
Ambonychia vetusta, *S. P. Woodward*, 1854. Manual of the Mollusca, p. 261.
— — *M'Coy*, 1855. Syst. Descript. Brit. Palæoz. Fossils, p. 482.
Posidonomya vetusta, *Eichwald*, 1860. Lethæa Rossica, vol. i, p. 943.
Inoceramus vetustus, *Griffith*, 1862. Journ. Geol. Soc. Dublin, vol. ix, p. 93.
Ambonychia vetusta, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 45.
Posidonomya vetusta, *Armstrong, Young, and Robertson*, 1876. Catal. Western-Scottish Fossils, p. 52.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 293.
— — *Etheridge*, 1885. British Foss., vol. i, Palæoz., p. 276.
Posidoniella vetusta, *de Koninck*, 1885. Faune du Calcaire Carbonifère, pt. 5; Ann. Musée d'Hist. Nat. Belgique, vol. xi, p. 184, pl. xxxi, figs. 1, 2, 8—11, 17, 18, 23—26.

Specific Description.—Shell for the most part regularly gibbose, quadrately ovate, produced downwards somewhat obliquely, alate, and compressed posteriorly

and above; equivalve. The anterior part of the shell is expanded and truncate, so that there is no anterior lobe; but there is a small lobule formed by the eversion of the anterior superior angle of the valve. The surface is bounded on its outer side by an obtusely angular edge, which, arising from the anterior side of the umbo above, forms the anterior border of each valve. This surface is ovate-cordate, flattened below, but depressed and concave above, where it excavates the anterior surface of the umbo. The inferior border is almost circular, passing with a regular curve into the posterior border. This is obliquely truncate, and almost straight above, where it may be at times slightly emarginate. The hinge-line is straight, meeting the posterior border at a slightly obtuse angle, short, projecting anteriorly to a slight extent, in front and below the umbones, giving rise to the false appearance of a little ear in large examples. The umbones are pointed, contiguous, raised above the hinge-line, and twisted inwards and forwards. Passing downwards from the umbones is a convexity rapidly increasing in its extent from side to side. Above, and especially towards the posterior superior angle, the shell is much compressed and flattened into the hinge-line and posterior border.

Hinge linear, not thickened; hinge-plate edentulous (on the authority of de Koninck). Muscle-scars not known; the posterior must be badly defined, because, although casts are frequent, nothing is to be seen of it. Shell very thin, surface covered with concentric, undulating ribs, arising as lines, crowded at the anterior superior extremity; the furrows commence immediately at the line which forms the anterior border. The undulations increase in size from the umbo downwards, the ribs becoming wider and further apart. Microscopically the undulations are covered with very fine concentric lines. Near the posterior border the shell is almost smooth, the undulations gradually becoming obsolete.

Dimensions.—Fig. 2, Pl. VII, measures—

Antero-posteriorly	47 mm.
Dorso-ventrally	70 mm.
Elevation of valve	15 mm.

Localities.—England: the Carboniferous Limestone of Castleton, where it is common in the quarry at the lower entrance to Cavedale; Park Hill, Derbyshire; Bolland (Phillips), Flasby, and Todmorden, Yorkshire; Kendal, Westmoreland. Ireland: Cultreagh, Clare, Kildare (Phillips). Scotland: Upper Limestone, Castlecary, and Burn Anne, opposite Cessnock Castle.

Observations.—This species was one of the few Carboniferous Lamellibranchs described and figured by Sowerby. He referred it to Inoceramus, to which genus its surface-markings and shape give it a marked resemblance. Phillips retained the generic name Inoceramus, but thought that it should be more correctly referred to Posidonia (Bronn), and in this he was followed by de Koninck.

M'Coy placed this species with Inoceramus, but afterwards referred it to Ambonychia, Hall, on account of the discovery of a specimen with a hinge, which he describes thus:—"Hinge-line entirely confined to the posterior side of the beak, straight, oblique, with a slender lateral tooth running below its margin for about two-thirds of its length;" and sums up, "It has no relation to the genus Inoceramus on the one hand, nor to Posidonia on the other; but is really a one-eared Avicula of the *remarkably thick-shelled* genus Ambonychia of Hall." Mr. H. Woods, the Curator of the Woodwardian Museum, informs me that the museum possesses no specimen showing the hinge, and therefore this observation cannot be confirmed. De Koninck points out that M'Coy was in error, as the genus Ambonychia, Hall, "se compose de coquilles munie d'une grande oriellette postérieure, et d'une bord cardinal droit est assez épaise pour porter un certain nombre de dents, qui lui sont parallèles et qui font complètement défaut ici. J'ajouterai que la surface de la plupart des Ambonychia est garnie de stries ou de côtes rayonnantes."

The shell of the species under description is exceedingly thin, and not likely to belong to a genus stated by M'Coy to be remarkably thick-shelled. Phillips thought the shell was inequivalve, and describes the upper valve "flattish, lower valve very convex;" but there appears to be no difference in the gibbosity of the valves. De Koninck states that the hinge is edentulous, and this fact will at once separate the shell from Ambonychia, Hall. I have been able to see the specimens on which de Koninck founded his genus Posidoniella, and they are undoubtedly similar to those now figured, but I cannot affirm any statement as to the nature of the anterior part of the hinge. This species can easily be distinguished from all others of the genus by its concentric folds and the convexity of its valves.

This species has a fairly wide horizontal distribution. Eichwald records it as occurring in the Carboniferous Limestone of Russia. Vertically its range is limited, and I have never found the shell except in pure limestone.

POSIDONIELLA PYRIFORMIS, sp. nov., *Hind.* Plate V, figs. 20, 21, 22; Plate VI, figs. 1, 2, 3, 3 *a*, 4.

PERNA?, *Phillips*, 1836. Geology of Yorkshire, pl. vi, fig. 14 (no description).
Compare MYTILUS AMPLIATUS, *de Ryckholt*, 1847. Mélanges Paléontologiques, pt. 1, p 141, pl. viii, figs. 9, 10.
— — WESEMÆLIANUS, *de Ryckholt*, 1847. Ibid., p. 140, pl. viii, figs. 11, 12.
— — OMALIUSIANUS, *de Ryckholt*, 1847. Ibid., p. 144, pl. viii, figs. 22, 23.

Specific Characters.—Shell pyriform, with a slight process on one side of the acute end, or obliquely subquadrate; only moderately convex, with a peculiar subspiral appearance. The anterior edge of the shell is dilated, so that there is an anterior surface cordate and concave; the posterior part is expanded and subalate. The anterior surface is bounded by a curved line forming the anterior border of each valve. This line starts from the apex of the umbo above and curves outwards at first; afterwards, gradually approaching the middle line, it unites with the edge of the valve, and passes gradually into the inferior border, which has a semicircular curve. The anterior border is straight but oblique. The posterior border is obliquely truncate, and almost straight in its upper two-thirds; passing below into the inferior border with a gradual curve. The hinge-line is straight, and forms much the shortest antero-posterior diameter of the shell, joining the posterior border at an angle a little greater than a right angle.

The umbones are terminal, swollen, acute, elevated above the hinge-line, and twisted inwards and forwards. They are excavated in front by the hollow anterior surface, and posteriorly are not well defined from the general gibbosity of the shell. The shell is swollen in front; at first the convexity is very narrow transversely, but gradually becomes broader and less pronounced as it approaches the edge of the shell. The absence of the anterior end of the shell, the terminal beaks, and oblique direction give the valve a twisted or subspiral appearance.

Interior.—The hinge-line is simple and edentulous posteriorly. Anteriorly the hinge is as yet unknown, but is somewhat thickened. The anterior adductor scar is small, round, and pit-like; the posterior is of moderate size, oval, situated a little nearer the upper than the lower border, and submarginal. The mantle-line is linear, entire, and remote from the margin.

Surface.—The valves are marked with fine lines of growth, parallel to the borders, all terminating on the hinge-line, with here and there an approach to concentric undulations by the thickening and throwing into relief of some lines of growth, which thus divide the smaller markings into groups. On the anterior surface the lines of growth are crowded but very distinct.

Dimensions.—Pl. VI, fig. 20, the fairly large specimen, measures—

Greatest oblique diameter . . .	43 mm.
Length of hinge-line	22 mm.
Elevation of valve	8 mm.

Localities.—The Carboniferous Limestone of Settle, Hill Bolton, Castleton, and Thorpe Cloud.

Observations.—Although a specimen of this species was figured by Phillips under the name of "Perna?" it was unaccompanied by description, and I have been unable to find any record of a similar shell. Fortunately Phillips's original specimen is preserved in the Gilbertson Collection of the British Museum (Natural

History), and I have permission to reproduce it here, Pl. VI, fig. 4. Other and better specimens, however, are in the same collection.

The details of the species have been worked out from a fine and numerous series from Settle in the Burrow Collection of the Woodwardian Museum, one or two specimens showing important details of the interior; but, on the whole, these shells are more gibbose than those of the same species from other localities.

Although none of the Settle specimens have both valves preserved, I have been fortunate enough to obtain perfect examples from other localities. The curious subspiral form in single valves has a close resemblance to certain Gasteropod shells.

There appear to be two forms or varieties of this species, but whether or no they are distinct enough to have different names I have been unable to decide. One form, represented by figs. 20, 21, and 22, Pl. V, is flatter, more compressed, and expanded. The other, figs. 1, 2, and 3, Pl. VI, are more convex, and have the posterior superior angle less marked. Intermediate forms occur which connect the two. This difference in concavity is not due to one valve being more tumid than the other, for fortunately both convex and flat specimens of both valves appear in the series. The flat valves resemble somewhat *Myalina amœna* and *M. ampliata* of de Koninck, but the casts show the absence of any rostral plates or striæ on the hinge.

The figures of *Mytilus ampliatus*, *M. Wesemælianus*, and *M. Omaliusianus* given by de Ryckholt are extremely like those of the species under description; but de Koninck does not recognise them in his great work. I have not therefore placed them as synonyms of this shell for the present, but have merely indicated these forms for comparison. Should it be shown that the British and Belgian species are identical, de Ryckholt's name "*M. ampliatus*" should probably stand for the species, though this form is stated to come from the coal-field of Mons. De Ryckholt's figures, however, are not to be trusted as conveying an accurate idea of the shell which he intended to depict.

POSIDONIELLA ELONGATA, *Phillips*, sp., 1836. Plate V, figs. 15—18 *a*, 19, 19 *a*; Plate VI, fig. 6.

MODIOLA ELONGATA, *Phillips*, 1836. Geology Yorkshire, pt. 2, p. 210, pl. v, fig. 24.

— — *Morris*, 1854. Cat. Brit. Foss., p. 209.

? MYALINA LAMELLOSA, pars, *de Koninck*, 1842. Anim. Foss. Belge, pl. iii, fig. 6 *c*.

— ELONGATA, *Brown*, 1849. Illust. Foss. Conch., p. 174, pl. lxxii, fig. 43.

MODIOLA ELONGATA, *Etheridge*, 1885. Brit. Foss., vol. i, Palæoz., p. 285.

Specific Characters.—Shell very narrow, transverse, produced downwards and obliquely backwards, amygdaloid with subparallel edges, acutely pointed and tumid in front, flattened and rounded behind.

The anterior edge of the valve is short, oblique, and prolonged downwards and outwards, a little concave above. This border marks off an anterior surface, elongate-cordate, hollow above, narrowing below to a point where the anterior and inferior borders join. The inferior border is obliquely ellipsoidal, with long limbs anteriorly and posteriorly, nearly parallel. The posterior border is long and straight, obliquely truncate, almost parallel with the anterior edge.

The hinge-line is short, straight, joining the posterior border at such an obtuse angle as to be often scarcely perceptible.

The umbones are acute, narrow, swollen, terminal, and twisted forwards and inwards. Proceeding backwards and downwards from the umbones is an oblique swelling, the greatest elevation of which is almost central, but the slope is more rapid on its posterior than on its anterior side.

There is little or no flattened and expanded posterior-superior angle.

Interior.—The internal surface is smooth. The anterior adductor scar is small, punctate, almost apical in position, represented in the cast by a small round elevation. The Yorkshire specimens show no trace of a pallial line, and the posterior adductor scar is faintly indicated; but in the Northumbrian specimen the pallial line is remote from the margin and entire, and the posterior adductor scar is situated low down, remote from the margin, shallow, and oval.

Exterior.—The surface is roughened by unequally marked lines of growth, which follow the general contour of the shell, and, arising from the anterior surface, arch over the convexity, and terminate in the short hinge-line. Shell of moderate thickness.

Dimensions.—Pl. V, fig. 16, measures—

Greatest oblique antero-posterior diameter .	40 mm.
Length of hinge-line	15 mm.
Elevation of valve	7 mm.

Localities.—The Carboniferous Limestone of Settle and Hill Bolton, Yorkshire; Thorpe Cloud, Derbyshire; Coombes Limestone, Redesdale, Northumberland.

Observations.—A series of three specimens of this very distinctive shell are in the Burrow Collection of the Woodwardian Museum, Cambridge. I am permitted by the kindness of Prof. McKenny Hughes to describe and figure them. Pl. V, fig. 16, shows a single valve (the left), possessing the greater portion of the shell, has its peculiar and characteristic shape preserved, as is at once apparent on placing the specimen with the umbo pointing forwards and the hinge-line horizontal.

Fig. 19, Pl. V, is the cast of a perfect example, and shows the two valves in apposition. Fig. 18, Pl. V, is the cast of a left valve, and this example shows the character of the anterior adductor. Although the casts seem to be in a good state of preservation, and the posterior adductor scar is just visible, I can see no indications of pallial line.

Like *P. pyriformis*, the shell, as a single valve, has a marked resemblance to the Gasteropod form Capulus, especially if the shell be held with the umbo directly vertical. This resemblance is due to the acute angle at which the anterior surface and hinge-line meet, and their short extent.

A fourth specimen has been obtained by Mr. J. Dunn from the Coombes Limestone of Redesdale, Northumberland, Pl. V, fig. 17. This is somewhat smaller than the Yorkshire specimens, and has the two valves crushed together to a slight extent in front, and therefore does not give a typical view of the anterior surface. This specimen fortunately shows in the right valve the pallial line and posterior adductor muscle-scar. The position of this scar at once separates the genus from Avicula, which has its scar subcentral.

A fifth specimen is numbered 67 $\bar{g}$ in the collection of Mr. G. H. Morton, of Liverpool, who has kindly permitted me to figure it. This is a left valve, and has the test preserved in a beautiful condition, Pl. V, fig. 15; but the locality unfortunately is not recorded.

I consider it highly probable that the original of Phillips's *Modiola elongata* belonged to the species under description, although we cannot be certain in the absence of the type. This is stated to have been in the Gilbertson Collection, but no shell now in that collection in the British Museum can be identified with the drawing. The original description is meagre, but suits the shells of the Cambridge Collection exactly, being as follows :—" Elongate, arcuate, margins subparallel, valves gibbous, subcarinated." I have therefore retained the specific name *elongata*. An additional reason for the probability of the identity of these shells with that of Phillips's type is that they are from the same district, Bolland.

One of the figures of *Myalina lamellosa* given by de Koninck (*op. cit.*) is so remarkably like the shell under description, and so different from the other specimens subsequently figured by him, that I have placed it with a ? as a synonym. True, the figure is stated to be 6 *c*, but it is not now certain that fig. 6 *a*, which shows the striated hinge-plate of the then new genus, was a portion of the same specimen, fig. 6 *a* being represented as a mere fragment. It is a pity that the original figure was not reproduced in de Koninck's great work on the Carboniferous Lamellibranchiata in 1885.

Posidoniella gibbosa, sp. nov., Hind. Plate V, figs. 12—14.

Specific Characters.—Shell evenly tumid, quadrate, equivalve. The anterior border of the shell is formed by the edge of the valve, which descends almost in a straight line, vertically, passing with a regular curve into the inferior border, which is almost semicircularly curved. The posterior border is truncate, very slightly oblique, joining the hinge-line above at an obtuse angle. The hinge-line is straight and prolonged forwards in front of the umbones to form a little ear, which is somewhat twisted on itself. The umbones are anterior, tumid, obtuse, elevated above the hinge-line, and curved very slightly forwards. The valves are regularly swollen; the line of greatest curvature is slightly oblique to the hinge-line, and the slope more rapid anteriorly than posteriorly; above, the shell is slightly expanded and compressed at the posterior superior angle. Anterior to the umbones is a little convex process, marked off from the general anterior slope by a curved line, giving the umbones the appearance of being situated almost subcentrally.

Interior.—No details of the hinge and the muscle-scars have as yet been seen in this species, all specimens yet obtained having the test preserved.

Exterior.—The surface is almost smooth, but ornamented with a few distant, accentuated, concentric striæ.

Dimensions.—Fig. 12, Pl. V, a left valve, measures—

Vertically	31 mm.
Hinge-line	18 mm.
Elevation of valve	10 mm.

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

Observations.—This species is founded on five specimens obtained by myself from the limestone of Thorpe Cloud, Dovedale, and Castleton. It is distinguished from other members of the genus by its general regular convexity, the absence of an anterior surface marked off from the rest of the shell, and by the possession of a small ear-like process in front of the umbo. Fig. 12, Pl. V, is a specimen with both valves lying open, showing that the shell was equivalve.

The possession of an anterior ear-like process proclaims a closer affinity to the Aviculidæ than the other species of this genus own, but the gibbosity and equivalve character of the shell at once serve to separate it from that family. Not having met with this species in any of the collections I have examined, and not finding any trace of a previous record, I am of the opinion that it must be very rare. Four of the specimens in my collection have been obtained from the

fossiliferous bed on the summit of Thorpe Cloud, at the entrance to Dovedale, a bed very rich in Molluscan forms; but scarcely any of the shells, except the Brachiopods, are to be got in anything like perfect condition. The valves are nearly all separated, and lie in all positions jammed into each other, and therefore the animals to whom they belonged must have been dead before the deposit was formed. The valves of Brachiopods, being more firmly united, are therefore more frequently found adherent. The fauna, taken as a whole, is not one which would be supposed to have had the same bathymetrical distribution, and I regard the bed as made up of the accumulation of washed débris from various depths of the sea-floor, though the specimens exhibit no sign of having been rolled. The famous fossiliferous beds of Wetton, Narrowdale, and Park Hill, which have yielded to Mr. Carrington a very large and varied fauna, are of the same character, and as they all occur near the top of the Carboniferous Limestone, and contain faunas which have very much in common, it may be that these beds mark a definite horizon.

Posidoniella semisulcata, sp. nov., Hind. Plate VI, figs. 7—11.

? Inoceramus, *Etheridge*, 1866. Mem. Geol. Surv. Gt. Britain: the Geology of the Country round Stockport, Macclesfield, Congleton, and Leek, p. 92.

Specific Characters.—Shell transversely triangular, obliquely swollen in front, expanded and flattened behind and above. The anterior end is obsolete, but the edge of the valve forms the margin, which descends downwards and backwards at an acute angle with the hinge-line, almost straight at first, but curved below, where it makes with the inferior border one convex sweep. The posterior border is truncate from above downwards, making an obtuse angle with the hinge-line; straight above, convex below. The hinge-line is straight, nearly as long as the whole of the shell. The umbones are blunt, swollen, anterior, and terminal, and are continuous with an oblique swelling which passes diagonally across the shell, the anterior slope of which is rounded but steep; the posterior more gradual and flatter.

Interior.—The anterior adductor scar is punctate, represented in casts by a small protuberance at the extreme anterior point interior to the umbo, as shown in the cast. The posterior muscle-scar is not visible; the hinge-line is grooved longitudinally and parallel to the border. The hinge-plate is slightly expanded and twisted on itself in front. Ligament probably lodged in the longitudinal groove and internal.

Exterior.—The shell is marked with numerous closely arranged sulcations, which, arising from the anterior edge of the valve, separate as they pass backwards

and downwards; as they cross the oblique swelling on the valve they become less distinct, and on the posterior wing are almost obsolete. These lines give a twisted subspiral appearance to the shell. The left valve is more gibbose than the right.

Dimensions.—Pl. VI, fig. 7, measures—

Length of hinge-line	9 mm.
Greatest vertical diameter . . .	8 mm.
Elevation of valve	4 mm.

Locality.—In a quarry on Congleton Edge, Cheshire, south-west of Hollywood, in a bed of dark shale with calcareous bullions, about 300 yards below the base of the Millstone-grit.

Observations.—This species is founded on several examples that occurred in one bullion in the bed and locality stated above. I have referred them to the genus Posidoniella on account of their general shape; but, as I know of no published form which in any way approaches it, I have named it after the markings characterising the surface.

This species differs from all others which I include within the genus by its greater transverse diameter, and in possessing a longer hinge-line. It also has not a depressed anterior surface marked off by the lines representing the anterior borders of the valves.

Casts show the anterior adductor scar to be almost terminal, and a hinge-line with an elongated groove. Unfortunately the hinge-plate of the other species of this genus has not yet been observed, so that it cannot be said, with our present knowledge, that this condition is typical of the genus.

In the 'Memoir of the Geological Survey: the Geology of the Country round Stockport, Macclesfield, Congleton, and Leek,' mention is made (pp. 72, 73), of the quarry in which the species under discussion occurs. Congleton Edge forms one limb of an anticlinal fold, on which the Biddulph portion of the North Staffordshire coal-field rests; and the west face of the hill shows a sequence of the Millstone-grit, so-called Yoredale beds, and Carboniferous Limestone, the last being thrown up as a dome by a couple of faults. The quarry south-west of Hollywood occurs nearer the upper part of the hill than the base, and is in direct sequence with the beds of grit forming the escarpment, so that the fossiliferous horizon is not very far below the base of the Millstone-grit at this point. The fauna occurring in the beds with *P. semisulcata* is rich in Molluscan forms, the following species and genera having been obtained there by me:

Goniatites, sp., 2.
Orthoceras, sp.
Pleurotomaria, sp.
Euomphalus, sp.
Macrocheilus, sp.
Loxonema? sp.
Bellerophon, sp.
Productus scabriculus.
— *cora.*
— *longispinus.*

Productus semireticulatus.
Chonetes Laguessiana.
Spirifer glaber.
— *bisulcatus.*
Orthis resupinata.
Athyris planosulcata.
Discina nitida.
Lingula mytiloides.
Streptorhynchus crenistria.
Modiola peralata.
— *transversa.*
Myalina lamellosa.
Nucula gibbosa.
— *æqualis.*
Posidoniella semisulcata.
Sanguinolites sulcata ?
Aviculopecten fibrillosus.
And the Crustacean *Dithyrocaris testudineus.*

The genera Inoceramus and Myalina are stated in the "Appendix on the Fossils" of the memoir mentioned above to occur in this quarry. It is possible that the shells now described as Posidoniella were at that time indicated by the name Inoceramus, to which genus the sulcations on the anterior part of the shell give it a marked resemblance.

POSIDONIELLA LÆVIS, *Brown*, sp., 1841. Plate VI, figs. 12—14, 24.

CATILLUS LÆVIS, *Brown*, 1841. Trans. Manchester Geol. Soc, vol. i, p. 226, pl. vii, fig. 66.
— KELLYI, *Brown*, 1841. Ibid., p. 226, pl. vii, fig. 67.
— MINUTUS, *Brown*, 1841. Ibid., p. 226, pl. vii, figs. 71, 72.
— LÆVIS, *Brown*, 1849. Illustr. Foss. Conch., p. 167, pl. lxvii, fig. 22.
— KELLYI, *Brown*, 1849. Ibid., p. 167, pl. lxviii, fig. 17.
— MINUTUS, *Brown*, 1849. Ibid., p. 167, pl. lxviii, figs. 18, 19.
POSIDONIA MINUTA, *Brown*, 1849. Ibid., p. 168, pl. lxi**, fig. 32.
— ? GIBSONI, *Salter*, 1862. Mem. Geol. Surv. Gt. Britain: Geol. Country round Wigan, 2nd edit., p. 35, fig. 1 *a*.
— — *Wild*, 1892. Trans. Manch. Geol. Soc., vol. xxi, p. 400, pl. ii, fig. 8.

Specific Characters.—Shell convex, somewhat smooth, obliquely ovate. The anterior border, truncate and straight, descends almost vertically downwards, passing with gradually rounded curve into the inferior border, which is extensive and almost semicircular. The posterior border is obliquely truncate, straight above, convex below. The hinge-line is short and straight, making a very obtuse angle behind with the posterior border. The umbones are small, convex, twisted forwards to become terminal, not elevated above the hinge-line. Proceeding from the umbo obliquely backwards and downwards, the valves are convexly swollen, the anterior slope being more rapid, and the line of greatest convexity being anterior. Above and behind, the valve, compressed and expanded, is subalate.

Interior at present unknown.

Exterior.—The surface is covered with concentric folds and lines of growth. Periostracum wrinkled.

Dimensions.—Fig. 12, Pl. VI, a right valve, partly decorticated, measures—

Antero-posteriorly	18 mm.
Dorso-ventrally	18 mm.
Elevation of valve	5 mm.

Localities.—In the roof of the Bullion-coal Foot-mine; Colne and Sholver, near Oldham, Starring, Dearnly. Over the Gannister coal, Pimbo, near Wigan. In a band with *Aviculopecten papyraceus*, Lower Coal-measures, Froghall, North Staffordshire. In the shales below the Millstone-grit; of the Coombe Valley, near Leek, Crimsworth Dean, Hebden Bridge, and High Green Wood, Todmorden.

Observations.—A number of specimens of this species, in different stages of growth and states of preservation, have been described and figured by Captain Brown (*op. cit.*) under several different names. Many of them were obtained from High Green Wood, Todmorden; and, strange to say, these names have escaped the notice of all cataloguers and palæontologists. The originals of these specimens are nearly all fortunately preserved in the Manchester Museum, Owens College, and I am permitted to re-figure them.

Mr. Salter, when working up the palæontology of the Lancashire coal-fields for the 'Memoirs of the Geological Survey,' uses the names *Posidonia Gibsoni*,[1] Brown, and *Posidonia lævigata*,[2] Brown, but gives no clue as to their origin. Brown in neither of his papers quoted above mentions these names, and the use of them will consequently have to be discontinued.

The original of *Catillus lævis* is evidently a specimen which has lost its periostracum and outer layer, and is therefore decorticated. This accounts for the different appearance of this specimen from others in a more perfect state, and doubtless gave origin to the specific name. When in a better state of preservation, as in Pl. VI, fig. 13, the shell is seen to possess well-marked concentric undulations.

The animal of *Posidoniella lævis* was gregarious, and many specimens are found together on slabs showing the shell in all stages of adolescence. This fact has very largely weighed with me, together with the disappearance of the original examples, in considering these forms as all belonging to one species. Apparently, too, all Captain Brown's forms occurred together.

Fig. 24, Pl. VI, shows a large number of examples, in all stages of growth, attached to a piece of fossil wood. It would therefore appear that this species was byssiferous. This block, obtained by Mr. G. Wild, of Ashton-under-Lyme from the Bullion Coal in the neighbourhood of Colne, was in his cabinet, and by his kind permission I was able to figure the specimen.[3]

[1] 'Geology of the Country round Wigan,' p. 35.

[2] 'Geology of the Country round Oldham,' p. 62.

[3] It is now in the Manchester Museum, Owens College.

The term *Posidonia Gibsoni* appears to be used in Lancashire for two very different shells. Mr. Wild figured the specimen here shown by fig. 14, Pl. VI, under this term; but in all collections specimens of *P. minor*, such as Pl. VI, fig. 15, also receive the same name. The latter is a much flatter and quadrate shell. Mr. H. Bolton, who has carefully gone into this question, considers the two forms to be perfectly distinct; and though at first I was inclined to the view that the latter represented *P. lævis* as it appeared when crushed and flattened in the shales, and with much of the shell removed, and the periostracum only left, I have come to the conclusion that he is correct, and I have therefore retained the two species.

Posidoniella Kirkmani, *Brown*, sp., 1841. Plate VI, figs. 16, 19—21.

Catillus Kirkmani, *Brown*, 1841. Trans. Manchester Geol. Soc., vol. i, p. 225, pl. vii, fig. 66.
— costatus, *Brown*, 1841. Ibid., p. 226, pl. vii, fig. 68.
— obliquatus, *Brown*, 1841. Ibid., p. 226, pl. vii, fig. 69.
— Kirkmani, *Brown*, 1849. Illustr. Foss. Conch., p. 167, pl. lxvii, fig. 24.
— costatus, *Brown*, 1849. Ibid., p. 167, pl. lxvii, fig. 25.
— obliquatus, *Brown*, 1849. Ibid., p. 167, pl. lxvii, fig. 23.

Specific Characters.—Shell small, moderately gibbose, produced downwards, obliquely subquadrate. The anterior end is small, and produced at the anterior superior angle into a small ear. The border is almost straight, and is directed downwards and slightly backwards. The inferior border is very bluntly but regularly curved, somewhat shorter than the superior. The posterior border is straight above and rounded below. The hinge-line is straight in front, angulated and depressed posteriorly, meeting the posterior border at an obtuse angle. The umbones are swollen, small, not raised above the hinge-line, situated anteriorly, but not terminal. There is often a bend in the posterior part of the hinge-line, which gives an erroneous impression of a very short hinge-line, and consequently subcentral umbones. The shell is evenly and obliquely swollen, the anterior slope being the steeper; above and behind, the valves are compressed into the posterior angle.

Interior.—Casts show that the anterior adductor scar is small, punctate, and situated near the apex of the umbo; the posterior small, and in the normal position for the genus. The interior of the shell was smooth, but with concentric undulations and obscure radiating striæ over the posterior portion.

Localities.—The Black Shales, below the Millstone-grit of Crimsworth Dean and Horse-bridge Clough, Vale of Todmorden.

Dimensions.—Fig. 16, Pl. VI, measures—

Antero-posteriorly	9 mm.
Dorso-ventrally	9 mm.
Elevation of valve	2·5 mm.

Observations.—By the courtesy of Mr. Hoyle and Mr. H. Bolton, Manchester Museum, Owens College, I have been able to study the series of shells from Todmorden named and figured by Captain Brown. In addition to these, several specimens were found with MS. names; but I am of opinion that, with one or two exceptions, these were only varying forms of those previously named, due to the state of preservation or growth.

The distinctive character of this species is the non-terminal position of the umbones, and the originals of the three published species of Brown's *Catillus Kirkmani*, *C. costatus*, and *C. obliquatus* have this peculiarity in common, although there may be some uncertainty (owing to the lapse of time, and the fact that the labels were loose) as to which was the original of each form. Still I believe, on comparing the shells with Captain Brown's figures, that fig. 16, Pl. V, in this Monograph represents *C. Kirkmani*, fig. 20 *C. costatus*, and fig. 19 *C. obliquatus;* the presence or absence of the anterior ear depending on the proper clearance of matrix in front. The specific name "*Kirkmani*" is retained, as it came first in Captain Brown's paper (*op. cit.*).

I would, however, draw attention to the fact that Captain Brown's figures are all much larger than the shells now illustrated.

The original description of *P. Kirkmani* is—"Oblong-ovate, convex, smooth, sides nearly equal, marked with four concentric lines of growth. Its umbones prominent, central, and rounded; with several inequidistant concentric lines of growth; margins sharp and even." The number of prominent lines of growth depends, of course, on the age of the shell and its environment; and more especially on the condition of the fossil, whether it is semi-decorticated or not. I would point out that Brown's figures of *C. obliquatus* and *C. costatus* show several equidistant lines of growth; but in these cases larger shells were depicted than that of *C. Kirkmani*. In the description of *C. obliquatus* the umbones are stated to be "placed considerably to one side," but the figure shows them to be subcentral, the slight difference in the two specimens being due to their different ages and sizes. A similar tendency to invent species on the weakest evidence, the result of accuracy in ocular observation only, is also shown in Brown's work on the "Unios (Carbonicolæ) of the Coal-measures," in the 'Annals Mag. Nat. Hist.,' vol. xii, 1843, where twenty-six new species are described and figured, every slight variation in form earning a new specific title.

Posidoniella minor, *Brown*, sp. 1841. Plate VI, figs. 15, 17, 18, 22, 23.

Gervillia minor, *Brown*, 1841. Trans. Geol. Soc. Manchester, vol. i, p. 227, pl. vii, fig. 70.
— — — 1849. Illustr. Fossil Conchology, p. 165, pl. lxi**, fig. 31.
Avicula squamula, *Brown*, 1849. Ibid., p. 161, pl. lxviii, fig. 10.
Posidonia? Gibsoni, *Salter*, 1862. Mem. Geol. Surv., Geol. country round Wigan, p. 35, fig. 1 *a*.
Gervillia minor, *Bolton*, 1895. Catal. Type Fossils Owens College, p. 12.

Specific Characters.—Shell equivalve, compressed; subquadrate, somewhat oblique. The anterior end of the shell is obsolete, the shell being most tumid at the extreme anterior edge, which is straight, and descends downwards, and only to a very slight extent backwards, passing with a semicircular curve into the inferior border, which is broad and convex downwards. The posterior border is obliquely truncate, forming above an obtuse angle with the hinge-plate, and descending downwards and backward, at first straight, then becoming curved into the inferior border. The hinge-line is straight, and a little shorter than the greatest transverse diameter. The umbones are slightly swollen, pointed forwards, terminal, and contiguous. The valves are equally and obliquely swollen from the umbones, the swelling being more marked in the anterior part of the shell, and becoming more expanded and less convex as it passes downwards. The valves appear to have been much flattened at the inferior and posterior borders; posterior to and above the swelling the valves are compressed and expanded.

Interior.—Unknown.

Exterior.—The surface is covered by irregular concentric folds, crowded in front, but becoming separated as they pass backwards. The periostracum is wrinkled, and appears to extend beyond the margins of the shell.

Dimensions.—Fig. 15, Pl. VI, measures—

Antero-posteriorly	15 mm.
Dorso-ventrally	16 mm.
Elevation of each valve . . .	2 mm.

Localities.—Lancashire: the Bullion Foot-mine, Lower Coal-measures, Trawden Colne. Height's Hay, near Sharnyford; near Rossendale, in shales below the Old Lawrence or Tumbling Cob Rock, and about 100 feet above the Lower Mountain-mine. Reap's Clough, Bacup, and at Green Clough, Portsmouth, in shale over the Upper Foot-mine. Towers Clough, in a shale 18 inches above, and thin coal which is immediately above the Upper Rough Rock. Yorkshire: the Shales below the Millstone-grit of Marsden, Hebden Bridge, and Tod-

morden. Staffordshire: in Shales of a similar horizon, Coombes and Swythamley, near Leek.

Observations.—This species I found to be well known amongst Lancashire collectors under the name *Posidonia Gibsoni*, which was applied by Salter to a shell that he figured, without full description, however, in the 'Survey Memoir on Wigan' (*op. cit.*), and Capt. Brown was quoted as the author. I have been unable to find any published account of a species with this name, but Mr. Herbert Bolton, of the Manchester Museum, Owens College, with whom I have discussed the matter, suggests that Capt. Brown was at the time of Salter's publication engaged at work on a series of shells to which the latter had access, and that the name *P. Gibsoni* was probably a MS. name used on the understanding that Brown was about to publish detailed figures and descriptions. Neither Mr. Bolton nor myself have any hesitation in recognising the shell which is commonly known in Lancashire as *P. Gibsoni* as the same as that figured by Brown (*op. cit.*) as *Gervillia minor;* and in the absence of any trace of *P. Gibsoni*, and on the grounds of priority, the specific name "*minor*" must be retained. The shell in question is very often found crushed in shale, but it appears to have been a flat equivalve form, without any trace of an anterior lobe or ear, and therefore cannot be referred to Gervillia.

Mr. Salter, when discussing the character of *Posidonia Gibsoni* in the 'Memoir of the Geological Survey on the Geology of the Country round Wigan,' p. 37, says, "This is evidently not a Posidonia, but it is not yet certain that it belongs to Ambonychia, Monotis, or any of the allied genera, from the want of hinge-characters; one species has even been given under the names *Gervillia minor* and *G. obtusa* in the cabinet of the Manchester Geological Society."

Salter's figure of the shell at p. 35 of the same memoir is very curious. He gives the shell the shape of a Pecten with a large posterior and short anterior ear; and in general outline it is very unlike any of the specimens figured by Brown. Mr. George Wild figured a specimen as *P. Gibsoni*, Brown (Salter), which is now reproduced as typical of Brown's *P. lævis*, and which, of course, has no anterior ear. It may have been possible that Salter altered the name *P. lævis* to *P. Gibsoni*, and still gave it as one of Brown's species, just as in the same volume he substituted the name *Browniana* as a specific title for Brown's *Avicula tenua*.

Indeed, it is not at all improbable that Brown's *Avicula tenua* may belong to the species under discussion; if so, it would appear to represent a specimen with the periostracum preserved. I have pointed out in my paper on the affinities of Anthracoptera, 'Quart. Journ. Geol. Soc.,' vol. xlix, p. 252, that I thought Salter was in error in referring Brown's shell to his new genus Anthracoptera, as Brown distinctly showed in his figure that in his shell the umbones were anterior and terminal, and that the anterior lobe was obsolete. Salter took it for granted

that Brown's shell was incomplete in front, and he dotted in an anterior lobe which brings the specimen into his new genus.

Avicula squamula, Brown, probably belongs to the same species as *A. tenua*, but whether or no they are examples of the species under discussion, there can be little or no doubt that they belong to the same genus. The vertical distribution of this species is of interest, as it occurs at different horizons in the Lower Coal-measures, and also in the series of shales below the Millstone-grit of Lancashire and North Staffordshire.

The names *Catillus rotundatus* and *C. tumidus* occur on the original labels of specimens in the Owens College Collection, from Todmorden. These do not occur in any publication that I can discover, and in my opinion they are forms of the species under description.

Posidoniella variabilis (*Brown*, MS.), sp. nov, Hind. Plate VII, figs. 7—9.

Mytilus variabilis, *Brown*, MS. Specimens in the Manchester Museum, Owens College.

Specific Characters.—Shell equivalve, produced downwards, mytiliform, roughly rhomboidal, very moderately convex in front and above. The anterior end is obsolete, but the valve is bent on itself along the anterior border to form the body-cavity. This border descends downwards and backwards, and is nearly straight. In some specimens the bending of the valve is so acute that an anterior surface, lanceolate in shape, is formed, and in others there is merely an expanded border. The inferior border is obliquely rounded and compressed. The posterior border is obliquely truncate, nearly parallel to the anterior; and is straight above and convex below. The hinge-line is straight, somewhat shorter than the greatest transverse diameter of the shell, and makes an obtuse angle with the posterior border. The umbones are small, gibbous, pointed forwards, and terminal. Extending obliquely downwards and backwards from the umbones is a swelling, which has a rapid rise on its anterior side, but posteriorly passes gradually into the flattened and expanded posterior portion of the valve.

Interior.—Though several specimens of casts are in the Owens College Collection, no details of hinge- or muscle-scars are apparent.

Exterior.—The surface is ornamented with fine, close, concentric lines of growth, with here and there more prominent lines or obsolete sulcations. These are all parallel to the borders, but are crowded in front.

Dimensions.—Fig. 8, Pl. VII, measures—

Antero-posteriorly	11 mm.
Dorso-ventrally	16 mm.
Elevation of valve	2 mm.

Locality.—Shales below the Millstone-grit, Vale of Todmorden.

Observations.—This species is founded on thirteen specimens in the Manchester Museum, Owens College. They are part of a collection, several specimens of which were described and figured in the first volume of the 'Transactions of the Manchester Geological Society' by Captain Thomas Brown, and the tablets on which these specimens are mounted bear the MS. names "*Mytilus variabilis*" and "*Mytilus?*" in his handwriting. They are very mytiloid in shape, but evidently belong to the genus Posidoniella, which is very close indeed in its general affinities to Mytilus. *P. variabilis* is not so convex as *P. lævis* and *P. Kirkmani*, and it is more oblique. From *P. minor* it is separated by its much less quadrate and more rhomboidal form.

Posidoniella subquadrata, sp. nov., Hind. Plate VI, fig. 25; Plate VII, fig. 10.

Specific Characters.—Shell obliquely subquadrate, moderately gibbose, especially in front and above, subulate posteriorly. The anterior border is straight, and descends downwards and to a very slight extent forwards; below, it is semicircularly curved, and thus passes into the inferior border, which is generally convex, but more markedly so in front and behind. The posterior border is straight above and obliquely truncate from above downwards and backwards, but below and where it joins the ventral border bluntly curved. The hinge-line is straight and short, joining the posterior border at an obtuse angle. The umbones are tumid, elevated above the hinge-line, contiguous, anterior, and terminal, and very slightly twisted forwards.

Proceeding downwards from the umbo is a well-marked gibbosity, which is more marked in front, and has an abrupt descent. On the anterior side, but posteriorly, the swelling becomes expanded as it descends, and is gradually lost on the shell surface. Towards the posterior superior angle the shell is much compressed.

Interior unknown.

Exterior.—The surface of the valves is covered by feebly marked folds, somewhat irregularly arranged, but parallel to the contour of the shell. These are very superficially decussated by almost obsolete, fine, radiating lines, more marked at the posterior superior angle.

Dimensions.—Fig. 10, Pl. VII, measures—

Antero-posteriorly (greatest across the lower third of the shell)	14 mm.
Dorso-ventrally	14 mm.
Elevation of valve	3 mm.

Localities.—The Bullion Mine, near Halifax, Colne, and New Hey, near Rochdale.

Observations.—I have been able to obtain access to only three specimens of this species, one of which (fig. 10, Pl. VII) is in the Owens College, and is the property of Professor W. Boyd Dawkins; one is in my own collection, and was obtained from Mr. Stock, of Bristol; and the other is a cast of the exterior on a small bullion from Colne. These specimens show the radiating lines over the posterior portion of the shell, and the short hinge-line.

Captain Brown's *Catillus costatus* is said to have "numerous very flat, longitudinal, diverging lines of growth;" but is "oblong-ovate" in shape; and I can find nothing in his collection at all like the species under description. The species marked *C. costatus* I have referred above to *P. Kirkmani*. The narrow hinge-line, general shape, and radiating lines are characteristic of this form, which approaches more closely to *P. pyriformis* of the Mountain-limestone of Settle than to any of the other forms.

Sub-family DREISSENNINÆ, *Stoliczka*, 1871.

Genus NAIADITES, *Dawson*, 1860.

(See the Monograph on "Carbonicola, Anthracomya, and Naiadites," Pal. Soc., 1895, p. 126.)

Generic Description.—Shell modioliform, obliquely triangular, inequivalve; anterior end lobed; umbones not terminal. Hinge-plate thickened, with many transverse striations, with an obscure cardinal tooth in front.

Anterior muscle-scars trifid and pit-like. Posterior adductor scar large, situated near the posterior border. Pallial line non-sinuate.

Species 1. NAIADITES MODIOLARIS, *Sowerby*, sp., 1840. Op. supra cit., p. 131, pl. xvii, figs. 8—10, 12—30.

„ 2. — TRIANGULARIS, *Sow.*, sp., 1840. Op. supra cit., p. 135, pl. xvii, figs. 31—38.

„ 3. — CARINATA, *Sow.*, sp., 1840. Op. supra cit., p. 138, pl. xviii, figs. 1—16.

„ 4. — QUADRATA, *Sow.*, sp., 1840. Op. supra cit., p. 140, pl. xviii, figs. 17—21, 23—25.

„ 5 — ELONGATA, *Hind*, 1895. Op. supra cit., p. 142, pl. xviii, figs. 22, 26—35.

Species 6. NAIADITES OBESA, *R. Etheridge, jun.*, sp., 1878. Op. supra cit., p. 144, pl. xix, figs. 1—16.
„ 7. — CRASSA, *Fleming*, sp., 1828. Op. supra cit., p. 147, pl. xx, figs. 1—11.
„ 8. — MAGNA, *Hind*, 1895. Op. supra cit., p. 151, pl. xix, figs. 17—20.

Genus MYALINA, *de Koninck*, 1842.

MYTILUS, *Phillips*, 1828. Phil. Mag., ser. 2, vol. iv, p. 403.
— *J. de Carle Sowerby*, 1829. Trans. Geol. Soc., 2nd ser., vol. iii, p. 120.
— *Goldfuss*, 1837. Petrefacta, pt. 2, p. 168.
GERVILLIA, *Geinitz*, 1841. Neues Jahrbuch, p. 639.
MYALINA, *de Koninck*, 1842. Animaux foss. Carbonif. Belgique, p. 125.
GERVILLIA, *Geinitz*, 1843. Gæa von Sachsen, p. 96.
MYTILUS, *Morris*, 1843. Catalogue British Fossils, p. 93.
AVICULA, *M'Coy*, 1844. Synops. Charact. Carbonif. Foss. Ireland, p. 82.
MYTILUS, *M'Coy*, 1844. Ibid., p. 76.
MYALINA, *Bronn*, 1848. Nomenclat. Palæontolog., p. 163.
MYTILUS, *Howse*, 1848. Trans. Tyne Nat. Field Club, vol. i, p. 248.
MYALINA, *King*, 1849. Monogr. Permian Fossils, p. 159.
MYTILUS, *d'Orbigny*, 1850. Prodrome Paléontol., vol. i, p. 134.
AVICULA, *d'Orbigny*, 1850. Ibid., p. 135.
MYTILUS, *de Ryckholt*, 1850. Mélanges paléontol., p. 132.
MYALINA, *Morris*, 1854. Catal. Brit. Foss., 2nd edit., p. 214.
— *Sedgwick and M'Coy*, 1855. British Palæoz. Rocks and Fossils, p. 491.
— *Shumard*, 1855. Report Geol. Surv. Missouri, pt. 2, p. 207.
— *Shumard and Swallow*, 1858. Trans. Acad. Sci. St. Louis, vol. i, p. 212.
— *McChesney*, 1859. Trans. Chicago Acad., vol. i, 1859, p. 57.
Non — *Baily*, 1860. Explan. Sheet 142, Geol. Surv. Ireland, p. 13.
— *Meek and Worthen*, 1860. Proc. Acad. Nat. Sci. Philad., 1860, p. 455.
Non — *Salter*, 1861. Mem. Geol. Surv., Iron Ores of S. Wales, p. 228.
— *Winchell*, 1862. Proc. Acad. Nat. Sci. Philad., 1862, p. 411.
— *Meek and Hayden*, 1865. Smithsonian Contributions, vol. xiv; Palæontology of the Upper Missouri, pp. 30, 33, woodcuts A and B; pl. i, figs. 12 *a*, *b*.
Non — *Huxley and Etheridge*, 1865. Cat. Foss. Mus. Pract. Geol., p. 110.
— *Armstrong and Young*, 1871. Carboniferous Fossils West Scotland, p. 54.
MYTILUS, *Armstrong and Young*, 1871. Ibid., p. 54.
MYALINA, *Stoliczka*, 1871. Palæontologia Indica, vol. iii, p. 366.
Non — *R. Etheridge, jun.*, 1875. Ann. Mag. Nat. Hist., ser. 4, vol. xv, p. 427.
— — — 1876. Ibid., vol. xviii, p. 103.
— — 1877. Quart. Journ. Geol. Soc., vol. xxxiv, p. 14.
— *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 309.
MODIOLA, *Bigsby*, 1878. Ibid., p. 307.
MYALINA, *Koenen*, 1879. Neues Jahrbuch für Min., &c., 1879, p. 335.

Non Myalina, *Kirkby*, 1880. Quart. Journ. Geol. Soc., vol. xxxvi, p. 585.
— — *Barrois*, 1882. Terrains anciens Asturias et Galice, p. 336.
— *Walcott*, 1884. Monogr. U. S. Geol. Surv., vol. viii, p. 237.
— *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 286.
Mytilus, *Etheridge*, 1888. Ibid., p. 287.
Myalina, *de Koninck*, 1885. Faune Calcaire Carbonif. Belgique, p. 168.
Mytilarca (Mytilus), *de Koninck*, 1885. Ibid., pp. 180, 279; explicat., pl. xxix, figs. 22 and 26.
Myalina, *Miller*, 1889. North American Geology and Palæontology, p. 492.
— *Whidborne*, 1891. Monogr. Devonian Fauna S. England, p. 45.

Generic Characters.—Shell of variable size, more or less triangular in shape. Anterior end obsolete. Shell oblique and strongly bent at anterior border, so that a more or less flattened anterior surface is formed. The posterior part of the shell alate, compressed, and expanded. Umbones pointed and terminal. Cardinal border straight. Hinge-plate much thickened, and longitudinally striated; the number of striæ greater in front than behind. The anterior adductor scar is situated on a shelf or hollow on the inner edge of the plate, just below the junction of the hinge-plate and anterior margin, which is here much thickened. The posterior adductor scar is very large and oval. The mantle-line is entire, and placed at some distance from the edge of the shell. Cartilage inserted in the hollows between the striæ of the hinge-plate. The lines of growth are well marked and often imbricate or lamellar.

Observations.—This genus was established in 1842 by de Koninck ('Anim. Foss. Carbonif. Belgique,' p. 125) for certain Mytiliform shells which possessed a striated hinge-plate, and had the anterior adductor muscle inserted on a little septum within the beaks. The acutely bent shell and flattened anterior surface, though not particularly mentioned, are probably included under the expression "La forme extérieure du genre Myalina ressemble assez bien à celle des *Mytilus*." De Koninck then describes three species of this genus—

Myalina Goldfussiana. *M. lamellosa.* *M. virgula.*

M'Coy, writing two years later, did not recognise the genus; a fact easily accounted for, as he had no interiors, and he referred two species—*Myalina Flemingi* and *M. compta*[1]—to *Mytilus;* and one—*Myalina Verneuilii*—to *Avicula.*

King, when discussing the generic affinities of the Permian representatives of this genus, notes that these have the umbonal plates and striated hinges of *Myalina;* but, as he thought that the Coal-measure shell *Naiadites* was indicated by de Koninck's description, and believing that "these were all fresh- or brackish-water shells" (one is seemingly warranted in characterising *Myalina* as a fresh-

[1] I consider that *M. compta*, M'Coy, is only a varietal form of *M. Verneuilii.*

water genus) he retained the name "Mytilus" for his Permian species Monogr., 1850, p. 159). With this view he fell into error, as de Koninck's shells were of undoubtedly marine habitat; and, though somewhat akin to the Coal-measure Mytiliform shells, perfectly distinguished by the non-terminal umbones, trifid anterior muscle-scars, absence of rostral septa, and the anterior lobe characteristic of the latter shells.

The name "Myalina" was adopted by Bronn and by Morris (2nd edit.) in their respective catalogues. Geinitz referred the Permian species to *Gervillia*, a genus with which there is little or no anatomical connection; for that genus possesses a well-marked anterior lobe and several pits along the hinge-line for the cartilage. It was M'Coy who first adopted the generic name *Myalina* in a descriptive work in 1855 (*op. supra cit.*),—but only for the Permian species, no mention being made of the Carboniferous forms.

In America the palæontologists of the different State Surveys at once recognised the genus as occurring in Carboniferous deposits, and a large number of species were soon described. Bigsby gives the following list in his 'Thesaurus Devonico-Carboniferus,' p. 308 :

Myalina angulata, Meek and Worthen.
— *aviculoides*, Winchell.
— *concentrica*, M. and W.
— *imbricaria*, Winchell.
— *Kansasensis*, Shumard.
— *Iowensis*, Winchell.
— *meliniformis*, M. and W.
— *Michiganensis*, Winchell.
— *perattenuata*, Meek and Hayden.
Myalina pernæformis, Cox.
— *pterineæformis*, Winchell.
— *rara*, Winchell.
— *recta*, Hawn.
— *recurvirostris*, M. and W.
— *Sancti-Ludovici*, W. and N.
— *squamosa*, Hayden.
— *subquadrata*, Shumard.
— *Swallovi*, McChesney.

S. A. Miller enumerates twenty-eight species from North American strata in his 'North American Geology and Palæontology,' pp. 492, 493. Some of these are probably synonyms, and one or two may be found to belong to *Naiadites*, but a number of the figures referred to are characteristic of the genus *Myalina*.

Baily in 1860 gave the name *Myalina Foynesiana* to a little Modioliform shell from the Coal-measures of Foynes Island, co. Limerick, which was associated with a marine fauna. The shell has neither the striated hinge, terminal beaks, nor rostral plates of *Myalina*; and I have referred it to *Modiola megaloba* (Pl. II, fig. 10).

The Naiadites of the Coal-measures were in 1861 referred, by Mr. Salter, to *Myalina*, but within one year he instituted the genus *Anthracoptera* for them, being unaware that Dawson had described one form under the name *Naiadites*. Mr. R. Etheridge, jun., adopted the name *Myalina* for the shell described by Fleming as *Mytilus crassus*, at the same time showing that this shell did not possess the terminal beaks and rostral septa of de Koninck's genus. Later on he

described *Myalina sublamellosa* and *M. trigonalis*, the latter of which seems to have no affinity to the genus. The genus was redefined by de Koninck in his last great work ('Faune Calc. Carbonif.,' p. 168), and nine species are described:

Myalina Mosensis, de Ryckholt, one specimen.
— *lamellosa*, de Kon., with which *M. virgula* is included as a synonym.
— *amœna*, de Koninck, one specimen.
— *ampliata*, de Ryckholt, very rare.
— *depressa*, de Koninck, very rare.
Myalina bursa, de Koninck, one specimen.
— *Goldfussiana*, de Koninck, very rare.
— *brevialata*, de Koninck, one specimen.
— *peralata*, de Koninck, three specimens.

Of these nine species, seven of which are new, four are founded on single specimens; of the others it is stated that three are very rare, and that no perfect example of *M. Goldfussiana* has been seen. I have been able to examine the type specimens of these species now in the Royal Museum at Brussels. It is unfortunate that so few specimens of each species have been found; some of them, too, in a very imperfect condition. I think it very highly probable that any additions to the number of specimens might considerably diminish the number of species.

The figures of *Myalina Goldfussiana* and *M. lamellosa* given in the earlier work of de Koninck differ very much from those in the later publication, and nothing is said in the explanations of the newer plates to indicate that the original figures have been reproduced. *M. Goldfussiana*, which should be the type of the genus, is very unlike all the other forms, being very gibbose and feebly carinated. The only known specimens are the type (?) and a cast, of which M. de Koninck says, "Je considère avec doute . . . . comme pouvant appartenir à la même espèce." The figure of *M. lamellosa*, one of the other earlier described species, reminds one very forcibly of the shell figured Pl. V, figs. 16—19, of *Posidoniella elongata*, but the view of a fragment with a striated hinge is given along with it; it is, however, impossible to say whether it belonged to the valve in question, as they are not now in the Natural History Museum at Brussels; and the figures were not reproduced when the species was re-described. I think it will be found that some of the specimens figured may belong to the genus *Posidoniella*, which is separated from *Myalina* by not possessing rostral plates for the anterior adductor muscle, by the twisted anterior border, non-carinate valves, and the absence of striations on the hinge-plate.

Whidborne,[1] who refers several shells from the Devonian of the south of England to this genus, states, in his definition of *Myalina*, that it possesses no byssal notch. I think that this statement is not universally correct; for it is beautifully shown in a fragment of *M. Redesdalensis* from Redesdale, collected by Mr. John Dunn, and figured in Pl. III, fig. 8.

[1] 'Monogr. Dev. Fauna,' vol. ii, part 1, 1892, p. 45.

Stoliczka includes the genus *Myalina* in his scheme of the Lamellibranchiata (*op. cit.*), classifying it with *Hoplomytilus*, Sandberger, *Anthracoptera*, Salter (= *Naiadites*, Dawson), *Septifer*, Recluz, *Dreissena* (*Dreissensia*), Van Beneden, and *Congeria*, Partsch, under the sub-family *Dreisseninæ*, to which *Mytilarca*, Hall, *Plethomytilus*, Hall, and *Gosseletia*, Barrois, belong. All these genera have many points in common, and I have retained this division of the family *Mytilidæ*.

The shells included in this sub-family all show a very close external resemblance. *Myalina* possesses terminal umbones, septiferous beaks, and a striated hinge-plate; *Naiadites* a striated hinge-plate, but non-terminal umbones, and no rostral plates; *Septifer* and *Dreissensia*, septiferous beaks and terminal umbones, but not a striated hinge-plate; *Hoplomytilus* has septiferous terminal umbones, but, instead of a striated hinge-plate, long, linear, transverse teeth; *Congeria* is given by Woodward as a synonym of *Dreissensia*, but Fischer retains it as a sub-genus of that group; it has a thickened cardinal plate and a rostral septum, but the mantle-line is almost marginal.

Myalina and *Hoplomytilus* occur in Devonian rocks: I am not aware of any named specimens from older strata, but Mr. Whidborne states of the range of *Myalina* that it "appears to extend from the Silurian to the Trias."

Myalina would seem to be at one end or other of the group included under Stoliczka's family *Dreisseninæ*, possessing the three characters, of which one or two only are found to obtain in the other genera. It may have been a parent- or race-form from which the others were developed by the suppression of one or other character. It would appear to have had the longest existence in point of time, and to have been richer in species than any of the other Palæozoic genera of the sub-family, though *Naiadites* (with eight British and possibly three American species) is not far behind in point of numbers. *Septifer* is, I believe, at present only known in the recent state; but *Dreissensia* is stated by Woodward to contain fifteen species, distributed in Europe, America, and Africa, and thirteen fossil (Eocene) forms.

The sub-family *Dresseninæ* forms a distinct link between the *Aviculidæ* and the *Mytilidæ*, both in form and anatomy. The striated, expanded hinge-plate of *Myalina*, however, is possessed by other genera of shells belonging to the same family, and is not in any way generic in character; and while, on one hand, these shells have in this hinge-plate a feature connecting them with the *Aviculidæ*, on the other they evidently are related to the *Arcidæ*, which possess, in addition to many hinge-teeth, a well-marked striated ligamental area. *Parallelodon* (*Modiola*) *squamifer*, Phillips, figured Pl. VIII, figs. 4—8, has a hinge-plate which resembles that of *Myalina* and its congeners very closely, but it has a typically arciform shell. The long lamelliform posterior teeth of the other species of this genus (*Parallelodon*), adopted by de Koninck, also recall such a striated hinge-plate.

It is very questionable whether it would not be advantageous to form a new family to receive on the one hand those shells, now classed under the *Mytilidæ*, which show marked aviculoid characteristics, such as the group marked off by Stoliczka; and, on the other hand, those genera at present classed under the *Aviculidæ*, as *Ambonychia*, Hall, *Mytilarca*, Hall, *Gosseletia*, Barrois, *Pinna*, *Pinnigena*, *Aviculopinna*, *Ptychodesma*, *Posidoniella*, de Koninck (type, *P. vetusta*), and others. I have removed the latter genus to the *Mytilidæ* from the *Aviculidæ* (*vide* p. 81).

In support of this contention it may be stated that while Dr. John Young, of the Hunterian Museum, Glasgow, has demonstrated the prismatic structure of the shell in many of the members of this group, and also in the *Aviculidæ*, he has not been able to find it in *Mytilus*, *Modiola*, or *Lithodomus*, the most typical members of the *Mytilidæ*.

Three of these Palæozoic Lamellibranchs are very closely allied to *Myalina*, viz. *Mytilarca*, Hall, the sub-genus *Plethomytilus*, and *Gosseletia*, Barrois. They all possess a striated hinge-plate and a mytiloid shape; but these three genera possess, in addition, hinge-teeth. These genera are found in the Devonian beds of North America, and have also been recognised in England by the Rev. G. F. Whidborne.

Hall gives the following diagnosis of his genus *Mytilarca* in 'Geolog. Survey State of New York, Palæontology,' vol. v, pt. i, Lamellibranchiata, i, 1884, p. xiv :

"*Mytilarca*, Hall. 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-genus *Plethomytilus*, Hall. Equivalve, mytiloid, gibbous shells, with finely striated ligamental area. Posterior side subalate. Hinge-line transverse. Lateral teeth small, oblique; no cardinal teeth have been observed. Test with concentric striæ."

The genus *Gosseletia*, Barrois, is thus defined by the same author :—"Shell subtriangular, truncate on the anterior side, subalate on the posterior. Ligamental area wide, longitudinally striate. Cardinal teeth strong, situated under the beak. Lateral teeth elongate. Surface marked by concentric striæ."

These three forms all differ from *Myalina* in possessing hinge-teeth as well as a striated hinge-plate, while in general external form they are all very similar.

The genus *Myalina* may be subdivided into two groups; one, containing *M. Redesdalensis* and *M. Flemingi*, being strongly angulated and much expanded anteriorly. The other group, of which *M. Verneuilii* may be taken as the type, to which most of de Koninck's species belong, are much flatter and more expanded,

but on anatomical grounds I can find no reason to separate these groups into two genera.

There has been some difference of opinion as to whether the shells of *Myalina* are equivalve or inequivalve. M'Coy and King state that they are inequivalve. De Koninck, who said in his original diagnosis that they were equivalve, came later to the conclusion that some species were equivalve and some not.

MYALINA REDESDALENSIS, sp. nov., *Hind.* Plate III, figs. 1—5, 7—13; Plate V, fig. 1; Plate VII, figs. 1, 1*a*.

Specific Characters.—Shell of moderately large size, triangularly mytiliform, obliquely produced, alate and compressed posteriorly. The anterior portion of the shell is entirely obsolete; but the shell is expanded from side to side, and acutely bent on itself at a right angle to form an extensive anterior surface, which is slightly convex above, and somewhat concave below from side to side. The anterior surface is oval in outline; the umbones project forwards, forming the extreme upper point, and below the borders approach each other, and unite to form at the lowest point the anterior extremity of the lower border, which is bluntly rounded. The posterior border is obliquely truncate from above downwards; in perfect specimens sinuously curved above. The hinge-line is comparatively broad and straight, and meets the posterior border at an angle a little greater than a right angle.

The umbones are acute, terminal, twisted inwards, outwards, and forwards, and overlap the hinge-plate. A strong acute ridge, marking off the anterior surface from the lateral, passes from the umbones obliquely backwards and downwards. Posterior to this ridge the shell is rapidly compressed and flattened.

The shell is very thick and massive in the umbonal region and hinge-plate, gradually becoming very thin posteriorly.

Interior.—The inner surface of the shell is very smooth. There is a deep, almost conical, smooth cavity in the thick anterior part of the shell, the apex of which is separated from the umbo in an adult specimen by fully half an inch of shell-matter. The hinge-plate is thickened, flat, and longitudinally striated. In front it forms an acute angle with the exterior of the shell, which rapidly becomes more acute as it proceeds backwards. While anteriorly the valve and the hinge-plate are only in contact above, the junction being very thick, posteriorly the valve is twisted on itself, so that the hinge-plate becomes the upper part of its inner surface, the Λ-shaped cavity which exists anteriorly being gradually obliterated. The hinge-plate is bounded in front by a sharp line directed from beneath the tip

of the umbo obliquely downwards to join the anterior edge of the shell. At the junction of the inferior border of the hinge-plate and the anterior edge is a shallow smooth cavity, bounded below by a more or less well-developed ridge or plate, which marks it off from the rest of the interior. This cavity is the hollow for the insertion of the anterior adductor muscle.

Just below the hinge-plate, as far as can be judged from fragments, about the centre are two or three pit-like cavities, probably the site of the attachment of the byssal and pedal muscles.

The posterior adductor muscular-scar is large, obovate, and situated in the upper and posterior quarter of the shell. The mantle-line is entire and remote from the margin of the shell. The byssal notch is high up on the anterior surface.

Exterior.—The surface of the shell is ornamented with fine striæ and lines of growth, which become markedly imbricate as they pass over the acute ridge. All of these start close to the umbo, and, following the contour of the shell, terminate in the upper border. On the anterior surface, near the edge of the valve, the striæ become very well marked, and may be traced over the edge of the hinge-plate to be continuous with the cartilage-striæ on it.

Dimensions.—Fig. 2, Pl. III. The only complete specimen known from the Redesdale Ironstone, though much crushed, measures—

Length of hinge-line (restored) . . .	48 mm.
Greatest lateral width	50 mm.
From umbo to posterior inferior angle . .	82 mm.

Locality.—The Redesdale Ironstone, Redesdale. ? Alnwick Moor. A fragment of a large shell, probably of this species, has been obtained from the Yoredale Rocks of Garsdale, by Miss Jane Donald. The Carboniferous Limestone of Derbyshire; and Narrowdale, Staffordshire.

Observations.—The knowledge of the characters of this fine new species is due to the indefatigable researches of Mr. John Dunn of Redesdale, who, by diligently collecting numerous fragments, has enabled the important points in the internal anatomy to be recorded. Only one specimen in at all a fair state of preservation has been found; this was presented by Mr. Dunn to Mr. Howse, of Newcastle-on-Tyne, who kindly permitted me to have drawings made.

The various fragments figured on Pl. III show the essential particulars of the anatomy of the species; but, owing to the great depth and angularity of the specimens, it has been somewhat difficult for the artist to indicate the correct measurements. For example, the distance between the angle and the anterior edge of the shell of fig. 1 is fully as great as that shown in the specimen fig. 3, where the anterior surface is viewed from the flat.

The position of the insertion of the anterior adductor scar is well seen in figs. 1 *a*, 1 *b*, 5, and 11. The overlapping terminal umbo is seen in Pl. III, fig. 3.

It is difficult to understand exactly how the hinge-plates were attached to each other. The overlapping umbo would seem to necessitate a fairly thick cartilage. Then was this cartilage attached to the whole of the hinge-plate, or only to the inferior edge? If we may judge from the conditions which are found in another species of this genus, *M. Flemingi*, there was little or no separation between the plates; and this would appear to be the case in the allied genus *Naiadites*.

Amongst some specimens, purchased by a grant from the Royal Society, from Palæozoic beds of North America, is a shell, *Ptychodesma Knappanum*, from the Hamilton group, Indiana, which possesses a striated hinge-plate. This specimen conclusively shows that the hinge-plates were only in contact at the lower edge, and that there existed an elongated V-shaped trench between the plates, probably filled up by cartilage in the recent state. I think that the same condition probably obtained in the larger species of *Naiadites* and *Myalina*, because the hinge-plate is placed, in these forms, at such an angle to the rest of the valve that it could only come into contact with its fellow at its lower edge.

Pl. III, fig. 7, shows the general contour of the shell, and its rapidly diminishing thickness posteriorly. Fig. 8 represents a fragment which fortunately has preserved the byssal notch, while Fig. 9 shows the distance of the pallial line from the edge of the shell. Figs. 12 and 13 show the pits for the insertion of the pedal muscles and their relation to the hinge-plate. Fig. 10 shows the change of the striæ of growth into marked imbrications as they pass over the oblique ridge.

This shell is apparently the largest member of the genus, and has a very restricted range. It is known only from one bed in Redesdale, and even here it seems to occur in only one part of the quarry. At this spot, however, it is very plentiful, though, from the fragile nature of the posterior portion of the shell, only fragments occur. It was therefore probably gregarious in habit. A few large examples, chiefly in the form of casts, are found in the Limestone of Derbyshire. One of these, in the York Museum, is figured in Pl. VII, figs. 1 and 1 *a*. In the list of fossils given in the Geol. Surv. Mem., Geology of the Carboniferous Limestone of Derbyshire, &c., *Myalina crassa* is quoted as occurring at Park Hill. It is probable that a specimen of *M. Redesdalensis* was mistaken for that species.

The only shell that this species is likely to be confounded with is the *Naiadites crassa* (*Mytilus* of Fleming). This shell has an anterior lobe, a cardinal tooth in the hinge, and a trifid pit-like anterior adductor scar in the apex of the shell. It differs from the species under description in having no broad anterior surface.

In its own genus *M. Flemingi* more closely approaches the species than any other; but the size, massiveness, and the great expansion of the posterior portion at once serve to distinguish the two forms.

Professor Lebour mentions the occurrence of *M. Flemingi* in the Redesdale

Ironstone, and the Geological Surveyors in the 'Memoirs on the Geology of Plashetts and Kielder,' and the 'Geology of the Country round Otterburn and Elsdon' mention *Myalina crassa*, *M. Verneuilii*, *M. lamellosa*, and *M.*, sp., from beds of the same age. It appears to me probable that fragments of the shell under description may have been mistaken for *M. Flemingi*, *M. crassa*, and possibly the others.

Miss Jane Donald has obtained specimens from a bed of arenaceous limestone of the Yoredale series of Garsdale. One, which I am allowed to figure, Pl. V, fig. 1, though compressed, shows very beautifully the condition of the upper and posterior angle of the shell, and the sinuously curved border with a similar curvature in the lines of growth just below their termination in the hinge-line.

MYALINA FLEMINGI, *M'Coy*, sp., 1844. Plate IV, figs. 9, 10, 10 *a*, 10 *b*.

MYTILUS FLEMINGI, *M'Coy*, 1844. Synops. Charact. Carboniferous Foss. Ireland, p. 76, pl. xi, fig. 29.
? — COMPTUS, *M'Coy*, 1844. Ibid., p. 76, pl. xiii, fig. 12.
— BEAUMONTI, *de Verneuil*, 1854. Geol. de la Russie d'Europe, vol. ii, p. 315, pl. xxii, fig. 2 *a*, *b*.
— FLEMINGII, *Morris*, 1854. Catal. Brit. Foss., 2nd edit., p. 214.
— — *Bigsby*, 1875. Thesaurus Devonico-Carboniferus, p. 309.
— — *Etheridge*, 1886. Brit. Foss., vol. i, Palæoz., p. 287.
— ? FLEMINGI, *de Koninck*, 1885. Faune Calc. Carbonif. Belg., p. 180.
MYTILARCA FLEMINGI, *de Koninck*, 1885. Ibid., pl. xxix, figs. 22, 26—28.

Specific Characters.—Shell of very moderate size, obliquely trigonal, keeled. The anterior end is obsolete, but the shell has a marked anterior surface, which is ovate-lanceolate in shape, slightly convex from side to side, above flat or slightly concave towards the centre, and again convex to a very small extent below. The margins of this surface are acutely angulated, especially on the right side, and, starting at the umbones, at first are directed outwards at a right angle, then they become arched downwards, still in an outward direction, till the centre of the shell is reached, when they gradually approximate and join in the anterior part of the lower border. The anterior surface is placed at an angle of about 45° with the hinge-line. The inferior border is bluntly curved, and is formed in front by the gradual version of the extreme edges of the valve, which become slightly elevated in the centre of the anterior surface. This border is somewhat angulated where it meets the posterior border, which is obliquely truncate or very slightly convex in outline, and has a general direction parallel to the anterior surface. The hinge-line is almost as long as the greatest antero-posterior horizontal

diameter of the shell. The umbones are narrow, acute, carinated, and terminal, contiguous and deflected forwards. The lateral surfaces of the shell are suddenly cut off in front, where they meet the anterior surface at an obtuse angle, and this is the most tumid portion of the shell. The carina forming the angle between the anterior and lateral surfaces is subacute in section, convex in profile, and is directed downwards and backwards to meet the anterior edge of the lower border, becoming near the lower edge of the shell less angular and somewhat expanded. The lateral surfaces are compressed from their anterior border rapidly into the hinge-line above, but more gradually in the other directions. The greatest lateral measurement is about the centre of the keel.

Interior.—The apex of a cast does not correspond with the external point of the shell, and is not terminal, and is separated from the anterior extremity by a sulcus occupied by the rostral plate. The posterior adductor scar is moderately large, remote from the posterior border, situated about the junction of the upper and lower halves of the shell. The mantle-line is entire, remote from the border. The hinge-plate is thickened and transversely striate.

Exterior.—The surface of the shell is ornamented with fine laminæ and lines of growth, which are crowded and directed obliquely downwards on the anterior surface till they reach the borders, when they are rapidly deflected and curved upwards over the lateral surface to terminate in the hinge-line and upper portion of the posterior border.

Dimensions.—The type specimen, a single valve, fig. 9, Pl. IV, measures—

Obliquely antero-posteriorly.	Length of hinge-line.
38 mm.	19 mm.

Another specimen, fig. 10, Pl. IV, measures—

Obliquely antero-posteriorly.	Length of hinge-line.	From side to side.
31 mm.	13 mm.	14 mm.

Localities.—England: From a bed of Millstone-grit, Pule Hill, Marsden, Yorkshire. Ireland: The limestone of Millicent, co. Cork; Clane, co. Kildare. Scotland: Garngad Road section, Glasgow.

Observations.—The type of this shell is preserved in the Griffith Collection, Museum of Science and Art, Dublin, and a figure of this specimen is given at Pl. IV, fig. 9. The original drawing does not give a very accurate idea of the characteristic shape of the species, owing to the fact that a view has been given with the specimen placed obliquely, so that the angle between the anterior and lateral surfaces is not apparent. The drawing has not been reversed on the stone, so that the right valve instead of the left appears. M'Coy's original description is "Trigonal, length twice the width; hinge half the length of the shell, depressed, smooth; anterior face truncated, bounded by a slightly sigmoidal ridge; beaks

acute, terminal, curved towards the anterior side; posterior margin convex." This description lays stress on the characteristic form.

In his observations M'Coy says, "This species, like *Dressina polymorpha*, has the truncated anterior face and ridge flexuous or sigmoidal." The external resemblance between this species and *Dreissensia polymorpha* is so close that, were it not for the characters of the hinge, undoubtedly the two shells would have been referred, if not to the same species, at least to the same genus; and I can see no external character to separate the fossil and recent forms. It is curious that two shells, living at such widely separated periods of time, should resemble each other so closely in external characters, and should possess such dissimilar hinges, though both possess a special shell-process for the insertion of the anterior adductor muscle. Was this form of *Myalina* the ancestor of the recent *Dreissensia*, in which the striated hinge-plate has been gradually atrophied and finally lost?

There can be little doubt that the *Mytilus Beaumonti* of de Verneuil is identical with M'Coy's shell; and although de Verneuil was aware of the similarity between them, owing probably to the meagre description given by M'Coy, he did not feel certain of the identity of the Russian and Irish specimens.

De Koninck expressed doubt as to the reference of this shell to *Mytilus*, and in the explanation of his pl. xxiv gave the name *Mytilarca*, Hall, to it, but without any generic description. He thought that the cardinal border was not striated, and so differed from *Myalina*, and that the shell might belong to *Anthracoptera*, Salter. This is not the case: for that genus, which is synonymous with *Naiadites*, Dawson ('Monogr. Carbonicola, &c.,' 1895, p. 129), I have shown, possesses a striated hinge-plate, but no shelf for the anterior muscle-scar, and the anterior part of the shell is lobular and not flattened into a surface, and the umbones are not terminal. De Koninck's reference to *Mytilarca* on the assumption of the absence of a striated hinge-plate was also equally erroneous, as this genus also possesses this character, and both cardinal and posterior teeth. De Koninck thought (1885) that the striated hinge-plate was absent from a specimen partially stripped of its shell, and figured in his pl. xxix, fig. 22; but this specimen, from its shape and outline, seems to belong to quite another species. *M. Flemingi* appears to be somewhat variable in shape and thickness, and some specimens have indication of an anterior lobe, the upper and median part of the anterior surface being somewhat produced, and much less flattened than in *M. Redesdalensis*. The Belgian specimens are somewhat finer than those I have yet seen from British rocks.

Fig. 10, Pl. IV, is a fairly perfect specimen from a bed of calcareous sandstone from the Garngad Road, Glasgow. At the time when the plates were drawn I had not seen the interior of the hinge. The discovery of a bed of marine fossils in the Millstone-grit of Pule Hill, Marsden, by Messrs. Barnes and Holroyd,

has enabled me to ascertain these details. Specimens show in reverse all the characters of the interior: the thickened hinge-plate, the hollow between the internal umbo and the anterior edge of the shell for the rostral plate, the remote entire pallial line, and the position of the insertion of the posterior adductor muscle.

The type of M'Coy's *Mytilus comptus* has unfortunately disappeared, but I think it very probable that it was one of these intermediate forms. Mr. Neilson possesses a specimen, having the same outline as that given in M'Coy's figure, which was obtained with typical *M. Flemingi* from the above-mentioned locality, and a similar series of varying forms occurs at Pule Hill.

MYALINA VERNEUILII, sp., *M'Coy*, 1844. Plate III, fig. 6; Plate IV, figs. 3—8.

AVICULA VERNEUILII, *M'Coy*, 1844. Synops. Charact. Carbonif. Foss. Ireland, p. 85, pl. xiii, fig. 19.

— — *d'Orbigny*, 1850. Prodrome Paléont., p. 136.

MYALINA VERNEUILII, *Armstrong and Young*, 1871. Carbonif. Fossils West of Scotland, p. 54.

AVICULA VERNEUILII, *Etheridge*, 1885. Brit. Foss, vol. i, Palæoz., p. 286.

Specific Characters.—Shell transversely subtrigonal, moderately flat. The anterior surface makes an obtuse angle with the rest of the shell, and projects above as a very small lobe, immediately below which the surface becomes slightly concave, while below it is convex from side to side, and from above downwards, narrowing to an edge where it joins the inferior border, which is short and obtusely rounded, the anterior limb of the curve being blunter and less regular than the posterior.

The posterior border is obliquely truncate from above downwards and backwards, slightly emarginate above, where it makes an obtuse angle with the hinge-line. The hinge-line is straight, and extends the whole length of the upper border, and forms an acute angle in front with the anterior edge of the shell.

The umbones are swollen, small, narrow, and terminal. Proceeding downwards and backwards from the umbones, and continuous with them, is a narrow ridge, which forms the angle between the anterior and lateral surfaces. This is gently rounded on either side, and becomes less and less conspicuous as it approaches the lower part of the shell, and is lost at the junction of the front and lower borders. The lateral surfaces of the shell are compressed and flattened.

The Interior.—In casts the umbo is not terminal, but is well marked off from an anterior lobe by a sulcus, which contained the process in which was the anterior adductor muscle-scar. The posterior adductor scar is large, circular, and

situated well within the posterior margin at a point about midway between the cardinal and lower borders. The pallial line is punctate, entire, and remote from the margin. The hinge-plate is thickened and striated transversely.

The Exterior.—The surface of the shell is marked with fine regular lines of growth, which arise in front close together, and arching over the ridge become separated and reflected upwards in subparallel curves, to terminate in the upper border. The surface is almost smooth in some specimens, with regularly distanced subimbricating lines on the lateral surfaces.

Localities. — England: In Millstone-grit, Pule Hill, Marsden, Yorkshire. Scotland: Upper Limestone, Auchinbeg; Middle Ironstone series, Inkerman, Paisley; Lower Limestone, Carluke; in the Lingula Ironstone and First Kingshaw Limestone; Craigenglen; Sculliongour, Campsie; Upper Limestone, Bankend, Lesmahagow; Limestone, East Kilbride; top of the Calciferous-sandstone series, St. Monans, Fife. Ireland: Arenaceous Shale, Drumcurren, Kesh, co. Fermanagh.

Dimensions.—Pl. IV, fig. 9, the original of M'Coy's figure, measures—

Greatest oblique diameter . . .	58 mm.
Length of hinge-line . . .	35 mm.
Depth of each valve . . .	6 mm.

Observations.—The type specimen of this species was obtained from Irish beds, and consists of a single valve, the left,—not, as depicted in the original drawing, a right valve. It is embedded in matrix, and not a perfect and free specimen, as the drawing would lead the readers to suppose. The possession of a small lobe anterior to the umbonal swelling is more characteristic of *Naiadites* than *Myalina*. The oblique ridge, however, is anterior, and at its front edge the valve is sharply deflected inwards; and in entire specimens the lobe is not so well developed. It would seem to be a form connecting the two closely allied genera *Naiadites* and *Myalina*. Referred to *Avicula* by M'Coy (to which genus it has only a very superficial resemblance), it has been catalogued in this genus by Etheridge, but was referred to *Myalina* by Armstrong and Young in their work, 'Carbonif. Fossils West of Scotland,' p. 53. In many Scotch collections this name is given to *M. Flemingi* (M'Coy, sp.). This species is not recognised as occurring in Belgian beds by de Koninck; and, though apparently rare in any one British locality, has a wide horizontal distribution. There appears to be a morphological plan in the specific variations of the genus *Myalina*, similar to that which obtains in *Naiadites*. There are forms of *Myalina* which, while possessing the generic characters of *Myalina*, also possess the general shape of *N. modiolaris*, *N. carinata*, *N. triangularis*, and *N. quadrata*. *Myalina Verneuilii* corresponds to *N. modiolaris*, being more regularly and transversely triangular, with a hinge-line as long as the shell or even longer.

M. pernoides corresponds to *Naiadites carinata*, being obliquely U-shaped. *Myalina lamellosa* corresponds to *Naiadites triangularis*, with a short hinge-line, but with transversely triangularly produced shell; and *Myalina peralata* has the quadrate character of *Naiadites quadrata*. Whether these four forms of each genus are strongly marked varieties, or easily recognisable species, is a moot point; but, as in the case of the four species of *Naiadites*, I have with *Myalina* retained the specific names.

The Scotch specimens are all much smaller than the type, and have the anterior lobe less well marked, though undoubtedly present.

There appears also to have existed a variety of this species, which was much more gibbose than the type specimens of this form, and which are figured on Pl. IV, figs. 5 and 6. This would appear to be a cross between *M. Flemingi* and *M. Verneuilii*, having the expanded form of the latter and the broad anterior surface of the former. All three forms seem to have been present together in the beds at Garngad Road, Glasgow.

MYALINA PERNOIDES, *Portlock*, sp., 1843. Plate IV, figs. 1, 2.

INOCERAMUS PERNOIDES, *Portlock*, 1843. Report Geology Londonderry, &c., p. 567, pl. xxxviii, fig. 5.
— — *Morris*, 1843. Catalogue of British Fossils, p. 111.
— — — 1854. Ibid., 2nd edit., p. 170.
AVICULOPECTEN ELLIPTICUS, *Baily*, 1884. Explanat. Sheet 26, Geol. Surv. Map of Ireland, p. 28.
INOCERAMUS PERNOIDES, *Etheridge*, 1888. British Foss., vol. i, Palæoz., p. 274.

Specific Characters.—Shell rhomboidal, obliquely extended in a dorso-ventral direction, of moderate size, moderately gibbose in front and above, but elsewhere compressed, flattened, and expanded. The anterior border is very long and almost straight; it may be slightly concave about the junction of the anterior and middle thirds. The inferior border is bluntly but regularly curved, the anterior limb of the curve being the more obtuse and extending further downwards than the posterior. The posterior border is much shorter than the anterior, and obliquely truncated downwards and backwards, gently convex, having a general direction almost parallel to the anterior border; it makes an obtuse angle with the hinge-line above, and passes with a gradual curve into the inferior border below. The hinge-line is straight and short, about equal in length to any diameter of the shell parallel to it. The umbones are pointed, convex, and terminal, not contiguous. From these a narrow, oblique swelling

passes downwards parallel to the anterior border, with an acute edge anteriorly, at which point the shell is bent sharply downwards at an obtuse angle, so that an anterior surface is formed by both valves when in contact, higher in the centre than at the sides. Posteriorly and above the oblique ridge the valves are gradually compressed and expanded into the borders, the oblique swelling being most marked in the upper third of the shell.

Interior.—The hinge-plate is thickened and transversely striated. The anterior adductor scar is situated on the edge of the shell in front of and above the internal umbo, which does not correspond in position with the external umbo on account of the thickness of this portion of the shell. The position of the posterior abductor and byssal muscle-scars has not as yet been observed.

Exterior.—The surface is ornamented with a number of folds and fine striæ, which are arranged parallel to the borders; commencing at the anterior border, which they follow, then curving over the edge of the oblique ridge, they expand and form a loop, the posterior end of which passes upwards to terminate in the hinge-line.

Dimensions.—Fig. 1, Pl. IV, measures—

From umbo to inferior border . . .	65 mm.
Length of hinge-line	25 mm.

Portlock's type (Pl. IV, fig. 2) measures 48 mm. in greatest diameter, and has a hinge-line of 20 mm. long.

Locality.—Redesdale Ironstone Shale, Northumberland; Ireland, from a bed of calcareous grit, Kildress River, co. Tyrone.

Observations.—This species was founded by Portlock upon a single specimen, which, being in the Geological Survey Collection, I am able to re-figure by the kind permission of Sir A. Geikie, Director-General of the Geological Survey. Only two specimens of this shell are known from British rocks,—one is the original of Portlock's type, which at first I thought might belong to the species which de Ryckholt described as *Mytilus Mosensis;* and, strange to say, only one specimen of that shell appears to have been discovered in Belgium, for it would seem that, when this species was re-described and figured in 1885 by de Koninck (*op. supra cit.*, p. 169), the drawings and observations were made from the original specimen, for he says, "Un seul spécimen de cette belle espèce a été découvert dans le Calcaire Carbonifère de Visé, par le Baron P. de Ryckholt;" and yet few would recognise that the two drawings had been made from the same shell, those by de Ryckholt being evidently, to a very large extent, idealistic. A personal examination of the original, now in the Brussels Museum, convinced me of the distinct characters of the Northumbrian and Belgian shells; the latter specimen being very beautifully and concentrically striated, though in shape and general aspect somewhat similar to Portlock's shell.

The second specimen I figure was obtained by Mr. John Dunn, who has for many years collected from the fossiliferous beds of the Redesdale district; and I am indebted to him for permission to figure and describe it.

This specimen occurred in shale, and consists of a left valve, one portion of the slab showing a fine cast of the exterior. The shell itself has somewhat disappeared, but faint traces of the striated hinge-plate and of the anterior adductor muscle-scar are to be seen.

This shell cannot be mistaken for any other, its great dorso-ventral extension and moderate convexity being characteristic of the species. The anterior portion of the shell is not so completely absent as in some members of the genus, owing to the angle made by the two portions of the shell at the ridge being greater than usual.

The *Naiadites* (*Anthracoptera*) *quadrata*, Sow., sp., has somewhat the same form as *M. pernoides;* but it is less oblique, and in large examples much more transverse relatively; and it possesses a trifid anterior muscle-scar, situated within the umbo.

Myalina Verneuilii is more transverse and not so extended downwards, though of all the species in the genus it has the greatest affinity to the one under description.

In the original description of *Myalina pernoides*, by Portlock, he says, "Beak slightly curved, and an obscure ridge extending to the margin."

Portlock speaks of another shell, somewhat akin to his *Inoceramus pernoides*, for he says in his remarks on that species, "The Derryloran shell is more gibbous and incurved, and may be called *I. gryphus*." Of this I can at present find no trace.

Baily, in the palæontological notes to the Explan. Sheet 26 (1844), Geol. Survey of Ireland, at p. 27, considers *Inoceramus pernoides* of Portlock to be a synonym of *Aviculopecten ellipticus;* but in this fact he must be mistaken, the shell having no affinity at all to that genus.

MYALINA PERALATA, *de Koninck*, 1885. Plate IV, figs. 11, 12; Plate VI, fig. 26; Plate VII, fig. 3.

MYALINA PERALATA, *de Koninck*, 1885. Faune du Calcaire Carbonifère de la Belgique, p. 172, pl. xxix, figs. 5, 12, 13.

Specific Characters.—Shell obliquely **U**-shaped, produced downwards, moderately and regularly convex. The anterior surface is less flattened than in other species, and the end formed by the junction of the valves is prominent, forming

an anterior border, which meets the hinge-line above at an acute angle; passing downwards and backwards, with a slight concavity, just above its centre it passes into the inferior border, which is bluntly rounded, the posterior limb of the curve being the more obtuse. The posterior border is almost straight or slightly convex, subparallel to the anterior border; obliquely truncate from above downwards in the upper portion, and rounded below, making an angle only a little greater than a right angle with the hinge-line above. The latter is straight, and is equal to the greatest transverse diameter of the shell, which narrows slightly on both sides from above downwards. The umbones are acute and terminal in testiferous examples. The shell is regularly convex; the greatest gibbosity being above and in front, a little below the hinge-line. In front the shell is bent at an obtuse angle from the oblique line of greatest gibbosity in the upper two-thirds, forming the anterior surface of the valve. The posterior part of the shell is compressed and expanded into its borders.

Interior.—The hinge-line is typically thickened and striated. The anterior adductor scar is shown, by the presence of a circular raised patch, in casts to be on the thickened edge of the shell below and in front of the internal beak (*i. e.* of the cast). The posterior adductor scar is very large and oval, and situated some way within the margin, equidistant from the upper and posterior borders, its inferior edge being at the middle point of the dorso-ventral diameter.

The internal umbo does not correspond with the external, being not terminal in the cast; and is marked off from the rest of the cast in front by a well-developed groove. The pallial line is at a considerable distance within the shell. The cast shows that the anterior edge of the shell was much thickened, and finely striate in its upper half.

Exterior.—The surface of the shell is ornamented by a large number of close subimbricating lamellæ, at times almost rugose, which have a direction parallel to the margins. Shell of moderate thickness.

Dimensions.—Fig. 11, Pl. IV, a cast, measures in greatest oblique diameter . . . 33 mm.
Hinge-line . . . . . 21 mm.
Elevation . . . . . 6 mm.
Fig. 12, a testiferous specimen, measures . . 33 mm.
Hinge-line . . . . . 21 mm.
Elevation . . . . . 6 mm.

Localities.—England: Carboniferous Limestone, Bolland, Hill Bolton, Yorkshire; shales below the Millstone-grit of Congleton Edge, Cheshire. Scotland: Carboniferous shales of the Calciferous-sandstone series, Eskdale.

Observations.—I have little doubt in referring the shells figured to de Koninck's species *M. peralata*, of which he gives three figures, one being a cast; but in the

text he states that only two specimens had been obtained. This species differs from most others in this genus in possessing a shell less acutely bent in front; and therefore it has not a flat anterior surface. The ridge is replaced by a more general gibbosity. De Koninck says, "Une forte gibbosité, ayant son origine au sommet des crochets, domine les valves, se rend en courbe vers l'extrémité inférieur du bord antérieur." In his remarks he notes the resemblance between his species and *Myalina recurvirostris* of Meek and Worthen ('Geological Survey of Illinois,' vol. ii, 'Palæontology,' p. 344, pl. xxvi, figs. 9 *a*—*c*), to which there is a very close resemblance; but this species seems to have had a great development of the umbones forwards, for they are shown to project about one-sixteenth of an inch in front of the rest of the shell; and the beak of the left valve is said to be "twisted," so as to make nearly one entire turn at the extreme point, which is directed obliquely forwards. A curious error has been made in the drawing. The striæ of the hinge-plate are depicted as more numerous, and the hinge-plate thicker and more expanded, behind than in front—a condition which would be impossible from the method of shell-growth from the umbones backwards.

The difference in shape between the cast and the shell is to be noted. This is due to the much-thickened anterior portion of the shell, and the non-correspondence in position and size of the umbones in the shell and the cast.

This species differs from *M. lamellosa*, of which it may after all only be a variety, simply in shape, being less oblique and having a longer hinge-line. Both forms occur together at Hill Bolton and Congleton Edge.

MYALINA SUBLAMELLOSA, *R. Etheridge, jun.*, 1877. Plate IV, fig. 15; Plate V, figs. 4—8.

MYALINA SUBLAMELLOSA, *R. Etheridge, jun.*, 1878. Quart. Journ. Geol. Soc., vol. xxxiv, p. 14, pl. i, fig. 15; pl. ii, figs. 16, 17.

— — *R. Etheridge, sen.*, 1885. Brit. Foss., part i, Palæoz., p. 286.

Specific Characters.—Shell flattened, trigonal, the anterior side obsolete. The anterior margin truncated, with a slightly sigmoidal margin, descending from the beak at rather less than a right angle. The ventral (inferior) margin is convex, passing upwards before and behind with a gradual curve into the anterior and posterior margins. The posterior part of the shell is flattened, with its margin slightly convex or subtruncate. The hinge-line is straight, equal in length to a little less than the greatest antero-posterior diameter, parallel to it, making behind

an obtuse angle with the posterior border. The umbones are acute, terminal, anteriorly curved, with a slightly prominent oblique swelling or ridge extending from each down the anterior side and close to its margin.

Interior.—The arrangement of the muscle-scars and the details of the hinge have not yet been exposed.

Exterior.—The surface is ornamented with fine concentric lines of growth, interrupted at intervals by shallow sulci.

Dimensions.—One of Mr. Etheridge's type specimens measures dorso-ventrally 16 mm., antero-posteriorly 11 mm. A flattened specimen from Abden (Pl. IV, fig. 15) measures dorso-ventrally 18 mm., antero-posteriorly 15 mm.

Localities.—In hardened cyprid shale at a quarry under Craiglockhart Hill, on the north side of Colinton Road, Edinburgh, Cement-stone group; in shale of the Calciferous Sandstone series at Abden; in the Yoredale Rocks of Swaledale.

Observations.—A shell typical of the genus, but smaller and flatter than most. I have in a very large measure adhered to Mr. Etheridge's very accurate and careful original description. In his observations the species is compared with *Mytilus* [*Myalina*] *Flemingi*, *Myalina lamellosa*, and two American species. It is then stated that "from *M. Flemingi* it may be distinguished by possessing a smaller and more truncated anterior end, the bounding ridge from the beaks being less posterior in position, a less depressed and shorter hinge-line, and a more broadly rounded ventral margin." Mr. Etheridge, jun., must have mistaken some other shell for M'Coy's type; as the anterior end being obsolete, and the bounding ridge from the beaks forming the margin of the flattened anterior face, it cannot possibly be said to be posterior in position to that in *M. sublamellosa*. Really the species under description is a much flatter shell, less acutely angular in transverse contour, and without such a markedly expanded anterior surface as that of *M. Flemingi*. I am enabled to figure some specimens obtained by Mr. Bennie for the Geological Survey of Scotland, from the locality whence the originals for Etheridge's description came, by the kindness of the Director-General; also some on a small slab, containing several examples, collected by Miss J. Donald from Swaledale.

It has occurred to me that this species may only be a dwarfed form of *M. Verneuilii* (M'Coy), but I have no evidence to support this assumption. The name "sublamellosa" suggests an affinity to de Koninck's shell, *M. lamellosa*, to which the species under description has no resemblance beyond a generic one. The original type examples are, I believe, preserved in the Museum of Science and Art at Edinburgh.

MYALINA COMPRESSA, sp. nov., *Hind.* Plate V, figs. 2, 3.

Specific Characters.—Shell much compressed, flattened, and expanded, subquadrate; anterior end quite obsolete. The anterior border of the shell is rounded and not well defined, arcuated and sinuously curved, concave above, convex below, passing insensibly into the broadly curved inferior border. The posterior border is convex in outline, joining the hinge-line at an obtuse angle. The hinge-line is straight, shorter than the transverse diameter of the shell. The umbones are pointed, anterior, and project forwards. The anterior part of shell is somewhat swollen, and forms an anterior surface, which is convex from side to side, and concave from above downwards. The gibbose portion of the shell is very limited; the remainder is flattened and expanded posteriorly. The right valve is much flatter than the left.

Interior.—The umbones of casts are pointed and separated by a wedge-shaped trench. The posterior adductor scar is large, situated close to and just below the posterior end of the hinge-line. Pallial line entire.

Exterior.—Not known. The greatest thickness of the shell is anterior and just below the umbones.

Dimensions.—Pl. V, figs. 2, 3, measures—

Vertical diameter	18 mm.
Horizontal diameter	18 mm.
Thickness of cast	6 mm.

Locality.—A marine band in the Coal-measures of South Staffordshire.

Observations.—This species is founded on certain casts in the possession of Mr. Johnson, of Dudley. They are typical of the genus, showing the space in front between the umbones (for the thickened hinge-plate), which gradually narrows and becomes linear. The posterior adductor muscle-scar is well marked, very high up, and close to the hinge-line—a condition very different from that which obtains in all the other species of which the interiors are known. This character has caused me to consider the species as separate from that described by Messrs. Meek and Worthen as *Myalina meliniformis* in the 'Proceedings of the Chicago Academy of Science,' vol. i, p. 19, 1866, and also in 'Geological Survey of Illinois,' vol. ii, 'Palæontology,' p. 343, pl. xxvii, fig. 3, where the posterior adductor scar is shown to be in the normal situation. One of the specimens which I figure (Pl. V, fig. 3) has very faint indications towards the lower part of the left valve of surface-markings. These are concentric, with occasionally stronger lines standing out in relief.

It is unfortunate that the exact horizon where these shells occur is not known, and also that testiferous examples are not to hand.

Since writing the above I have received Dr. Tornquist's work, 'Das fossilführende Untercarbon in den Südvogesen,' 1896, in which he describes a new species of *Myalina*—*M. tenuisulcata*—p. 66, pl. xvii, fig. 10, which is very similar to the above; and, if the two forms are shown to be identical, Dr. Tornquist's specific name must take the place of *compressa*.

MYALINA LAMELLOSA, *de Koninck*, 1842. Plate IV, figs. 13, 14, 14 *a*, 14 *b*.

MYALINA LAMELLOSA, *de Koninck*, 1842. Anim. foss. terrain Carbonif. Belgique, p. 126, pl. iii, fig. 6.
— VIRGULA, *de Koninck*, 1842. Ibid., p. 127, pl. vi, fig. 3.
— LAMELLOSA, *Bronn*, 1848. Nomenclat. Palæontolog., p. 763.
— VIRGULA, *Bronn*, 1848. Ibid., p. 763.
MYTILUS LAMELLOSA, *d'Orb.*, 1850. Prodr. Paléontol., vol. i, p. 135.
AVICULA VIRGULA, *d'Orbigny*, 1850. Ibid., p. 138.
MYALINA LAMELLOSA, *Morris*, 1854. Catal. Brit. Foss., p. 214.
— — *Armstrong and Young*, 1876. Catal. Western Scottish Fossils, p. 54.
— — *Bigsby*, 1878. Thesaur. Devonico-carboniferus, p. 309.
— VIRGULA, *Bigsby*, 1878. Ibid., p. 309.
MYTILUS VIRGULA, *Bigsby*, 1878. Ibid., p. 311.
MYALINA LAMELLOSA, *de Koninck*, 1885. Ann. Musée. Roy. d'Hist. Nat. de Belgique, tom. xi, p. 169, pl. xxix, fig. 11.
— — *Etheridge*, 1888. Brit. Foss., part i, Palæoz., p. 286.

Specific Characters.—Shell of moderate size and variable shape; obliquely elongated and roughly triangular; thickened anteriorly, compressed and subalate posteriorly. The anterior border is straight, sloping downwards and backwards, and the valve is expanded, so that the shell has a well-marked anterior surface. The inferior border is bluntly rounded. The posterior border is thin and truncate from above downward, making an obtuse angle with the posterior end of the hinge-line, which is straight and short. The umbones are small, pointed, and terminal. Extending backwards and downwards to the junction of the anterior and superior borders is a well-marked oblique gibbosity, with a rapid slope anteriorly, but posteriorly to it the shell is gradually compressed and expanded.

Interior.—The hinge-plate is expanded and longitudinally striated. Mantle-line and muscle-scars normal in arrangement.

Exterior.—The surface is covered with a large number of moderately fine concentric lamellæ, more or less imbricated.

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

Antero-posteriorly	32 mm.
Dorso-ventrally	19 mm.
From side to side	14 mm.

Localities.—England: The Carboniferous Limestone of Hill Bolton, Yorkshire, and Thorpe Cloud, Derbyshire.

Observations.—This species was one of the first of the genus described by de Koninck, and it has been freely reported from nearly every British locality of Carboniferous Limestone; but at the time of arranging the plates I was able to obtain only two specimens (both in the collection of the Geological Survey at Jermyn Street) which belonged to the species in question. Since then I have obtained several specimens from the limestone of Hill Bolton, near Grassington, and from Thorpe Cloud, Dovedale, in some of which the details of the hinge and interior are finely shown. I regret that they were found too late to be drawn on the plates for this Part. I have noted, in my remarks on *M. peralata*, the distinguishing characters between these two forms. I believe that most of the forms reported in various lists as belonging to *M. lamellosa* should be more correctly referred to *M. Verneuilii* or *M. Flemingi*. This species appears to be a connecting link between the two forms, being flatter than *M. Flemingi* and more gibbose than *M. Verneuilii*. The specimen figured on Pl. IV, fig. 14, has on its reverse side a portion of the hinge-plate visible, and shows also the pallial line.

I find that the specimen of this species figured by de Koninck in his first work (1842) differs essentially in shape from that given in his later publication (1885), the former resembling very strongly the series I figure on Pl. V, figs. 15 to 19, of *Posidoniella elongata*. I think it not at all unlikely that some of the other species figured by de Koninck, *e. g.* *M. amœna* and *M. bursa*, may be shown, when a larger number of specimens have been collected, to be merely varietal examples of *M. lamellosa*. De Koninck himself recognised in his later work (*op. supra cit.*) that one of the original species of this genus, *M. virgula*, was only a variety of *M. lamellosa*.

Family ARCIDÆ.

Genus Parallelodon, *De Koninck*, 1885.

Synonyms:

Arcites, *Martin*, 1809. Petrifact. Derbiensia, pl. xliv, fig. 7.
Arca, *Sowerby*, 1825. Min. Conch., vol. v, p. 115, pl. cccclxxiii, fig. 2.
— *Fleming*, 1828. Hist. Brit. Anim., p. 399.

Modiola, *Phillips*, 1836. Geol. Yorks., part 2, p. 209.
Cucullæa, *Phillips*, 1836. Ibid., p. 210.
Arca, *de Koninck*, 1842. Anim. foss. Belg., p. 111.
Cypricardia, *de Koninck*, 1842. Ibid., p. 92.
Cucullæa, *Morris*, 1843. Cat. Brit. Foss., p. 84.
Pullastra, *Portlock*, 1843. Geol. Londonderry, p. 440.
Arca, *M'Coy*, 1844. Synop. Carb. Foss. Ireland, p. 71.
Cucullæa, *M'Coy*, 1844. Ibid., p. 72.
Byssoarca, *M'Coy*, 1844. Ibid., p. 72.
Venerupis, *M'Coy*, 1844. Ibid., p. 67.
Psammobia, *M'Coy*, 1844. Ibid., p. 53.
Pullastra, *M'Coy*, 1844. Ibid., p. 54.
Modiola, *M'Coy*, 1844. Ibid., p. 74.
Lanistes, *M'Coy*, 1844. Ibid., p. 76.
Arca, *de Verneuil*, 1845. Géol. Russie, vol. ii, p. 313.
Mytilus, *de Ryckholt*, 1847. Mélanges paléontol., part 1, p. 143, pl. viii, figs. 18, 19.
Byssoarca, *King*, 1849. Monog. Perm. Foss., p. 171.
Arca, *Brown*, 1849. Foss. Conch., p. 191.
Cucullæa, *Brown*, 1849. Ibid., p. 193.
Arca, *de Koninck*, 1851. Supplément Anim. Foss. Belg., p. 670.
— *d'Orb.*, 1851. Prodrome Pal., vol. i, p. 134.
Cypricardia, *d'Orb.*, 1851. Ibid., p. 130.
Omalia, *de Ryckholt*, 1853. Mélanges Pal., pt. 4, p. 72.
Macrodon, *M'Coy*, 1855. Brit. Palæoz. Foss., p. 510.
Arca, *Cox*, 1857. Third Report Geol. Surv. Kentucky, p. 567.
— *Shumard and Swallow*, 1858. Trans. Acad. Sci. St. Louis, vol. i, p. 209.
— *d'Eichwald*, 1860. Lethæa Ross., vol. i, pt. 1, p. 986.
— *Winchell*, 1863. Proc. Acad. Nat. Sci. Phil., p. 15.
Macrodon (Parallelodon), *Meek and Worthen*, 1866. Proc. Chicago Acad. Sci., p. 17.
— *Dawson*, 1868. Acadian Geol., p. 302.
Arca, *Dawson*, 1868. Ibid., p. 304.
Macrodon (Parallelodon in foot-note), *Meek and Worthen*, 1870. Proc. Acad. Nat. Sci. Phil., p. 40.
— — — 1873. Geol. Surv. Illinois, vol. v, p. 575.
Arca, *Young and Armstrong*, 1874. Trans. Geol. Soc. Glasgow, vol. iv, p. 276.
Macrodon, *Meek*, 1875. Geol. Surv. Ohio, vol. ii, pt. 2, p. 334.
Arca, *Armstrong and Young*, 1876. Catal. West. Scot. Foss., p. 53.
— *Römer*, 1876. Lethæa Geogn., pl. xliv, fig. 12 *a*.
— *Bigsby*, 1878. Thesaur. Devonico-Carb., pp. 298–9.
— *Koenen*, 1879. Neues Jahrbuch für Min., p. 336.
Carbonarca, *Barrois*, 1882. Terr. Anc. Asturias, p. 337, pl. xvii, fig. 1.
Macrodon, *Walcott*, 1884. Monogr. U.S. Geol. Surv., vol. viii, p. 243.
Parallelodon, *de Koninck*, 1885. Ann. Mus. d'Hist. Nat. Belge, vol. xi, p. 140.
Arca, *Etheridge*, 1885. Brit. Foss., part i, Palæoz., p. 279.
Modiola, *Etheridge*, 1885. Ibid., p. 285.

Psammobia, *Etheridge*, 1885. Brit. Foss., part 1, Palæoz., p. 289.
Macrodon, *Hall*, 1885. Pal. New York, vol. v, pt. 1, No. 2, pp. xxviii and 349.
— *Miller*, 1889. N. Amer. Geol. Pal., p. 487.
— *Worthen*, 1890. Geol. Surv. Illinois, pt. 8, p. 123.
Parallelodon, *Whidborne*, 1892. Monogr. Devonian Fauna (Pal. Soc.), vol. ii, pt. 1, p. 39.
Macrodon, *Keys*, 1894. Geol. Surv. Missouri, vol. v, pt. 2, p. 120.
Macrodus, *Tornquist*, 1896. Fossil-führ. Untercarbon in den Südvogesen, p. 84.

Generic Characters.—Shell subrhomboidal, with a compressed dorsal slope, which is bounded below by a ridge or rounded swelling, expanded posteriorly; borders, as a rule, subparallel. Hinge consisting of several small oblique teeth in front, and a few long subparallel teeth behind, not extending the whole length of the shell. A ligamental area is always present. Surface, even in the smoothest forms, shows transverse striæ with, as a general rule, radiating striæ, at least on the dorsal slope.

Observations.—The name *Parallelodon* was first brought into use by de Koninck, though he assigns the origin of the term to Meek and Worthen. As a matter of fact, the name was invented by these authors, but never adopted by them; and it is evident that they did not recognise that the Carboniferous Arciform shells, though closely allied to Lycett's *Macrodon* of the Lias, were distinct from it. In a note to the description of *Macrodon tenuistriatus* (*op. supra cit.*) Messrs. Meek and Worthen expressed themselves as follows :—" Should it be thought desirable to change the name of this extinct genus, in consequence of the fact that Müller had used it for a genus of fishes in 1842, it might be called *Parallelodon*, from its elongated parallel posterior teeth." They do not seem to have adopted this term themselves; but, in common with all American authors, use the name *Macrodon*, Lycett, for the Arciform shells of the Devonian-Carboniferous period.

The following is the description by Lycett of his new genus *Macrodon*, at p. 98 of Murchison's ' Outline of the Geology of the Neighbourhood of Cheltenham,' 1845 :—" General figure that of *Byssoarca* ; umbones small, situated near the anterior extremity of the shell, and separated from each other by an area, an hiatus in the ventral margin for the passage of a byssus, producing a corrugation in the edge of the shell bordering it. Hinge-line straight and extended ; that of right valve has six oblique parallel teeth placed at its anterior extremity, the innermost tooth or posterior one extending the whole length of the hinge-line. The left valve is destitute of teeth, but has fissures to receive the teeth of the other valve. The muscular impressions closely resemble those of *Cucullæa*, the anterior having a sharp prominent ledge projecting from the side of the shell ; the posterior one expanded and indistinct." It will be noticed that the genus *Macrodon* has not the diverging subparallel elongate teeth of *Parallelodon*, and that the anterior teeth are fewer in

the latter genus. The anterior adductor muscle-scar in *Parallelodon* has no sharp, prone edge.

All the other characters enumerated above are those of the family *Arcidæ*, and are not of generic value. *Fischer* points out, in his 'Manuel de Conchyliologie,' 1885, p. 976, that *Macrodon* "diffère de *Parallelodon* par ses dents antérieurs oblique et non subhorizontales." The anterior teeth in *Parallelodon*, however, are not subhorizontal, but oblique. A number of genera have been described from time to time with very similar characters. *Palæarca*, Hall, 1858, which Tate, in his Appendix to Woodward's 'Manual of the Mollusca,' 1875, p. 70, says is synonymous with *Megalomus*, Hall, 1852; *Cyrtodonta*, Billings, 1858; and *Cypricardites*, Conrad, 1841. The general characters are those of *Arca*, but the hinge has "two to eight oblique anterior teeth beneath or a little in front of the umbones; two to four remote lateral teeth, parallel with the hinge-line." These lateral teeth, Fischer states, are very oblique. The distribution of *Palæarca* is Silurian-Devonian.

Nemodon, Conrad, from the Chalk, has the form of *Macrodon;* hinge with three teeth in front parallel to the hinge-line, and two long lamelliform teeth behind.

Thus we have a series of genera, represented in several beds from the Silurian to the Chalk, which have much the same external form and characters, but differ slightly from each other in details of hinge character, chiefly due to a variation in the obliquity and length of the teeth. There can be little doubt that, had the shells from the various systems occurred in one bed, the variations in the hinge could have been regarded as of specific value only.

The difference in the hinge details of *P. squamifer* (Phillips), *P. squamosus*, de Kon., and *P. decussatus*, M'Coy, are as great as those on which the various genera enumerated above are founded. Much will remain to be done in the matter of nomenclature, but no real attempt can be made in this direction until the accurate description of the Lamellibranchiata of all the geological epochs has been accomplished. Then a revision of all the generic names will be absolutely necessary; and I am strongly of opinion that the custom of inventing new names for every form of a family which happens to occur in a different system of strata will be found to be based on faulty observation, and that genera and even species survived for much longer periods than is at present recognised.

The hinge characters at once separate *Parallelodon* from *Arca*, *Byssoarca*, and *Cucullæa*, to which the Carboniferous shells were for the most part referred by the early palæontologists. Phillips, however, described a typical form as *Modiola*. M'Coy referred species of this genus to no less than eight genera; but the poorness of his specimens, absence of details of hinge-structure, and the retention of the "genera" of previous authors probably in a very great measure account for this confusion.

Barrois adopted Meek and Worthen's name *Carbonarca* for a shell from the Carboniferous series of Spain, *C. Cortazari*. He describes it as having oblique teeth in front and parallel teeth posteriorly, and therefore it differs from the diagnosis of *Carbonarca* as laid down by the authors of that genus,[1] which is "cardinal margin a little arched, with, at the anterior extremity in each valve, two rather oblique, comparatively stout teeth, and extending along its entire length, from immediately behind these, a row of minute interlocking teeth or crenulations, as in *Arca*."

De Koninck describes forty-three species of *Parallelodon* from the Carboniferous Limestone of Belgium, twenty-eight of which are new, four of the new species being founded on single specimens. He was, however, mistaken in placing the *Cucullæa arguta* of Phillips in this genus, to which it has no affinity whatever.

The genus *Omalia* was invented by de Ryckholt (1853) to receive a number of uncertain species that had been placed under various genera (Modiola, Avicula, Pullastra, Cypricardia, Mya, Venus, Venerupis, and Pterinea) at different times. *Modiola amygdalina*, Phillips, from the Devonian strata, heads this heterogeneous list, and therefore there is no question of the name standing for those shells which, having a place lower down the list, do not conform to the type. I am not aware that any one of the shells mentioned possesses the peculiar generic characters affirmed of it.

Four of the species which I now refer to *Parallelodon* are included in this list—*Pullastra bistriata*, M'Coy; *Modiola squamifera*, Phillips; *Modiola concinna*, M'Coy; and *Venerupis cingulatus*, M'Coy. The diagnosis given for the genus Omalia (p. 73) is quite unsuitable for these shells, being—"Ces coquilles sont dépourvues de dents à la charnière, que le ligament est intérieure, ... que les impressions palléales, d'ailleurs assez superficielles, montrent un sinus non anguleux, comparativement profond," &c.

I am in doubt as to whether some or all of the species described as *Cypricardinia* by Hall,[2] from the Devonian beds, should not really be referred to *Parallelodon*. Several shells figured by him bear a close resemblance to *P. bistriatus*, which de Koninck has shown to possess the characteristic hinge. The date of *Cypricardinia* is 1859, and the name would therefore take precedence of *Parallelodon*. *Cypricardinia scalaris* of the Devonian of Devonshire resembles *P. cingulatus* very closely. All that Hall says of the hinge of this genus is, "Hinge-line marked by a long fold or lateral tooth in one valve; cardinal teeth not determined." Fischer does not place the genus *Cypricardinia* in any family; but, comparing the figured species with *P. bistriatus* and *P. cingulatus*, it seems to me that the *Arcidæ* is the proper group for them to be placed in.

It is interesting, from an evolutionist's point of view, to note that the striated hinge-plates of some of the *Aviculidæ* and *Mytilidæ* (*Myalina*, *Naiadites*, &c.) are

[1] 'Geol. Surv. Illinois,' vol. vi, 1875, p. 530.

[2] 'Geol. Surv. N. York: Palæontology,' vol. iii, 1859, p. 266.

represented by a few subparallel posterior hinge-teeth in *Parallelodon*. Doubtless, too, the striæ seen in the elongated ligamental area are the homologues of some of the striæ in the anterior portion of the hinge-plates of *Myalina* and allied genera.

There seem to be three well-divided sub-groups in the genus *Parallelodon*, to which, however, I do not propose to give subgeneric names, but merely indicate the subdivisions.

Group A. With transverse, widely separated, imbricating lamellæ :

P. squamifer.
P. squamosus.
P. Verneuilianus.
P. cingulatus.
P. bistriatus.

Group B. With reticulate markings :

P. cancellatus.
P. reticulatus.
P. corrugatus.
P. semicostatus.
P. Lacordaireanus.
P. Walciodorensis.
P. concinnus.
P. ornatissimus.
P. tenuistriatus.
P. decussatus.
P. fallax.

Group C. Surface smooth, with transverse, or with microscopic lines only :

P. obtusus.
P. theciformis.
P. Geinitzi.
P. Haimeanus.
P. Fraiponti.

Parallelodon squamifer, *Phillips*, sp., 1836. Plate VIII, figs. 4—8.

Modiola squamifera, *Phillips*, 1836. Geol. Yorkshire, pt. 2, p. 209, pl. v, fig. 22.
Non Cypricardia squamifera, *de Koninck*, 1842. Anim. Terr. Carb. Belg., p. 92, pl. iii, fig. 11.
Modiola squamifera, *Morris*, 1843. Catal. Brit. Foss., p. 92.
— scalaris, *M'Coy*, 1844. Carbonif. Foss. Ireland, p. 75.
— squamifera, *Brown*, 1849. Illust. Foss. Conchology, pl. lxxii, fig. 39.
Cypricardia squamifera, *d'Orb.*, 1850. Prodrome Paléontol., vol. i, p. 130.
Omalia squamifera, *de Ryckholt*, 1851. Mélanges Paléont., p. 74.
Modiola squamifera, *Morris*, 1854. Catal. Brit. Foss., 2nd edit., p. 210.
Cypricardia squamifera, *Bigsby*, 1878. Thesaur. Devonico-Carbonif., p. 305.

Modiola squamifera, *Bigsby*, 1878. Ibid., p. 307.
— (Cypricardia?) squamifera, *Etheridge*, 1885. British Fossils, part 1, Palæoz., p. 285.

Specific Characters.—Shell subarciform, tumid, transversely oblong, wider in the dorso-ventral direction behind than in front. The anterior end is very short, and is the narrowest part of the shell. The shell is moderately convex, but above is hollowed out just in front and below the umbonal swelling. The junction with the hinge-line is rounded; the anterior border is subelliptically curved, the lower limb descending rapidly downwards and backwards, and joining imperceptibly the lower margin, which is almost straight, and is directed backwards and slightly downwards. The posterior border is obliquely truncate from above downwards and backward, straight above, but very bluntly rounded below, so that there are two subangular points, one above, a little below the centre, where the straight portion of the posterior border joins the curved, and one below, where the posterior and inferior borders join.

The hinge-line is straight, equal in length to about four-fifths of the greatest length of the valve; elevated behind, and joins the posterior border at an obtuse angle.

The umbones are very blunt, incurved, and tumid, not contiguous, raised above the hinge-line, and situated in the anterior fifth of the shell. They are not marginal, but a narrow, elongate area exists between them and the edge of the valves.

The valves are evenly swollen; but there is an almost obsolete compression a little in front of the middle line, marked by a very slight irregularity in the surface-markings. A well-defined posterior umbonal ridge, starting from the apex of the umbo, passes backwards and downwards to terminate at the junction of the straight and curved portions of the posterior border. Above this line, and between it and the elevated posterior portion of the hinge-line, the valve is compressed and hollowed so as to be concave. The tumidity of the shell extends close up to the posterior border, and the valves are close all round. There appears to have been a byssal notch in front.

Interior.—No specimen shows the position and character of the muscle-scars. The hinge-plate is thickened. The extreme anterior portion is not known. Just beneath the umbo there is a transversely elongated portion, which behind divides into four or five elongate, slightly diverging ridges, separated by grooves, which form the posterior lateral teeth.

Exterior.—The surface is adorned with few (ten to twelve) subequidistant, narrow, regularly elevated, imbricating ridges, separated by broad, flat, almost smooth spaces. These ridges are oblique to the long axis of the shell, and, though moderately close in front, separate as they pass over the shell from before backwards, and are continued over the posterior umbonal ridge to terminate in the

hinge-line. Posteriorly the lower portion of the spaces between the ridges is adorned with almost obsolete radiating ribs.

Dimensions.—Pl. VIII, fig. 4, measures—

Antero-posteriorly	49 mm.
Dorso-ventrally (greatest at post. superior angle) .	24 mm.
From side to side	18 mm.

Localities. — England: Carboniferous Limestone of Settle and Bolland, Yorkshire; Castleton, Derbyshire. Ireland: Graigne, co. Limerick; represented by one poor specimen in the Geological Survey Collection, Dublin.

Observations.—Fortunately the type specimen of Phillips's *Modiola squamifera* is still preserved in the Gilbertson Collection in the British Museum (Natural History), South Kensington, and I am permitted by the kindness of the authorities to re-figure it (Pl. VIII, fig. 5). The exposure of the hinge in two specimens in the Geological Survey Museum, Jermyn Street (Pl. VIII, figs. 6 *a* and 7), together with the general contour of the shell, shows that Phillips's original reference of this species to *Modiola* was an error, and that the shell belongs to the *Arca* group; and from the long, diverging, posterior teeth at the posterior part of the hinge-plate to the genus *Parallelodon*, unfortunately I have been unable to isolate the anterior portion of the hinge.

The species *P. Verneuilianus* is the one that most closely resembles *P. squamifer*, but it is more quadrate and less elongate, and has radiating markings very highly developed all over the surface of the valves between the imbricating lamellæ. In *P. squamifer*, however, radiating markings are rarely seen, and, if present, only at the extreme posterior part of the shell. This is well shown in fig. 8, Pl. VIII, a specimen from Settle, in the Burrow Collection of the Woodwardian Museum, Cambridge. It is unfortunate that no other details of the interior are exposed in any of the specimens that I have been able to examine.

This shell appears to be rare even in those localities where it does occur.

PARALLELODON VERNEUILIANUS, *de Koninck*, 1842 and 1885. Plate IX, figs. 13—17 *a*, *b*, *c*.

ARCA VERNEUILIANA, *de Koninck*, 1842. Anim. foss. Carb. Belgique, p. 120, pl. ii, fig. 12.

CUCULLÆA VERNEUILIANA, *Bronn*, 1848. Nomencl. Palæont., p. 361.

ARCA VERNEUILIANA, *d'Orb.*, 1850. Prodrome Paléont., vol. i, p. 134.

— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 299.

PARALLELODON VERNEUILIANUS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 156, pl. xxiv, figs. 31—33.

Specific Characters.—Shell only of medium size, transverse, subtrapezoidal, slightly oblique, and only slightly swollen. The anterior end is small, compressed, and narrowed in its dorso-ventral diameter. Its border is semicircularly rounded below at the expense of the anterior inferior angle, but is straight above, and makes a right angle with the hinge-line. The inferior border is slightly curved with its convexity downwards, more so at either extremity. The posterior border is straight, obliquely truncate from above downwards and backwards, forming an obtuse angle above with the hinge-line, and a blunted acute angle below. The hinge-line is straight, and as long as the greatest transverse diameter of the shell.

The umbones are small, swollen, pointed, directed forwards and inwards, only slightly raised above the hinge-line, and situated at the junction of the anterior and middle thirds of the cardinal border. They are close but not contiguous, and are separated by a narrow ligamental area. Passing downwards and backwards from the posterior border of the umbo is a well-marked angular ridge, which becomes less conspicuous as it approaches the posterior inferior angle, and separates the body of the shell from the compressed and hollowed dorsal slope; in front of the diagonal ridge the valves are slightly but regularly convex.

Interior.—The details of the interior have not been observed in British specimens. De Koninck (*op. supra cit.*, p. 157) states that the hinge possesses three elongate posterior teeth, subparallel with the cardinal border.

Exterior.—The surface is ornamented with several (ten to fifteen) subequidistant, prominent, rough, imbricating, concentric lamellæ; separated by slightly hollowed concentric spaces, wider behind than in front, which become less concave and flatter towards the lower border. These spaces are covered by regular, close, fine, radiating striæ, interrupted by each concentric lamella, visible to the naked eye, and becoming coarser on the posterior slope. In the neighbourhood of the byssal sinus there is considerable irregularity to be seen in the concentric lamellæ.

Dimensions:

	Antero-posteriorly.	Dorso-ventrally.	Laterally.
Pl. IX, fig. 13 measures	25 mm.	15 mm.	11 mm.
Pl. IX, fig. 14 . .	25 mm.	15 mm.	—

Localities.—England: The Carboniferous Limestone of Castleton, Derbyshire; Wetton, Staffordshire. Ireland: The Carboniferous Limestone of Little Island, co. Cork.

Observations.—This is a readily distinguished species, and is easily diagnosed from all others by the very distinctive ornament. It forms, however, a natural link between *P. squamifer*, which has, as a rule, only the strong concentric lamellæ common to both species, and the other species of the genus, as *P. reticulatus* and *P. tenuistriatus*, which possess a radiating ornament largely in

excess of the concentric markings. Even where *P. squamifer* possesses radiation on the interlamellar surfaces this is very large, and only found on the posterior slope. It is of interest that the two species occur together in the same bed of limestone on Trey cliffs, Castleton.

As far as I can ascertain, this species has not hitherto been described from Great Britain. I am permitted by the kindness of the possessors to figure four specimens (Pl. IX, figs. 14—17) from the cabinet of Mr. Joseph Wright, from Little Island, co. Cork, and another example (Pl. IX, fig. 13), from the cabinet of Mr. W. F. Holroyd.

The English example (Pl. IX, fig. 13) is a much coarser shell, with the concentric lamellæ more conspicuously raised than obtains in the Irish examples; but the shape and details of the ornament are precisely identical, and the difference is due probably entirely to environment, the comparative dimensions being the same in both the Castleton and the Little Island shell.

The Irish series fortunately show the species at various stages of growth, and it is to be remarked that the typical ornament is present even in the smallest example, Pl. IX, fig. 17. This specimen is the most perfect of the series, and I have had enlarged drawings, as well as those of natural size, made of it to show the view from above, fig. 17 *c*, and the ornament of the valves, fig. 17 *a*.

PARALLELODON BISTRIATUS, *Portlock*, sp., 1843. Plate IX, figs. 5—12.

CYPRICARDIA SQUAMIFERA, *de Koninck*, 1842. Anim. Foss. Carbonif. Belgique, p. 92, pl. iii, fig. 11.
PULLASTRA? BISTRIATA, *Portlock*, 1843. Geol. Londonderry, p. 440, pl. xxxvi, fig. 13.
— — *M'Coy*, 1844. Carb. Foss. Ireland, p. 54, pl. xiii, fig. 22.
— — *Bronn*, 1848. Nomencl. Palæont., p. 1059.
OMALIA BISTRIATA, *de Ryckholt*, 1853. Mélanges Paléont., part 2, p. 75, pl. xiv, figs. 19, 20.
PULLUSTRA BISTRIATA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 222.
— — *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. viii.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 311.
OMALIA BISTRIATA, *Idem*. Ibid., p. 311.
PULLASTRA BISTRIATA, *Etheridge*, 1885. Brit. Foss., part 1, Palæozoic, p. 289.
PARALLELODON BISTRIATUS, *de Koninck*, 1885. Annal. Mus. Hist. Nat. Belgique, vol. xi, p. 142, pl. xxi, figs. 7—9; pl. xxvi, figs. 13, 14.

Specific Characters.—Shell equivalve, small, clavate, somewhat compressed, almost pointed posteriorly, somewhat oblique. The anterior end is very short, but produced downwards, so that it has the largest dorso-ventral diameter of the

shell; its border is bluntly and somewhat obliquely rounded, and passes with a regular curvature into the inferior border, which is almost straight in its anterior two-thirds, and may be slightly concave downwards about the centre; the posterior third sloping gradually upwards to meet the lower part of the posterior border, and forming a narrow acutely rounded postero-inferior angle. Above this angle the posterior border is long and straight, obliquely truncate from before backwards and from above downwards, making a very obtuse and therefore almost imperceptible angle with the hinge-line, which is straight, short, and very slightly raised posteriorly, projecting very slightly in front of the umbones. The umbones are small, pointed, curved inwards and forwards, and somewhat raised above the hinge-line; close, but not contiguous, and situated very far forwards. Passing downwards and backwards from the umbones to the upper part of the pointed postero-inferior angle is a well-defined angular ridge, marking a flexure in the valve, which separates the upper and lateral surfaces. Above this ridge the shell is expanded and compressed laterally, and there is a broad hollow in the posterior slope on the outer side of the edge of each valve. Laterally the valves are gently convex, and become gradually compressed towards the lower border.

Interior.—The position of the muscle-scars and the details of the hinge have not been observed in British specimens; but De Koninck describes the hinge, from a Belgian example, as having three little very oblique and short anterior teeth, and two very thin posterior teeth, parallel to the cardinal border, which, however, do not occupy the whole of the space between the umbo and the posterior extremity.

Exterior.—The surface is ornamented with well-marked, regular, more or less imbricating flattened concentric folds, which are wider behind than in front, and covered with a very beautiful, finely reticulate, zigzag pattern, especially well marked in the posterior portion of the shell. This marking seems to be confined to a thin outer layer of the shell, which has frequently been accidentally removed.

Dimensions.—Pl. IX, fig. 9, a full-grown example from the Carboniferous Limestone of Park Hill, near Longnor, measures—

Antero-posteriorly	19 mm.
Dorso-ventrally	10 mm.
Laterally	8 mm.

Localities.—England: The Carboniferous Limestone of Thorpe Cloud, Castleton, and Park Hill, Derbyshire; Wetton Hill and Waterhouses, Staffordshire. Ireland: In the Carboniferous Shales of Benburb and Aghaloo, co. Tyrone; Carboniferous Limestone of Seafield, Wexford; Carboniferous Slate of Poulscadden, Howth; and Lisnapaste, Ballintra.

Observations.—This species was doubtfully referred to the genus *Pullastra* by

Portlock, in which he was followed by M'Coy and others. The true generic character was discovered by de Koninck in 1885. This talented observer had, however, long before that date recognised that the shell had none of the characters of *Pullastra*, and had referred it to *Cypricardia*, but curiously at that time mistook the shell for a much larger example of the same genus, *Parallelodon squamifer* (Phillips).

De Koninck was fortunate enough to obtain a specimen showing the character of the hinge; but he states (p. 142), "Je regrette vivement que ce spécimen ne soit parvenu après le tirage de la planche sur laquelle l'espèce est représentée."

P. bistriatus is very closely allied to two other species determined by de Koninck, *P. elegantulus* and *P. normalis*. There is, however, a slight difference in shape between the species, and the former is stated to be devoid of the reticulated ornament possessed by *P. bistriatus*. With regard to this character, it is entirely absent in decorticated specimens, one of which is represented at Pl. IX, fig. 7.

Portlock noted the occurrence of striated and smooth forms together, and while referring the latter to *Venus elliptica?*, Phillips, says (*op. supra cit.*), "I am disposed to think they belong to the same species." Whatever the smooth specimens may have been, it is quite certain that the *Venus elliptica* of Phillips is an entirely different shell from *P. bistriatus*, and I therefore suspect that they were semi-decorticated examples.

M'Coy re-described the species (*op. supra cit.*), stating that it was "exceedingly common in the Carboniferous Slate of several districts in Ireland;" but unfortunately he gave an impossible figure, which shows a long hinge-line pointed behind, with a posterior border hollowed and sulcated above, and with which the description, "posterior end obliquely subtruncate, hinge-line straight, three-fourths the length of the shell," hardly corresponds.

Of British species of *Parallelodon*, the one which approaches most closely to *P. bistriatus*, and which has been confounded with it by Etheridge, is *P. cingulatus*, M'Coy. This is markedly inequivalve, less transverse, more oblique, less pointed posteriorly, with a strongly curved inferior border, and it differs in ornament by having its concentric folds less flattened and often distinctly raised into ribs, and by having no radiating striæ. Both species occur together at Castleton and Thorpe Cloud, Derbyshire. No other species of the genus *Parallelodon* has the peculiar zigzag reticulate ornament which obtains in *P. bistriatus* as far as has been observed up to the present. This ornament, however, is not always reticulate, but is sometimes V-shaped, as on the posterior end of the shell figured at Pl. IX, fig. 5 *a*.

I am fortunately able, by the kindness of Sir A. Geikie, to reproduce the figure of Portlock's type-specimen of *Pullastra bistriata* preserved in the Museum of the Geological Survey at Jermyn Street, Pl. IX, fig. 12. It is the right valve

of a shell of medium size. A right valve, which is said to have served as the type of M'Coy's figure, is also reproduced, Pl. IX, fig. 11, by the kind permission of Dr. Scharff, Director of the Science and Art Museum, Dublin, where it is preserved in the Griffith Collection. This is a very small shell indeed, and it is very probable that it is not the figured specimen at all; because, although the figure at Pl. XIII, fig. 20, of M'Coy's work (*op. sup. cit.*) appears to be that of a "right valve," yet, as in "The Synopsis" none of the drawings were reversed on the stone, the original must have been a left valve, and the shell which I now figure is that of a right valve, and only half the size of M'Coy's figure.

PARALLELODON CINGULATUS, *M'Coy*, sp., 1844. Plate IX, figs. 1—4.

VENERUPIS CINGULATUS, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 67, pl. x, figs. 1 *a*, *b*.
CYPRICARDIA CINGULATUS, *d'Orb.*, 1850. Prodrome Paléont., vol. i, p. 130.
VENERUPIS CINGULATUS, *Bigsby*, 1878. Thesaur. Devonico-Carboniferus, p. 315.
— — (*vide* PULLASTRA BISTRIATA), *Etheridge*, 1888. Brit. Foss., part 1, Palæoz., p. 291.

Specific Characters.—Shell inequivalve, the right valve being more convex and higher than the left, gibbose, obliquely quadrilateral, produced posteriorly. The anterior end is almost obsolete, compressed, narrow, overlapped above by the umbones, which project forwards, and form the most anterior portion of the valve. The anterior border is curved, and passes gradually into the inferior border, which is directed obliquely downwards and backwards; and, although but gently convex downwards in front, becomes strongly so in the posterior two-thirds, where it is curved upwards to join the posterior border, which is straight and obliquely truncate from above downwards and backwards, becoming bluntly rounded as it joins the inferior border. The hinge-line is straight, equal in length to about two-thirds of the greatest (antero-posterior) diameter of the valve, somewhat elevated posteriorly, where it joins the posterior border at a very obtuse angle. The umbones are anterior, small, pointed, convex, curved inwards and forwards, raised above the hinge-line, and the right one very much higher than the left. Proceeding downwards and backwards to the posterior inferior angle is a well-marked angular fold, below which the valve is evenly convex, the right being the more so; above the fold the shell is compressed and hollowed on each side of the hinge-line.

Interior.—The details of the interior have not at present been observed in British specimens.

Exterior.—The surface is ornamented with regular, eccentric, sub-imbricating

folds, the lower edges of which are raised into rib-like processes, more pronounced on the right valve than on the left, and becoming wider apart towards the lower border of the shell. There is no trace of radiating lines, as a rule, or of zigzag markings.

Dimensions.—Pl. IX, figs. 1 *a*, *b*, measures—

Antero-posteriorly	19 mm.
Dorso-ventrally	11 mm.
Laterally	8 mm.

Localities.—England: the Carboniferous Limestone of Trey Cliff, Castleton, and Thorpe Cloud, Derbyshire. Ireland: Lower Limestone; Howth.

Observations.—I am permitted by the kindness of Dr. Scharff to re-figure the original specimen of M'Coy's *Venerupis cingulatus*, now in the Griffith Collection of the Museum of Science and Art, Dublin. M'Coy's description is "transversely elongate, oval, cylindrical, very convex; beaks close to the anterior side, which is very small, rounded; posterior side elongated, obliquely truncated, rounded; surface with about ten or eleven large, angular, concentric ribs, which are sometimes crossed by fine longitudinal striæ." He remarks, "In this species the concentric ribs are very regular; they are large, angular, and sharp above."

The type specimen (Pl. IX, fig. 4) is not well preserved; but, although fragmentary, shows very markedly the obliquity of the shell. I can see no traces of radiating striæ on the wax-cast that has been sent me for study, and cannot bear out M'Coy's observation that the ribs are "sometimes crossed by fine radiating striæ," though such a character might be almost expected in the genus. Mr. Etheridge seems to have been of the opinion that this species was a synonym of *Pullastra bistriata* (Portlock); but the two species are very distinct, and I have indicated the chief points in the different published diagnoses in my "Observations" on that species, p. 135.

P. cingulatus is the only species of the genus which has unequal valves, and this character is very marked indeed (see figs. 1, 1 *a*, 1 *b*, 2, 2 *a*, Pl. IX). It will be interesting to note if this character is accompanied by any concomitant change in the details of the hinge. I hazard the suggestion that this character may afford an indication of the descent of the genus *Parallelodon* from some unequal-valved ancestor, a subject which I have referred to previously, p. 129.

PARALLELODON SQUAMOSUS, *de Koninck*, sp., 1842. Plate IX, figs. 18—22, 22 *a*.

ARCA SQUAMOSA, *de Koninck*, 1842. Anim. foss. terr. Carb. Belgique, p. 121, pl. ii, figs. 13 *a*, *b*.

— FIMBRIATA, *de Koninck*, 1843. Ibid. (parmi les corrections), p. 634.

ARCA FIMBRIATA, *Bronn*, 1848. Nomencl. palæont., p. 94.
— — *d'Orb.*, 1850. Prodrome paléont., vol. i, p. 134.
— — *Armstrong and Young*, 1876. Catal. Western-Scot. Foss., p. 53.
— SQUAMOSA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 299.
— — *Etheridge*, 1885. Brit. Foss., part 1, Palæozoic, p. 280.
PARALLELODON FIMBRIATUS, *de Koninck*, 1885. Annales Musée Hist. Nat. Belgique, vol. xi, p. 155, pl. xxiv, figs. 44, 45.

Specific Characters.—Shell of only moderate size, transversely subquadrate, obliquely swollen. The anterior end is short, compressed; its border almost straight above, where it makes a rounded right angle with the hinge-line, and semicircularly curved below, where it joins the inferior border, which is gently rounded, with its convexity downwards. The posterior border is almost straight, obliquely truncate (de Koninck). The hinge-line is straight, about as long as the greatest transverse diameter of the shell. The umbones are small, pointed, non-contiguous, but close; raised above the hinge-line, and situated in the anterior fourth of the hinge-line. Between the umbones is a well-marked, deeply sunk ligamental area, striated longitudinally. The valves are moderately swollen above and obliquely from the umbones to the posterior inferior angle, flattened below, and much compressed and expanded at the posterior superior angle.

Interior.—The details of the muscle-scars are unknown. The hinge consists of a few small teeth in front, placed obliquely from above downwards and backwards, and two very fine linear teeth posteriorly.

Exterior.—The surface is raised into a few (eight to twelve) concentric lamellæ, which are convexly swollen from above downwards, and have their lower borders imbricating. These folds are separated by concentric V-shaped grooves, and become wider as they pass from the front to the posterior part of the valve. There is an obscure angulation in the folds where they become bent upwards to reach the superior border. The folds and grooves appear to be quite smooth, without any trace of radiating lines.

Dimensions:

	Antero-posteriorly.	Dorso-ventrally.	Elevation of valve.
Pl. IX, fig. 19, measures	18 mm. (estimated)	13 mm.	5 mm.

Localities.—England: The Carboniferous Limestone of Settle and Hill Bolton, Yorkshire; Wetton, Staffordshire.

Observations.—*Parallelodon squamosus* is a very easily distinguished species, differing decidedly in shape and ornament from all other species of the genus.

Originally described by de Koninck (*op. supra cit.*) as *Arca squamosa*, the specific name was altered to *A. fimbriata*, in the Appendix, for reasons of nomenclature. Incidentally in the same year M'Coy adopted the same name for a

totally different species of the same genus, and I am unable to decide on the priority in this case; but fortunately the reference of the Palæozoic Arcas to *Parallelodon* permits the retention of de Koninck's original specific name.

The only British specimens which I have been able to examine are unfortunately all incomplete posteriorly; consequently I have been compelled to follow the description of this part of the shell as given by de Koninck, who states that the posterior border is shorter than the anterior, owing to the rapid upward curvature of the posterior part of the inferior border.

De Koninck figures two specimens of *P. squamosus* in his later work, which are the extreme terms of variation in a species which he describes as very variable (p. 156), " Elle varie entre celle representée, pl. xxiv, fig. 44, et celle de la pl. xxv, fig. 15, que j'avais d'abord considérée comme spécifiquement différente, mais que se relie à la première par des specimens intermédiares."

On the same page (p. 156) he proceeds to describe the specimen figured on his pl. xxv, fig. 15, as a new species, under the name of *P. undatus*, of which he says, " ce Parallelodon ressemble au *P. fimbriatus* par les plis de sa surface qui sont cependant plus minces et plus lamelleux; et en diffère considérablement par sa petite taille et par sa forme relativement beaucoup plus allongée."

I have been fortunate enough to isolate the greater part of the hinge in a specimen (Pl. IX, fig. 22, of which 22 *a* is an enlarged drawing) in the Burrow Collection of the Woodwardian Museum, Cambridge, which, with others of this species, I am permitted to figure by the kindness of Professor McKenny Hughes. Two other specimens are in the Collection of the Geological Survey, Jermyn Street, from the Carrington Collection, one of which, Pl. IX, fig. 18, is figured; and these, with one other from Hill Bolton, near Grassington, in my own collection, are all the specimens of this species that I have any knowledge of. It is, therefore, probably very rare.

PARALLELODON CORRUGATUS, *de Koninck*, 1885. Plate X, figs. 16—19.

PARALLELODON CORRUGATUS, *de Koninck*, 1885. Ann. Musée R. Hist. Nat. Belge, vol. xi, p. 160, pl. xxv, figs. 1, 2.

Specific Characters.—Shell of moderate size, subrectangular, and gibbose. The anterior portion of the shell is compressed and narrowed. Its border is rounded above, forming an obscure lobe at the anterior superior angle; it then descends downwards and inwards, becoming semicircularly curved into the inferior border, which is almost straight, but markedly sinuated at the junction of the anterior

and middle thirds for the byssal opening. The posterior border is obliquely truncate from above downwards and backwards in its upper portion, but broadly rounded below. The hinge-line is straight, joining the anterior border with a rounded right angle, but making an obtuse angle behind with the posterior border.

The umbones are tumid, obtuse, elongated, twisted forwards, raised above the hinge-line, and widely separated. They are situated in the anterior third of the valve, and are somewhat excavated in front where the umbo commences to rise from the surface of the valve. Internal to the umbones, and separating them, is a large ligamental area, with almost parallel borders, which are slightly concave inwards, so that the area vanishes posteriorly. The surface of this area is finely striated antero-posteriorly.

Arising from the umbo, and forming its posterior and upper border, is a fairly pronounced keel, which passes downwards and backwards to the lower part of the posterior border. The shell in front of this line is markedly tumid, but has a well marked but shallow byssal sinus. Behind and above the ridge the valve is rapidly compressed into the upper border, so as to become slightly concave.

Exterior.—The valves are ornamented with well-marked and regular concentric folds, parallel to the borders, and separated by grooves, which have about double the width of the ridges. In the neighbourhood of the byssal sinus these folds and grooves are all slightly arched, so as to become concave downwards. The umbonal portion of the valves is almost smooth, and the markings are more pronounced over the most tumid portion of the shell, and near the inferior border. The folds and grooves are crossed by fine, radiating lines, more pronounced in the grooves than on the ridges, and almost absent on the posterior slope.

Interior.—Very few details have been noted. The anterior muscle-scar has not been exposed. The posterior scar is large, and situated on the posterior slope, well within the margin, and bounded below by the groove representing the oblique ridge. The pallial sinus is situated some distance from the margin, and is entire.

The hinge is narrow in the middle two-thirds, and thickened anteriorly and posteriorly. Further details are wanting.

Dimensions.—Fig. 16, Pl. X, measures—

Antero-posteriorly	40 mm.
Dorso-ventrally	20 mm.
Depth of valve laterally . . .	13 mm.

Localities.—The Carboniferous Limestone of Settle, Yorkshire; and Castleton, Derbyshire.

Observations.—This species was founded by de Koninck, on a few specimens, all more or less uncomplete, from the limestone of Visé. I have only met with five examples, all of which are unfortunately fragments. Four of them are

in the Burrow Collection in the Woodwardian Museum of Cambridge, and I am indebted to the authorities for permission to figure and study their specimens.

Fig. 16, Pl. X, gives a fair idea of the general shape of the shell and the characteristic markings of the external surface. It also shows, owing to a removal of the posterior part of the test, the posterior adductor muscle-scar and the entire pallial sinus.

Fig. 17, Pl. X, shows the large ligamental area and the hinge-line; though, unfortunately, owing to the fact that the specimen probably had been much rolled before it was embedded, details of the hinge are almost absent. There seem to be some obscure crenulations, just anterior to the umbo, which may indicate teeth; and the thickening of the anterior and posterior ends of the hinge-plate seems to show that they once bore the teeth characteristic of other shells of this genus.

Figs. 18 and 19, Pl. X, are younger forms, but show the external folds and sulci very plainly.

De Koninck thought that the species under description came nearer to *P.* (*Byssoarca*) *reticulatus* (M'Coy), which also possesses a large ligamental area; but in this species the radiating striæ are much more marked, and the transverse markings are fine, narrow, and more numerous. *P. corrugatus* appears to occupy a position between *P. Verneuilianus* and *P. reticulatus*.

PARALLELODON RETICULATUS, *M'Coy*, sp., 1844. Plate IX, figs. 23—25 *a*; Plate X, figs. 1—4; Plate XII, fig. 1.

BYSSOARCA RETICULATA, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 73, pl. xii, fig. 9.

? LANISTES RUGOSUS, *M'Coy*, 1844. Ibid., p. 76, pl. x, fig. 8.

CUCULLÆA RETICULATA, *Brown*, 1849. Illus. Foss. Conch., p. 193, pl. lxxviii, fig. 13.

ARCA RETICULATA, *d'Orbigny*, 1850. Prodrome de paléontol., vol. i, p. 134.

— — *Bigsby*, 1875. Thesaurus Devonico-Carboniferus, p. 299.

— — *Etheridge*, 1885. British Fossils, part 1, Palæozoic, p. 280.

Specific Characters.—Shell transversely oblong, trapezoidal, moderately gibbose. The anterior end is short, convexly swollen, and its border is straight above, semicircularly curved below, where it passes uninterruptedly into the inferior border. The latter is long and almost straight, and parallel to the cardinal border, but becomes curved upwards at its posterior end to join the posterior border. The

latter is truncate and straight above, and though variable, as a rule, very slightly oblique downwards and backwards, but bluntly rounded below. The hinge-line is straight, as long as the greatest diameter of the shell, making an angle which is either a right angle, or only slightly greater than a right angle, with the posterior border, and a blunted right angle with the anterior border. The umbones are large, swollen, curved inward, and twisted very slightly forwards, non-contiguous, raised above the hinge-line, and situated about the junction of the anterior and middle thirds of the hinge-line. There is a well-marked elongated ligamental area, interior to the umbones, which does not, however, extend the whole length of the shell. Proceeding downwards and backwards from the upper edge of the umbones to the posterior inferior angle is a rounded ridge, marking off the compressed and hollowed dorsal slope from the rest of the valve, which is generally convex, but in its middle third there is a flattening or compression in the region of the byssal sinus.

Interior.—The anterior adductor muscle-scar is shallow, round, and situated just within the anterior superior angle of the shell; that of the posterior adductor muscle is also circular, larger than the anterior scar, and very shallow, situated on the posterior slope at some little distance from the posterior extremity, and a little way below the cardinal border. The pallial line is entire and distant from the margin. The hinge-plate is thickened in front, and has anteriorly several (eight) small oblique, shallow teeth; posteriorly there are two to three linear teeth. The inner surface of the shell is smooth except on the dorsal slope, where there are obscure radiating striæ.

Exterior.—The surface is adorned with fine, regular, concentric lines of growth and striæ, which near the margin become deeper and rugose. These are decussated by radiating striæ, which are crowded in the neighbourhood of the umbones, and become more widely separated and stronger as they approach the lower border of the valves. On the posterior slope the radiating striæ become so much coarser as to be developed into distinct ribs, but even there they are crossed by the concentric lines of growth. In the neighbourhood of the byssal sinus the concentric lines become irregular, and exhibit a small concavity directed downwards.

Dimensions.—Pl. IX, fig. 25, measures—

Antero-posteriorly	50 mm.
Dorso-ventrally	27 mm.
Elevation of valve	10 mm.

Localities.—England: the Carboniferous Limestone of Settle and Grassington, Yorkshire; Castleton and Park Hill, Derbyshire. Ireland: the Carboniferous Limestone (Lower) of Millicent, co. Cork; Clane and Killmallock. Scotland: the Carboniferous Limestone of Clatteringwell Quarry, Kingswood, Kinross; Upper Limestone, Gare; Lower Limestone, Craigenglen.

Observations.—This is, perhaps, the most common of all species of *Parallelodon* in the Carboniferous Limestone of England, and reaches a greater size than any other species. It appears to occupy an intermediate position between *P. cancellatus* and *P. Walciodorensis*, being more transverse with finer radiating striæ and a less acute, oblique diagonal ridge than the former; but with a stronger ridge, more strongly marked radiating concentric lines, forming the characteristic reticulate ornament, than obtains in the latter. In casts, even, it is possible to distinguish these three forms. In the interior of *P. cancellatus*, Pl. X, figs. 6 and 8, the radiating lines are more strongly ribbed on the body of the shell; in the interior of *P. reticulatus* radiating lines are found on the dorsal slope only, but no trace of such radiating lines to be seen on casts of *P. Walciodorensis*.

The reticulate ornament of the species under notice varies much in detail in different specimens; the reticulations being much larger in the shell from Settle, here figured, Pl. X, fig. 4.

It is interesting to note that de Koninck does not describe this species amongst the forty-three forms which he figures from Belgian Carboniferous strata.

The shape of the posterior end and of the posterior superior angle appears to be somewhat variable; but it is very difficult to obtain perfect examples.

I think it probable that the *Byssoarca clathrata* of M'Coy is only the young form of the shell under discussion, but, as the original specimen has disappeared, it is impossible to speak with any degree of certainty on the subject.

PARALLELODON CANCELLATUS, *Martin*, sp., 1809. Plate X, figs. 5—9, 9 *a*.

ARCITES CANCELLATUS, *Martin*, 1809. Petrificata Derbiensia, pl. xliv, fig. 7.
ARCA CANCELLATA, *Sowerby*, 1824. Min. Conch., vol. v, p. 115, pl. cccclxxiii, fig. 2.
— — *Fleming*, 1828. Hist. of Brit. Animals, p. 399.
— LACORDAIRIANA, *de Koninck*, 1842. Anim. Foss. terr. Carb. Belge, p. 119, pl. ii, fig. 14.
— CANCELLATA, *Brown*, 1849. Illustr. Foss. Conch., p. 190, pl. lxxvii, fig. 18.
CUCULLÆA CANCELLATA, *Brown*, 1849. Ibid., p. 193, pl. lxxviii, figs. 14 and 16.
BYSSOARCA COSTELLATA, *M'Coy*, 1854. Synopsis Carb. Foss. Ireland, p. 72, pl. xi, fig. 36.
ARCA CANCELLATA, *M'Coy*, 1854. Ibid., p. 71.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 299.
— COSTELLATA, *Bigsby*, 1878. Ibid., p. 299.
— CANCELLATA, *Etheridge*, 1885. Brit. Foss., part 1, Palæoz., p. 279.
— COSTELLATA, *Etheridge*, 1885. Ibid., p. 279.

Cf. PARALLELODON COMOIDES, *de Koninck*, 1885. Ann. Musée Hist. Nat. Belge, vol. xi, p. 159, pl. xxiv, fig. 52.

Specific Characters.—Shell of moderate size, transversely produced, convex. The anterior end is small, compressed, and the narrowest part of the shell. Its border, commencing above near the hinge-line, with which it makes a right angle, rapidly descends backwards in a broad curve, so that the anterior superior angle is the most anterior portion of the shell. The inferior border is nearly straight, with a well-marked byssal sinus in anterior third, and near the posterior inferior angle the lower border is raised in a slight curve to meet the posterior border, making with it an angle a little less than a right angle. The posterior border is straight and obliquely truncate from above downwards and backwards. The hinge-line is straight and long. The umbones have a broad base where they spring from the valve, are raised above the hinge-line, and are placed in the anterior fifth of the shell. The beaks are incurved, and apparently directed forwards by the angulation of the posterior border, and are non-contiguous. Internal to the umbo is a narrow elongate area, broadest in front, becoming gradually narrower till it vanishes posteriorly. Descending from the umbo backwards and downwards to the posterior inferior angle is a sharp ridge, dividing the shell into two unequal portions. Above and posterior to this ridge the shell is so much compressed as to become concave from above downwards; anterior to the ridge the valve is evenly and regularly curved, except where there is an oblique irregular sinus corresponding to the successive byssal apertures formed during the growth of the shell.

Interior.—The adductor muscle-scars are shallow, not having left an impression in the casts examined. The hinge-plate is narrow in the middle, and broadens behind and in front; the posterior portion shows two or three subparallel, narrow, elongate teeth or ridges. The anterior portion has not been exposed. The inner surface of the shell is crossed by numerous radiating blunted ridges and grooves, especially well marked near the lower border and close to and in front of the oblique line corresponding to the diagonal ridge. There are one or two distant concentric grooves, more marked in the position of the byssal sinus. The pallial line is entire and remote from the margin.

Exterior.—The whole of the surface is covered by radiating folds, more marked between the byssal sinus and the oblique ridge, especially so near the lower margin of the valve at this point. The hollow of the dorsal slope has also well-marked radiating folds. These lines are decussated by concentric lines of growth, which are so marked in front and behind the byssal sinus that the radiating folds are decomposed into lines of tubercles. In the neighbourhood of the byssal sinus the concentric lines are bent somewhat irregularly, and are concave downwards.

Dimensions :

	Pl. X, fig. 5.		The type specimen, Pl. X, fig. 7.
Antero-posteriorly (estimated) . .	38 mm.	...	29 mm.
Dorso-ventrally . . .	21 mm.	...	18 mm.
Elevation of valve . . .	12 mm.	...	5 mm.

Localities.—England : the Carboniferous Limestone of Settle, Yorkshire, and Park Hill, Derbyshire. Ireland : Blacklion Upper Limestone. The species was described by M'Coy without a locality. The type of this species came from Derbyshire, but no locality was mentioned by Martin.

Observations.—This species is distinguished from all others by the strength of the radiating lines, which become distinct ribs, and are marked even on the interior of the valves (as seen in casts), and by the diagonal ridge between the body of the shell and the dorsal slope, which is stronger in this species than in any others. M'Coy calls attention to this fact in his description of *Byssoarca costellata* (p. 72), which is as follows :—" Width twice and a half the length, very convex; beaks rather large, prominent; anterior end short, pointed; posterior end rectangular; posterior slope separated from the body of the shell by a very steep ridge; entire surface ornamented with equal, rounded, radiating ribs." The type specimen seems not to be in the Griffith Collection at the Dublin Natural History Museum; and, although it seems to have been immature, there is no difficulty in recognising such a well-marked shell as belonging to Martin's species.

The shell upon which Martin founded his species, " *Arca cancellata*," and which was subsequently figured by Sowerby (*op. sup. cit.*) is probably one preserved in the Sowerby Collection at the British Museum (Nat. Hist.); and by the kind permission of the authorities I am able to figure this specimen, Pl. X, fig. 7. It is somewhat more fully grown than M'Coy's specimen, and has the test well preserved. The acute ridge and truncated posterior end are well marked. Sowerby says of it, " From the Derbyshire Limestone, apparently the same shell that was figured by Mr. Martin." Martin says of it, " A fossil shell, the original an Arca. The hinge straight, extending the whole breadth of the shell. Valves equal, somewhat rhomboidal; their anterior extremity sloped and angular, the other end more rounded; surface cancellated with longitudinal and transverse equal striæ. The beaks small, placed nearer the rounded extremity." The shell is not to be identified from the figure; but this is immaterial, as the original of Sowerby's shell is still in existence. The description given by that author is, " Twice as wide as long, convex, longitudinally and transversely sulcated; anterior [posterior] side defined by a keel, truncated posterior side rounded; marginal sinus short, but deep; beaks nearly close."

M'Coy recognised this species as occurring in the Irish Carboniferous Limestone, and even goes so far as to give a diagnosis (p. 71), but without

re-figuring the shell. In this description he says, "posterior diagonal ridge rounded; surface equally cancellated by coarse, radiating, and transverse sulci;" and "the reticulations on the posterior slope are similar to those on the body of the shell." Why should he have altered the "anterior [posterior] extremity sloped and *angular*" of Martin into the "posterior diagonal ridge *rounded*" if, as I take it, "angular" referred not to the border, but to the slope?

M'Coy described the posterior end as rectangular; but I am of opinion, from observation of the shell figured, Pl. X, figs. 5, 7, and 9, that this is not quite correct, the angles in adult specimens not being right angles. It is to be noted that the smaller of these two shells is more nearly rectangular than the larger one, and that in young shells such was the shape of the posterior extremity. Martin's type is certainly not rectangular.

Casts have the radiating striæ much more strongly marked over the surface of the valve, especially just anterior to the angulated oblique keel, Pl. X, figs. 6, 8, and 9; and this fact distinguishes casts of this species from all others of the genus.

Judging from the figure and description, the shell used for the diagnosis of *Arca Lacordairiana*, de Koninck, in 1842, belongs to the species under discussion. The acute posterior inferior angle, strong oblique keel, and the comparative measurements, are very characteristic. *Parallelodon comoides* of the same author is very probably a synonym of the same species.

Fig. 9, Pl. X, is a small specimen preserved in the Museum of the Geological Survey, Jermyn Street, from Park Hill, which shows the posterior teeth of the hinge, an enlarged view of which is given in fig. 9 *a*. These teeth are also to be seen in fig. 6, Pl. X.

PARALLELODON LACORDAIRIANUS, *de Koninck*, 1885. Plate X, fig. 10.

Non? ARCA LACORDAIRIANA, *de Koninck*, 1842. Anim. Foss. Terr. Carb. Belgique, p. 119, pl. ii, figs. 14 *a*—*c*.

PARALLELODON LACORDAIREANUS, *de Koninck*, 1885. Ann. Musée Roy. Hist. Nat. Belge, vol. xi, p. 157; pl. xxiv, figs. 48, 49; pl. xxv, figs. 19—21.

Specific Characters.—Shell transversely rhomboidal, evenly swollen, of medium size. The anterior end is very short and evenly rounded in contour. Its border, almost straight above, becomes broadly rounded, and passes into the inferior border, which is regularly curved with the convexity downwards, but interrupted a little anterior to its centre by a byssal notch. The posterior end is straight and obliquely truncate from above downwards, joining the lower border by a rounded obtuse angle, and making an obtuse angle also with the hinge-line above. The

hinge-line is straight, a little shorter than the greatest length of the shell. The umbones are obtuse, gibbose, elevated above the hinge-line, incurved, non-contiguous, and situated in the anterior quarter of the shell. The umbones rise very gradually from the surface of the shell. Behind, the umbonal slope is continued downwards and backwards, till it becomes lost near the posterior inferior angle. This slope is gently rounded, without any approach to a ridge. Above and behind this the posterior slope is quickly compressed, so that it becomes concave before it reaches the posterior part of the upper border.

The surface of the valve is uniformly curved from above downwards, and from before backwards; an almost imperceptible flattening marking the byssal sinus.

The *interior* of the shell is at present not known from British specimens, but de Koninck states that the hinge is composed of three or four anterior teeth, somewhat short and oblique; posterior teeth very elongate, laminar, and sub-parallel to the cardinal border. The area internal to the umbo is of moderate size.

Exterior.—The surface of the valve is ornamented with fine concentric striæ, which are interrupted towards the lower border by strong, unequal, subimbricating folds. Fine, regular, radiating striæ are seen all over the shell, most strongly marked in the posterior two-thirds.

Dimensions.—Pl. X, fig. 10, measures—

Antero-posteriorly	34 mm.
Dorso-ventrally	20 mm.
Elevation of valve	8 mm.

Locality.—England: the Carboniferous Limestone of Trey Cliff, Castleton.

Observations.—There is much ambiguity about this species, which has been quoted from several British localities; and this uncertainty no doubt results from the very great difference in the shells described by Prof. de Koninck in his two great works. I cannot but think, both from the figures and description, that the shells figured in his later work are of a different species from those depicted in the former. I will quote and compare portions of the two descriptions which appear to me to be contradictory.

Arca Lacordairiana, 1842 (p. 119).	*Parallelodon Lacordaireanus*, 1885 (p. 157).
Posterior border.—"Fortement tronqué et formant avec l'inférieur un angle aigu."	"Un peu obliquement tronqué et plus angleleux vers le bord ventral."
Ventral border.—"Les bords cardinal et inférieur sont à peu près parallèles."	"Celui-ce est arqué."
Oblique posterior slope.—"Son corcelet est bordé par une forte carène oblique."	"Carène oblique et obtuse."
Dimensions.—7 ∴ 8 : 18.	16 ∴ 20 : 40.

The strongly-marked keel and acutely angulated posterior inferior angle are characteristic of *P. cancellatus*, to which, I am of opinion, the shell described in

1842 really belongs. This shell is not reproduced in the later work, but entirely new examples are depicted.

Most of the specimens in the museums in Britain bearing the label "*Arca Lacordaireana*" are narrow elongate forms, easily distinguished from that species by the narrow dorso-ventral measurement. At present I am able to give only one English locality for this species, the shells quoted as belonging to it from other places being distinctly different. On account of the uncertainty mentioned above, I have omitted in the list of synonyms all references made to this species where figures and descriptions are absent.

The anterior end is much shorter in the specimen which I think may belong to *P. Lacordairianus* than in those more closely resembling it; and this fact, taken with the absence of any angularity in the obtuse ridge, great comparative depth (dorso-ventrally and laterally), and the finer ornament of the valves, serves to distinguish it from other species of the genus. But it is possible a larger number of specimens might demonstrate that the shell which I figure is only a variety of the species to be described next.

PARALLELODON WALCIODORENSIS, *de Koninck*, 1885. Plate X, figs. 11—15.

PARALLELODON WALCIODORENSIS, *de Koninck*, 1885. Annales Musée Roy. Hist. Nat. Belge, vol. xi, p. 161, pl. xxx, figs. 13, 27, 28, and 43.

? — TENUISTRIA, *de Koninck*, 1885. Ibid., p. 162, pl. xxv, figs. 36, 40, 44; pl. xxvi, fig. 4.

Specific Characters.—Shell of moderate size, elliptically transverse, relatively very moderately gibbose, but regularly convex. The anterior end small, and somewhat compressed. Its anterior superior angle is a right angle, below which the border is semicircularly curved, and passes without break into the inferior border, which is feebly convex in its greater portion, but more so at each extremity. The posterior border is straight and obliquely truncate from above downwards. The posterior inferior angle is bluntly rounded, and is the most posterior portion of the shell. The posterior superior angle is a little greater than a right angle. The hinge-line is straight, and quite as large as the longest transverse diameter of the valve. The umbones are swollen and obtuse, raised above the hinge-line, incurved, and almost contiguous, being separated by an almost linear ligamental area. They are situated in the anterior quarter of the hinge-line.

The valves are compressed immediately in front and also at the posterior superior angle, above a line passing from the posterior border of the umbo to the posterior inferior angle; elsewhere they are regularly convex, more so from above downwards than from before backwards. The greatest convexity is subumbonal.

Interior.—Muscle-scars normal in position. Hinge-plate very indistinctly known, but with two or three long, posterior lateral teeth. Internal surface smooth, with obsolete radiating lines.

Exterior.—The surface is ornamented with very fine concentric lines, here and there one being so pronounced as to be subimbricating; but the concentric markings are over the posterior two-thirds of the valve quite secondary in appearance to the radiating lines, which are fine, straight, regular, and under the microscope punctate. In the anterior third of the shell the concentric lines are the most prominent, and these are very irregular in the line of the byssal sulcus. Shell thin.

Dimensions.—Pl. X, fig. 13, measures—

Antero-posteriorly	38 mm.
Dorso-ventrally (at umbo) . . .	23 mm.
Elevation of valve	8 mm.

Localities.—The Carboniferous Limestone of Settle and Hill Bolton, Yorkshire; Castleton, Derbyshire. Scotland: Pot-metal Plantation, Bogie, Kirkcaldy.

Observations.—This species has not been previously noted in the Carboniferous beds of Great Britain, but has been confounded with *P. tenuistria*, which it resembles somewhat. But it is easily distinguished by the broad posterior end, and the presence of well-marked concentric lines of growth. I think that most of the species referred by de Koninck to *P. tenuistria* should, for this reason, more properly be placed under *P. Walciodorensis*.

Remarking on *P. tenuistria*, de Koninck says (p. 162), "Quoique les ornements dont la surface de cette espèce est couverte soient un peu plus apparents que ceux que M. F. M'Coy a fait représenter par le dessin qu'il a publié de sa *Cucullæa tenuistria*, je ne crois pas me tromper en identifiant avec elle l'espèce que je viens de décrire; elle n'a d'ailleurs de l'analogie qu'avec le *P. Walciodorensis*, qui s'en distingue par une hauteur relativement moins grande et par la profondeur plus forte des striés qui servent à produire les ornements garnissant sa surface." It is evident, therefore, that the essential difference in the contour of the posterior end was not grasped by de Koninck, probably because he had only specimens of *P. Walciodorensis* for examination.

P. Lacordairianus, which has some resemblance to the species under discussion, is distinguished by the less transverse, more quadrate form, but narrowed posterior end, large ligamental area, blunter gibbose umbones, and greater convexity of the valves.

The University of Cambridge possesses a fine series of *P. Walciodorensis* in various states of growth, all obtained by the late Mr. Burrow from the Carboniferous Limestone of Settle, and some of these I have been permitted to figure, Pl. X, figs. 11, 12.

PARALLELODON TENUISTRIA, *M'Coy*, sp., 1844. Plate XI, figs. 1—4 *a*.

CUCULLÆA TENUISTRIA, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 72, pl. xii, fig. 10.
ARCA MACCOYANA, *de Koninck*, 1851. Supplement Anim. Foss. Carb. Belg., p. 670, pl. lvii, figs. 8 *a—c*.
CUCULLÆA TENUISTRIA, *Morris*, 1854. Cat. Brit. Foss., p. 197.
— — *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 92.
— TENUISTRIATA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 305.
— TENUISTRIA, *Etheridge*, 1885. Brit. Foss., part 1, Palæoz., p. 282.
? PARALLELODON TENUISTRIA, *de Koninck*, 1885. Ann. Musée Roy. Hist. Nat. Belge, p. 162, pl. xxv, figs. 36—40, 44; pl. xxvi, fig. 4.
Non MACRODON TENUISTRIATUS, *Meek and Worthen*, 1867. Proc. Chicago Acad. Sci., vol. i, p. 17.
— — — *Meek*, 1872. U. S. Geol. Surv. Final Report Nebraska, p. 207, pl. x, figs. 20 *a*, *b*.

Specific Characters.—Shell transversely oblong, subcylindrical. The extreme anterior end compressed, but elsewhere, except on the dorsal slope, the valves are regularly convex and gibbose. The anterior end is short; the anterior superior angle projects forwards, below which the border is semicircularly curved, and so passes into the inferior border. This is convex in front, slightly so in its median portion, and almost straight posteriorly, but directed somewhat upwards. The posterior border is narrower than the greater portion of the shell, truncate from above downwards and somewhat backwards, and almost straight, making an obtuse angle above with the hinge-line, and a rounded obtuse angle below with the inferior border. The hinge-line is straight, and equals the longest diameter of the shell. The umbones are small, gibbose, approximate, slightly raised above the hinge-line, and situated in the anterior fourth of the hinge-line. The ligamental area is narrow and elongate. The valves are flattened at the anterior superior and posterior superior angles; elsewhere they are regularly swollen from before backwards, and above downwards. The posterior slope is comparatively narrow and hollowed out, but not bounded below by a ridge.

Interior.—The muscle-scars are normal in situation, but very indistinct and shallow. The pallial line is entire and remote from the margin. Of the hinge-plate I am only acquainted with the anterior portion, which is similar to that in the other species of *Parallelodon*.

Exterior.—The surface is ornamented by regular, fine, radiating striæ, which become more marked as they approach the inferior border, being almost invisible to the naked eye near the umbones.

Transverse markings are almost obsolete, though occasionally here and there some indications of these growth-lines may be traced.

Dimensions.—Pl. XI, fig. 4, the type specimen, measures—

Antero-posteriorly	49 mm.
Dorso-ventrally	21 mm.
Laterally	22 mm.

Localities.—Ireland: The Carboniferous Limestone of Garrahies, Co. Kerry; Townland of Cruicerdth, three and a quarter miles south-east of Drogheda, Co. Meath; Cregg and Nobber, Co. Meath; in Yellow Sandstone at Bruckless.

Observations.—This species, as far as I am aware, is confined to the Carboniferous beds of Ireland, and was one of the forms described by M'Coy in his early work (1844). I am fortunately able, by the kindness of the authorities, to reproduce the figures of the original specimen (Pl. XI, fig. 4), now preserved in the Griffith Collection, Dublin Museum of Science and Art. The other specimens are in the Collection of the Geological Survey of Ireland, under the same roof; and these I figure, Pl. XI, figs. 1, 2, and 3, through the kindness of Sir A. Geikie.

In the Supplement to his work on the 'Carboniferous Fossils of Belgium' (*sup. cit.*), de Koninck changed M'Coy's specific name to *Arca Maccoyana*, in order that the shell might not be confounded with *Arca tenuistriata* of Münster. In his later work, however, de Koninck restores the name *Parallelodon tenuistria*, but does not record the fact that his *Arca Maccoyana* is a synonym.

I very much doubt whether any of the shells figured in this later work are correctly referred to the species under discussion, though the former figure is evidently correctly placed as identical with *Cucullæa tenuistria* of M'Coy. All the shells that de Koninck figures as *P. tenuistriatus* have numerous well-marked concentric lines; in fact his description (p. 162) of the exterior is, "Surface garnie de striés concentriques d'accroissement, croisées par des striés rayonnantes nombreuses et peu distinctes."

I should feel inclined to place all those shells that de Koninck refers to *P. tenuistria* under *P. Walciodorensis*, to which species *P. tenuistria*, M'Coy, is closely related in shape and size; the distinguishing features between the two species being that in *P. tenuistria* the posterior end is much narrower dorso-ventrally than the rest of the shell; while in *P. Walciodorensis* this is not the case, and in the latter species concentric striæ are always present, and much contorted in the line of the byssal sinus.

For de Koninck's remarks (p. 162) on this species see above, page 150. I am doubtful whether such small differences should be considered of sufficient value for the erection of separate species; but, as a reference to the figures of *P. Walciodorensis*, Pl. X, figs. 11—15, *P. tenuistria*, Pl. XI, figs. 1—4, will show,

there is a very marked difference between the two forms in surface-ornament; and for this reason I am unable to satisfy myself that the shells referred to *P. tenuistria* by de Koninck belong to that species at all.

In shape *P. tenuistria* closely resembles *P. obtusus;* but the latter shell does not possess radiating striæ, and can at once be recognised if the test be preserved. The approximation of the superior and inferior margins posteriorly in *P. tenuistria* may be relied upon, when in the state of casts, in identifying the species.

It is unfortunate that Messrs. Meek and Worthen gave the specific name *Macrodon tenuistriatus* to a shell from the Upper Coal-measures of Illinois, which has no affinity with M'Coy's species, but seems to me to be probably identical with *P. semicostatus* of that author. The figure and minute description agree entirely with some of the British specimens.

PARALLELODON CONCINNUS, *M'Coy*, sp., 1844. Plate XII, figs. 16—22, 22 *a*.

? ARCA FIMBRIATA, *M'Coy*, 1844. Carb. Foss. Ireland, p. 71, pl. xii, fig. 8.
MODIOLA CONCINNA, *M'Coy*, 1884. Ibid., p. 74, pl. xi, fig. 28.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 309.
— — *Etheridge*, 1885. Brit. Foss., pt. 1, p. 285.

Specific Characters.—Shell transversely oblong, gibbose in front, obscurely diamond-shaped. The anterior end is short, tumid, and the narrowest part of the shell in a dorso-ventral direction. The anterior-superior angle is a right angle, from which point the anterior border becomes semicircularly curved, and passes gradually into the inferior border, which is almost straight, but sinuated anterior to its middle point for the byssal opening; posteriorly it passes slightly upwards to meet the posterior border at an acute angle. The posterior border is straight and very obliquely truncate from above downwards and backwards; above, it makes a very obtuse angle with the hinge-line. This is much shorter than the transverse diameter of the shell, straight and elevated posteriorly. The umbones are obtuse, incurved, only very slightly raised above the hinge-line, pointed inwards and forwards, and situated in the anterior fifth of the shell. They are non-contiguous, and separated from each other by a well-marked ligamental area; comparatively broad in front, but becoming obsolete posteriorly.

The valve is regularly swollen, but compressed towards the posterior-superior angle, posterior to a line passing from the upper border of the umbo to the posterior-inferior angle. The posterior end is lanceolate in outline, owing to the acuteness of its lower angle. The byssal sinus is very well marked.

Interior.—The anterior adductor scar is moderately large, shallow, not marginal; the posterior is situated within the posterior slope, and is elongate and remote from the posterior margin. The hinge-plate has two or three oblique short teeth anteriorly, and four elongate posterior lateral teeth, arranged so that the upper one is the longest, and those below gradually shorter; all terminating behind at the same place, which is not near the posterior margin. The pallial sinus is entire and remote from the border.

The *exterior* surface is ornamented with fine lines of growth, which become more widely separated as they occupy a position nearer the inferior edge of the valve; under the microscope these are decussated by very obscure radiating ribs, less visible at the anterior end.

Dimensions.—Fig. 17, Pl. XII, measures—

Antero-posteriorly . . .	. 23·5 mm.
Dorso-ventrally . . .	. 10 mm.
Elevation of valve . . .	. 3 mm.

Localities.—England: the Carboniferous Limestone of Castleton and Thorpe Cloud, Derbyshire; Hill Bolton, Yorkshire. Middle White Limestone, Flintshire. Ireland: Arenaceous Limestone, Townparks, Killeshandra.

Observations.—The type specimen of this species, preserved in the Griffith Collection in the Dublin Science and Art Museum, under the title *Modiola concinna*, is not a very perfect specimen (Pl. XII, fig. 16), still there is enough of it to demonstrate that it is a member of the *Arca* family. The peculiar shape of the posterior end and the ornamentation are very characteristic, and serve to distinguish the species from all others. Owing, doubtless, to the shell being described under the generic name *Modiola*, the species seems to have been identified by no authors with the exception of R. Etheridge, who inserted the name in his catalogue under the original generic name.

I have been fortunate enough to obtain from the limestone of Hill Bolton (which, from its situation, most probably is composed of the uppermost beds of that deposit) a specimen, Pl. XII, fig. 22 *a*, which gives most perfect details of the interior from a cast. It possesses the peculiar shape of posterior end so characteristic of the species, and has both ends of the obverse of the hinge-plate preserved, which is shown to be true to the generic type. The muscle-scars are also shown. The peculiarity in the cast itself is the absence of any concentric or radiating markings, which in most species are present on the interior of the valves, or at least on the dorsal slope.

PARALLELODON ORNATISSIMUS, *de Koninck*, 1885. Plate XIII, figs. 1—6.

PARALLELODON ORNATISSIMUS, *de Koninck*, 1885. Ann. Musée. Roy. Hist. Nat. Belg., tom. xi, p. 161; pl. xxiv, figs. 1, 2; pl. xxv, figs. 3, 30.

Specific Characters.—Shell large, very inequilateral, tumid, transversely oblong, wider in a dorso-ventral direction behind than in front. The anterior end is comparatively short, comprising about one eighth of the valve; it is compressed. The anterior border makes a prominent right angle with the hinge-line above, from which point it descends downwards and backwards, becoming gradually semicircularly curved below, where it joins the inferior border without a break. The latter is almost straight and descends at first downwards and backwards, but towards the posterior end gradually rises to meet the posterior border at a very pronounced but blunted angle, which is produced backwards considerably beyond the rest of the valve. The posterior border is straight, obliquely truncate from above downwards and backwards, forming an obtuse angle above with the hinge-line, which is straight and as long as the greatest transverse diameter of the shell.

The umbones are tumid, elongated, incurved, and pointed forwards, raised above the hinge-line, widely separated and situated in the anterior fifth of the valve. The ligamental area is comparatively very wide, and extends backwards nearly the whole length of the hinge-line; it is longitudinally striate in its whole length. In front, this area is separated from the umbones in full-grown specimens by a smooth surface; and behind, the area is depressed below the extreme upper border of the valve, which forms a raised, linear, longitudinal ridge external to it.

The valves are much compressed in front, and the umbones rise suddenly, being well marked off in front. From this point the valve becomes gradually and convexly swollen, the greatest convexity being above at the level of the ligamental area; posteriorly the valves are compressed and expanded in the dorso-ventral diameter. There is an absence of oblique ridge, but the dorsal slope is gradually rounded into the rest of the valve; towards the posterior part of the upper border the dorsal slope is slightly concave.

Interior.—The anterior adductor muscle-scar is large, circular, shallow, and bounded behind by a slight ridge. It is situated at the base of the umbonal swelling, some distance within the margin of the valve. The posterior adductor scar is large, circular, very shallow, situated on the dorsal slope some considerable distance within the margin of the shell. The pallial line is entire and remote from the margin.

The hinge-plate is expanded in front, and bears a few small obliquely inclined

teeth. The posterior hinge-teeth have not yet been observed, but there is an elongate ridge just below and parallel with the hinge-line just behind.

Exterior.—The surface is ornamented by transverse concentric sub-imbricating lines crossed by radiating striæ, so that the lower edge of each band is marked by a regular series of points. In front of the valves in adults and in the young the radiating striæ are only microscopic, but to the naked eye the concentric lines appear to be finely punctate. There is some irregularity in the concentric lines in the neighbourhood of the byssal sinus.

Shell moderately thick.

Dimensions.—Fig. 2, Plate XIII, measures—

Antero-posteriorly	70 mm.
Dorso-ventrally	36 mm.
Elevation of valve	15 mm.

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

Observations.—This species was established by de Koninck, and he states that it attains to the largest size of all species of the genus *Parallelodon*.

I have obtained a fine series of examples in all stages of development from the fossiliferous beds of Thorpe Cloud, Derbyshire, and have been able to work out some of the details of the hinge and muscular insertions. Pl. XIII, fig. 2, which possesses the greater part of its test in a well-preserved condition, has about the dimensions given by de Koninck, 70, 36, 15 mm., as compared to 74, 34, 14 mm. I have not been able to give the exact dimensions of my specimen in the antero-posterior diameter, as it is not perfect behind. Specimens of *P. obtusus* seem to have attained to quite as large a size. That from the Gilbertson Collection of the Natural History Museum, South Kensington, figured on Pl. XIV, fig. 1, measures 77, 38, 29 mm.

Indeed, these two species are very closely allied, and I have been in some doubt as to the wisdom of separating them. However, the ornamentation of *P. ornatissimus* is very distinct, and in the adult the shells are expanded posteriorly, though in the young the contour of the two species is very similar. Another difference between these species is the presence of a very wide and long ligamental area in *P. ornatissimus*, a feature not so marked in *P. obtusus*.

I have not been able to see the posterior hinge-teeth, although in several specimens I have stripped off the shell along the posterior part of the hinge-line. Most of the full-grown examples are semi-decorticated, and have evidently been rolled, and do not show the peculiar and characteristic markings. This ornament is very similar to that which obtains in *P. concinnus*, a much smaller form, with a lanceolate posterior end, and not having the very acutely produced posterior-inferior angle of the species under discussion.

PARALLELODON SEMICOSTATUS, *M'Coy*, sp., 1843. Plate XI, figs. 5—10; Plate XIII, figs. 15, 15 *a*.

BYSSOARCA SEMICOSTATA, *M'Coy*, 1843. Synops. Carbonif. Foss. Ireland, p. 73, pl. xi, fig. 35.
ARCA SEMICOSTATA, *d'Orbigny*, 1850. Prodrome Paléont., vol. i, p. 134.
MACRODON TENUISTRIATA, *Meek and Worthen*, 1867. Proc. Chicago Acad. Sci., vol. i, p. 17.
— — *Meek*, 1872. U.S. Geol. Surv., Final Rep. Nebraska, p. 207, pl. x, figs. 20 *a*, *b*.
ARCA RETICULATA, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, p. 49.
— — — 1876. Cat. Foss. West. Scot., p. 49.
ARCA SEMICOSTATA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 299.
MACRODON TENUISTRIATA, *Bigsby*, 1878. Ibid., p. 426 *d*.
ARCA SEMICOSTATA, *Etheridge*, 1885. British Fossils, vol. i, Pal., p. 280.

Specific Characters.—Shell small, oblong, subrectangular, subcylindrical, gibbose in comparison with its length. The anterior end is small, with its anterior-superior angle pointed; from this point the anterior border descends with a rapid curve, and passes gradually into the inferior, which is almost straight, but slightly curved upwards at each end. The posterior end is straight, obliquely truncate from above downwards, making a rounded obtuse angle below, and an angle only a little greater than a right angle with the upper and lower borders respectively. The hinge-line is straight. The umbones are elongate, compressed from side to side, incurved, non-contiguous, and elevated above the hinge-line, from which they are separated by a fair-sized elongate ligamental area, which becomes obsolete behind. The umbones are situated in the anterior third of the shell. Passing downwards and backwards, and defining the posterior limit of the umbonal swelling, is an oblique keel, which is acute above, but becomes less and less angular and prominent till it terminates at the junction of the posterior and inferior borders. Above and behind this ridge the shell is compressed rapidly, so that it becomes slightly hollow. Anterior to the ridge the valve is swollen, and there is a somewhat obscure, oblique byssal sulcus, a little anterior to the centre of the shell.

Interior.—The adductor scar is small, circular, situated at the anterior superior angle, but remote from the anterior margin. The posterior adductor scar is small, shallow, situated some little distance within the margin and above the oblique depression corresponding to the ridge. The pallial sinus is entire and remote from the margin. The anterior part of the hinge has several small oblique teeth; the posterior portion consists of three long, slightly diverging teeth.

Exterior.—The convex surface of the valve is ornamented with fine striæ and

lines of growth, parallel to the margins. Under the microscope the valves are seen to be covered by minute radiating lines, so that the shell has a very finely reticulated appearance. On the posterior slope the radiating lines are strongly marked, six to eight in number; but they become gradually obsolete as they pass over the oblique ridge.

Dimensions.—The type of M'Coy's shell measures—

	Antero-posteriorly.	Dorso-ventrally.	Elevation of valve.
Pl. XI, fig. 5	22 mm.	9 mm.	—
Pl. XI, fig. 8, from Dalry	21 mm.	8·5 mm.	5 mm.

Localities.—England: Mallerstang; shale above the Main Limestone, Millgill, Askrigg. Scotland: Linn Spout, Dalry, in a bed of shale below the Linn Limestone, and Orchard Quarry, Upper Limestone series; Craigenglen, Campsie, Lower Limestone series; Wilkieson, Fife. Ireland: Middle Limestone or Calp series, Manorhamilton. Coal-measures eight miles south-west of Kilkee, Co. Clare.

Observations.—There is, fortunately, no doubt about this species, as the type which I am permitted to refigure (Pl. XI, fig. 5) is preserved in the Griffith Collection of the Dublin Science and Art Museum. The species is fairly common at Linn Spout, Dalry (where I was taken by Mr. Smith of Kilwinning). A single specimen marked "Mallerstang" is in the collection of Miss Jane Donald, of Carlisle. *P. semicostatus* is recorded in Young and Armstrong's 'Catalogue of the Fossils of the West of Scotland' under "*A. reticulata.*"[1] Only five species of this genus are listed in the above work—*A. arguta*, Phillips; *A. faba*, de Kon.; *A. fimbriata*, de Kon.; *A. Lacordaireana*, de Kon.; and *A. reticulata*, M'Coy.

As Prof. de Koninck observes that his *P. meridionalis* somewhat resembles *P. semicostatus;* but in that species the form and general shape differ, there are no ribs on the posterior slope, and it is altogether more tumid.

P. semicostatus does not seem to attain any great size, and I have never as yet met with it in limestone at Dalry; it is associated with *P. Geinitzi*, *Nucula gibbosa*, Fleming, *Nuculana attenuata*, Fleming, sp., *N. lævirostrum*, Portlock, sp., *Edmondia unioniformis*, Phillips, sp., and a fairly rich and varied Lower Carboniferous Molluscan Fauna, although the Linn Limestone is at the top of the "Carboniferous Limestone series" of Scotland. Many of the species of this fauna occur in the lower portion of the Calciferous Sandstone series of Fifeshire, but *P. semicostatus* has not yet been found at such a low horizon. Although *P. semicostatus* has much the same shape and size as *P. Geinitzi*, the other species with which it occurs, it is easily distinguished by the presence of strongly marked

[1] Dr. John Young writes me that he knows of only two species from the Carboniferous rocks of the West of Scotland, and that Armstrong was responsible for the list. Dr. Young kindly submitted his specimens to me, and I identify the *A. reticulata* as *P. semicostatus;* and I think it probable that *A. faba* of the catalogue is the *P. Geinitzi*, de Koninck.

radiating ribs on the dorsal slope, and the very fine almost microscopic radiating lines over the rest of the shell, best seen in front and near the lower margin, both of which characters are absent in the latter species. The type specimen comes from the Calp or Middle Limestone series of Manorhamilton, the horizon of which is seen, on reference to the general sequence of the Carboniferous rocks of Ireland given at page 14. In the neighbourhood of Dublin, however, it is impossible to draw a line of demarcation between the Middle Limestone or Calp and the Upper Limestone. It is noteworthy that the species also occurs in beds near Kilkee, Co. Clare, which are classed as Coal-measures by the Irish Geological Survey. The specimen is in the Survey Collection at the Science and Art Museum, Dublin.

Fig. 10, Pl. XI, has not come out well in the drawing. It is the cast of the interior, and does show some of the details of the posterior part of the hinge, but they are hidden behind the cast of the umbo, and therefore could not be depicted by the artist.

PARALLELODON DECUSSATUS, *M'Coy*, sp., 1844. Plate XI, fig. 22; Plate XII, figs. 11, 12, and 15.

PSAMMOBIA DECUSSATA, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 53, pl. x, fig. 2.
ARCA ANATINA, *d'Orbigny*, 1850. Prodrome Pal., vol. i, p. 134.
— — *de Koninck*, 1851. Anim. Foss. Terr. Carb. Belgique, Supplement, p. 671, pl. lvii, fig. 7.
PSAMMOBIA DECUSSATA, *Morris*, 1854. Cat. Brit. Foss., p. 222.
ARCA ANATINA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 299.
— DECUSSATA, *Bigsby*, 1878. Ibid., p. 299.
— — *Etheridge*, 1885. Brit. Foss., part 1, Palæoz., p. 279.
PARALLELODON DECUSSATUS, *de Koninck*, 1885. Ann. Musée Roy. Hist. Nat. Belge, tom. xi, p. 154, pl. xxv, fig. 29.

Specific Characters.—Shell of moderate size, obliquely sub-ovate, moderately gibbose. The anterior end is short and somewhat swollen, its border is straight for a short distance above, where it joins the hinge-line at a right angle; it soon becomes semicircularly curved, and passes into the inferior border, which is also regularly curved, and convex downwards. The posterior border is obliquely truncate from above downwards, and straight, joining the inferior and superior borders at obtuse angles, the lower one being rounded. The hinge-line is straight and somewhat shorter than the longest diameter of the shell. The umbones gibbose, elevated above the hinge-line, incurved, very close, separated only by a linear ligamental area.

The valves are regularly curved from above downwards, and before backwards, the latter part of the curve being less rapid than the former on account of the greater length. The shell is rapidly compressed into the posterior-superior angle above the line running from the posterior edge of the umbo to the posterior-inferior angle; the dorsal slope becomes hollow on section. There is no oblique ridge, but the rest of the valve passes with a rounded gradual curve into the compressed portion.

Interior.—The anterior adductor scar is almost obsolete, and is remote from the margin in the hollow of the anterior portion of the umbonal curve. The posterior scar is situated some distance from the posterior-superior angle in the hollow of the posterior slope. The hinge-plate is expanded in front and behind. In front there are four oblique short teeth (de Koninck); behind, two or three slightly diverging elongate teeth, subparallel to the hinge-line, but terminating some distance from the posterior-superior angle, at which point the hinge-plate is quite smooth, and the opposite surfaces of the two valves are in contact for some little distance. The pallial line is entire.

Exterior.—The surface of the valve bears very fine, close-set concentric lines, hardly visible to the naked eye, decussated by fine, regular radiating striæ, most marked at the posterior end, and especially at the posterior-superior angle.

Dimensions:

	Antero-posteriorly.	Dorso-ventrally.
Pl. XI, fig. 22, M'Coy's type	30 mm.	21 mm.

Localities.—England: the Carboniferous Limestone of Castleton, Derbyshire, and Narrowdale, Staffordshire. Ireland: the Limestone of Little Island, near Cork.

Observations.—The original of M'Coy's *Psammobia decussata* is in the Griffith Collection of the Dublin Museum of Science and Art. It is a left valve, Pl. XI, fig. 22, and I am permitted to figure it by the kindness of the authorities. De Koninck pointed out, in the Supplement to his earlier work on the Carboniferous Fossils of Belgium (*op. supra cit.*), that the shell has no affinity at all to *Psammobia*, and really belonged to the *Arca* family. Owing to the name "*Arca decussata*" being already in use by Münster, he changed the specific name to *A. anatina*. In his latest work, however, recognising that the Arca-like shells of the Carboniferous period had a distinct and characteristic hinge-apparatus, he resumed M'Coy's specific name as *Parallelodon decussatus*. The type shell is much larger than that figured by de Koninck, and is larger than any that I have been able to study. It is not very well preserved. From M'Coy's figure the original would appear to have been drawn from a right valve, but in all his figures Prof. M'Coy's artist did not allow for the reversal of the figure during the process of lithographing.

I have not yet been able to obtain specimens which show any details of the

interior or the hinge, and have therefore quoted the hinge-characters from de Koninck's description.

The obliquely ovate form of this species is very characteristic, and marks off the species distinctly from *P. fallax*, to which de Koninck thought it had some resemblance. The latter shell is not oblique, and has a squarely cut posterior end; and in *P. decussatus* the umbones are better developed, and the anterior-superior angle is less square, and the whole shell is more convex.

I have with some hesitation referred three shells to this species, which I have figured, Pl. XII, figs. 11, 12, and 15. They are from two different localities, and are all imperfect specimens. Fig. 15 is in the Collection of the Geological Survey, Jermyn Street, and was obtained from Narrowdale; only a moiety of the shell is left at the umbo and the dorsal slope; in the latter position the microscope reveals very fine, close-set, radiating and concentric lines. This fact, with the tumid umbo and semicircular anterior end, has, I hope, warranted my reference.

Of the two specimens, figs. 11 and 12 from Castleton, the former is a cast and the latter a much worn testiferous example; but the former has small portions of the test preserved at the anterior border and the dorsal slope, which show, especially in the latter position, the characteristic fine decussating lines of the species. Unfortunately the type specimen is somewhat imperfect at the anterior-superior angle, but the species is more ovate in form than any others of the same genus, and the umbones are more regularly rounded and tumid than obtains as a rule in Parallelodon, or even in the other genera of the Arcidæ.

PARALLELODON FALLAX, *de Koninck*, sp., 1851. Plate XI, figs. 23—27 *a*, *b*; Plate XII, fig. 14.

ARCA FALLAX, *de Koninck*, 1851. Anim. foss. terr. carb. Belgique, Supplement, p. 672, pl. lv, figs. 6 *a*—*c*.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 299.
PARALLELODON FALLAX, *de Koninck*, 1885. Ann. Musée Roy. Hist. Nat., tom. xi, p. 153; pl. xxv, figs. 4—9.

Specific Characters.—Shell of moderate size, very inequilateral, equivalve, subquadrate, convexly swollen. The anterior end is very short and compressed. The anterior border meets the hinge-line at a right angle, and descending, at first in a straight line, becomes semicircularly curved, and passes into the inferior border without a break. The latter is regularly rounded, and meets the posterior border at a rounded, slightly obtuse angle. The posterior border is truncated and almost perpendicular, though in some examples the posterior-superior angle, which is generally a right angle, is rounded off. The hinge-line is straight, and as long as the greatest transverse diameter of the valve; slightly elevated posteriorly

and produced forwards in front of the umbones. The umbones are small, convex, incurved, non-contiguous, situated at the junction of the anterior and second quarter of the hinge-line, and hardly raised above it. They are separated by a narrow elongate ligamental area. The valves are evenly and regularly curved in the greater part of their extent, but above and posterior to a line passing from the umbo towards the posterior-inferior angle are rapidly compressed into the posterior-superior angle, so that the dorsal slope becomes slightly concave. There is a slight flattening of the valve to be observed in some specimens in the neighbourhood of the byssal sinus.

Interior.—The anterior adductor muscle-scar is situated some little way from the anterior-superior angle in the anterior part of the umbonal hollow; it is shallow and round. The posterior adductor scar is in the hollow of the dorsal slope, immediately below the end of the posterior hinge-teeth. The pallial line is entire and remote from the margin. The hinge-plate is expanded before and behind, and consists of a few small oblique teeth in front, inclined from above downwards and backwards, and several (five to six) long narrow lateral teeth behind, all terminating some distance from the posterior border, and the upper teeth being longer than those immediately below.

Exterior.—The surface is adorned with very fine concentric lines of growth, with here and there a deeper one, decussated by a series of close, regular, radiating lines, more strongly marked on the dorsal slope. Occasionally the radiating striæ appear to be absent.

Dimensions.—Pl. XI, fig. 25, measures—

Antero-posteriorly	17 mm.
Dorso-ventrally	12 mm.
From side to side	8 mm.

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

Observations.—This is one of the species described as *Arca* by de Koninck in the supplement to his first great work (*op. supra cit.*), and redescribed in 1885 as *Parallelodon*.

The Woodwardian Museum, Cambridge, possesses a series of four specimens from the Carboniferous Limestone of Settle collected by the late Mr. Burrow, three of which I figure, Pl. XI, figs. 23, 25, 26. The last two specimens are almost perfect examples, possessing both valves well preserved. The shells shown, Pl. XI, fig. 24, and Pl. XII, fig. 14, obtained from Narrowdale by the late Mr. Carrington, are in the Collection of the Geological Survey at Jermyn Street, and are chiefly casts; they fortunately exhibit the details of the muscle insertions and the hinge. The shell, where the test is preserved, has not the radiating striæ which usually adorn the surface in this species. De Koninck noticed the fact, for of some of his

specimens he remarked (*op. sup. cit.*), "souvent les côtes rayonnantes disparaissent si complètement . . . . . que l'on pourrait croire que l'on a affaire à une espèce differente."

P. fallax resembles *P. decussatus* more nearly than any other species, but it is very easily distinguished from the latter by its square form, and the projecting anterior-superior angle. It seems to have never attained the dimensions of *P. decussatus*. De Koninck states that the ornaments of the surface in *P. fallax* resemble those of *P. Haimeanus*, but the latter species is only described in the earlier work, and I do not see the least similarity in the markings of the two species, as will be seen on comparing the figures of *P. fallax* with those of *P. Haimeanus* on Pl. XI, figs. 23—31.

In the original description de Koninck contrasts the species with *A. Maccoyana* (*P. decussatus*, M'Coy) and *A. anatina* (*P. tenuistriatus*, M'Coy). The latter is a much more transverse shell and of much larger growth, and I do not think that, although the surface-markings are very similar, the two forms are different states of growth or even varieties of the same species.

The series of samples from Settle in the Woodwardian Museum at Cambridge are very fine and perfect examples, Pl. XI, figs. 23, 25, and 26. It appears that the radiating striæ are much better marked in young examples, and become gradually obsolete with adolescence.

The shell, fig. 24, Pl. XI, from the Geological Survey Collection, Jermyn Street, shows the details of the interior very well. The hinge-plate behind is perfectly seen, but in front it is difficult to accurately make out the teeth. De Koninck states that there are four anterior teeth, and shows them in his original drawing of *A. anatina* (*op. supra cit.*).

PARALLELODON HAIMEANUS, *de Koninck*, sp., 1851. Plate XI, figs. 29—31; Plate XIII, fig. 8.

ARCA HAIMEANA, *de Koninck*, 1851. Anim. Foss. Terr. Carb. Belgique, Supplement, p. 672, pl. lvii, figs. 9 *a—c*.

— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 299.

PARALLELODON MULTILINEATUS, *de Koninck*, 1885. Ann. Musée Hist. Nat. Belge, vol. xi, p. 144, pl. xxi, figs. 16—18.

Specific Characters.—Shell compressed, expanded, suborbicular, somewhat oblique. The anterior part of the shell is compressed, and the narrowest portion of the shell is in the dorso-ventral direction. Its border is an elliptic curve, and passes into the inferior border without a break. The latter is curved at each extremity, but in the median portion is almost straight. It is directed downwards

and backwards, but posteriorly is curved upwards to meet the posterior border, which is very much prolonged above and regularly curved. The hinge-line is very short, straight, and elevated posteriorly; its junction with the posterior border is almost imperceptible.

The umbones are anterior, but almost at the centre of the hinge-line, very small, inconspicuous, hardly raised above the hinge-plate, and almost contiguous. There is no area to be seen.

The valves are regularly and gradually but slightly curved from above downwards, and from before backwards, the posterior-superior angle being slightly compressed. There is no ridge nor fold, and the most gibbose part of the valve is near the umbo.

Interior.—The anterior adductor scar is small and round, submarginal, and situated not quite halfway down the anterior border. The posterior adductor scar is small, and situated just below the hinge-plate, but at some distance from the posterior border.

The hinge-plate is expanded in front and behind, and has elongate subparallel teeth posteriorly, not reaching to the end of the hinge-plate, and small oblique teeth in front. Pallial sinus entire.

Exterior.—The surface is ornamented with a number of well-marked, subimbricating, irregularly placed lines of growth, parallel to the borders; the spaces between the lines are covered with numerous very fine, regular, microscopic lines.

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

Antero-posteriorly	30 mm.
Dorso-ventrally	19 mm.
Laterally (one valve)	3·5 mm.

Localities.—The Carboniferous Limestone of Castleton, Derbyshire, and Narrowdale, North Staffordshire.

Observations.—Very unlike a member of the Arca family, and, as de Koninck observes (*op. supra cit.*), "la forme de cette *Arca* a une si grande ressemblance avec celle des *Cardinia* qu'il eut été difficile de la ranger parmi ses congénères, si je n'etais pas parvenu à dégager une partie de la charnière." I figure an interior, Pl. XI, fig. 28, and if I am correct it would appear that in adults the valves became relatively flatter as they expanded in other directions. In the fine specimen from Castleton, Pl. XI, fig. 30, I have been able to ascertain that there was an expanded hinge-plate posteriorly; the details are shown in Pl. XI, figs. 28 and 28 *a*.

It is curious that in de Koninck's great work of 1885 (*op. supra cit.*) the species *Parallelodon Haimeanus* is not described nor figured, nor is this term stated to be a synonym of any other form. A solitary mention, however, is made of that species in the remarks on *P. fallax*, p. 153, which is stated to resemble that shell

in some external characters. A new species, *P. multilineatus*, appears to me to be undoubtedly the same shell as that previously described as *Arca Haimeana*. The description of the external ornament, which is stated in the remarks to be peculiar to the species, is as follows (p. 144) :—" Surface ornée de quinze ou seize plis concentriques assez larges et peu saillants, séparés les uns des autres par un étroit sillon, qui les fait paraitre imbriqués ; chacun de ces plis porte cinq ou six fines striés, peu perceptibles à la simple vue."

The external shape of the shell seems to differ from that of the cast in de Koninck's original figures and in my own. This is doubtless due to the overgrowth of the edges of the valves, and to their being in contact and obscuring the typical Arciform shape that is so apparent in casts.

PARALLELODON FRAIPONTI, *de Koninck*, 1885. Plate XII, figs. 8, 10, and 13.

PARALLELODON FRAIPONTI, *de Koninck*. Annales Musée R. Hist. Nat. Belge, vol. xi, p. 146, pl. xxiv, figs. 3 and 24 ; pl. xxv, fig. 23.

Specific Characters.—Shell of moderate size, evenly gibbose, transversely subquadrate. The anterior end is short, convex in contour ; the narrowest part of the valve in the dorso-ventral direction. The anterior border is semicircularly curved, and passes below without break into the inferior border, which is very gently convex downwards for the greater part of its extent, but curves upwards behind to meet the posterior border at a very much rounded obtuse angle. The posterior border is straight and obliquely truncate from above downwards and backwards ; it is nearly twice as long as the anterior border, and joins the hinge-line above at a well-marked obtuse angle. The hinge-line is straight, somewhat shorter than the longest transverse diameter. The umbones are comparatively large, obtusely rounded, incurved, and directed forwards, slightly elevated above the hinge-line, non-contiguous, and situated in the anterior third of the cardinal line. The valves are regularly swollen, convex in the anterior two-thirds of the shell, the most gibbose portion being near the umbo. Behind a line passing from the posterior border of the umbo to the posterior-inferior angle the valve is rapidly compressed, so as to be hollow, but there is no angularity or ridge to mark the change. The ligamental area is very narrow.

Interior.—I have seen no specimen showing the muscle-scars, or the hinge-plate. The pallial sinus is entire. Casts show several concentric, irregularly placed grooves, which correspond to the deeper concentric lines on the exterior of the shell.

Exterior.—The surface appears almost smooth to the naked eye with an occasional deep concentric line, but under the microscope the valve is seen to be

covered with numerous regular, close-set, concentric striæ, which follow the contour of the shell, and are divided into groups by the deeper lines. There is no trace of any radiating striæ.

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

Antero-posteriorly.	Dorso-ventrally.	Elevation of valve.
(Restored) 30 mm.	20 mm.	10 mm.

Localities.—The Carboniferous Limestone of Settle, Yorkshire; Castleton and Thorpe Cloud, Derbyshire.

Observations.—A rare form, somewhat resembling *P. decussatus*, but more gibbose, and with no radiating lines.

I have referred the shells figured Pl. XII, figs. 8, 10, and 13, to *P. Fraiponti*, de Koninck, to which species I think they have the greatest resemblance. It is difficult to be completely sure without comparing the specimens side by side, and it is now several months since I examined the types at Brussels. The description given by de Koninck for the *P. Fraiponti* corresponds in every particular with the shells I have for description.

He lays stress on the smooth surface and occasional deep concentric marking, but states in his remarks that fine concentric striæ are absent, and adds that the hinge consists of three or four long posterior teeth, and the same number of oblique teeth in front. I think it probable that *P. latus* of this author is only another example of the species under discussion. They both have the same surface ornament, are closely similar in shape, and occur at the same horizon at Visé, where both are stated to be very rare. De Koninck's largest example of *P. Fraiponti* measures 53 mm. transversely, 34 mm. dorso-ventrally, and 16 mm. in thickness, but it is not stated if the latter is the depth of a single or both valves.

In shells which have not come out of the matrix very perfectly the outer layers of the test are often left behind, and therefore the microscopic concentric lines are only seen in the very best preserved examples, which will perhaps account for the fact that de Koninck so pointedly remarks on their absence.

The ornamentation of the valve by groups of fine lines, separated by more strongly marked striæ at unequal distance, is that which obtains in *P. Haimeanus*, but the strong lines are more numerous in the latter, and the shapes of the shell are very different in the two species.

I figure a fine example of *P. Fraiponti* on Pl. XII, fig. 10, from the Carboniferous Limestone of Settle, which is in the York Museum. It has unfortunately lost the anterior portion of the test, which is shown to be moderately thick, far thicker than in any other shells of the same species which I have obtained from other localities.

Though not common, this species seems to have a tolerably wide distribution in the Upper Beds of the "Massif" of Carboniferous Limestone.

PARALLELODON OBTUSUS, *Phillips*, sp., 1836. Plate VIII, fig. 9; Plate XII, figs. 2—6, and 9; Plate XIII, fig. 7; Plate XIV, figs. 1—3.

CUCULLÆA OBTUSA, *Phillips*, 1836. Geol. Yorks., vol. ii, p. 210, pl. v, fig. 19.
ARCA OBTUSA (pars), *de Koninck*, 1842. Anim. Foss. Terr. Carb. Belgique, p. 112, pl. ii, figs. 15 *c* and *d*.
BYSSOARCA OBTUSA, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 73.
ARCA OBTUSA, *Bronn*, 1844. Nomencl. Palæont., p. 97.
CUCULLÆA OBTUSA, *Brown*, 1849. Illust. Foss. Conch. Gt. Brit., p. 194.
ARCA OBTUSA, *d'Orbigny*, 1850. Prodrome paléont., pt. i, p. 134.
CUCULLÆA OBTUSA, *Morris*, 1854. Cat. Brit. Foss., p. 197.
BYSSOARCA OBTUSA ?, *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 93.
CUCULLÆA OBTUSA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 305.
? PARALLELODON OBTUSUS (pars), *de Koninck*, 1885. Ann. Musée Hist. Nat. Belge, vol. xi, p. 147, pl. xxiv, figs. 6, 14—20, 22, 34, 35.
ARCA OBTUSA, *Etheridge*, 1885. Brit. Foss., part i, Palæoz., p. 279.

Specific Characters.—Shell of moderate size, transversely oblong, gibbose, with subparallel borders. The anterior end of the shell is compressed and narrowed in its dorso-ventral diameter, and has a very pronounced anterior-superior angle, which is a right angle. The anterior border descends for a short distance in a straight line, then becomes rapidly and elliptically curved, and passes into the inferior border. This is almost straight for the greater part of its length, and passes into the posterior border with a broadly rounded curve. This is straight and obliquely truncate from above downwards and backwards, making a well-marked obtuse angle with the hinge-line posteriorly. The hinge-line is straight, a little shorter than the transverse diameter of the shell. The umbones are large, tumid, curved inwards and forwards, separated, much raised above the hinge-plate, and situated in the anterior fourth of the hinge-line.

The umbonal swelling is well marked off in front from the anterior end, though it rises gradually from the body of the valve. The valve is arched from above downwards, so that the crown of the arch is at about the centre of the dorso-ventral curve. Behind an oblique line passing from the posterior edge of the umbo to the posterior-inferior angle, the valve becomes rounded off into the dorsal slope, and is compressed and flattened towards the posterior-superior angle. The ligamental area is large, wide in front, and gradually narrowing till it becomes obsolete towards the posterior end; it is striated longitudinally for the attachment of the external ligament.

Interior.—I have seen no specimens showing the position of the adductor muscles. The hinge-plate is thickened in front, on which are traces of several small

oblique teeth; posteriorly it is thickened, and there are two or three long subparallel lateral teeth. The pallial sinus is entire, and not very far from the border of the valve.

Exterior.—The surface is ornamented with a large number of concentric lines, hardly perceptible to the naked eye above, but somewhat more marked near the lower border. These are slightly interrupted in the neighbourhood of the byssal sinus; even under the microscope the fine radiating lines, so characteristic of the genus, appear to be obsolete. Shell moderately thick.

Dimensions:

	Antero-posteriorly.	Dorso-ventrally.	Elevation of valve.
Pl. XII, fig. 5 (incomplete),	60 mm.	26 mm. (near umbo)	14 mm.
Pl. VIII, fig. 9 (a cast),	57 mm.	25 mm. ,,	8 mm.

Localities.—The Carboniferous Limestone of Thorpe Cloud, Park Hill, near Longnor, and Castleton, Derbyshire; Hill Bolton, Bolland, and Settle, Yorkshire. Ireland: Congleton Edge; Dunsink, Co. Dublin; Graigue, Co. Limerick.

Observations.—Unfortunately the type specimen has been lost, but the species is a well-recognised one, and four good specimens are preserved in the Gilbertson Collection of the British Museum, three of which are figured, Pl. XIV, figs. 1—3. It has also been re-described on two occasions by de Koninck (*op. sup. cit.*). He himself admits that one of the specimens figured on the first occasion does not belong to the species; and even on the last occasion he says (p. 147), "Je ne suis pas certain que l'espèce ci-dessus représente exactement celle qui a été figurée par J. Phillips sous le nom de *Cucullæa obtusa*, d'après un echantillon plus ou moins défectueux [the specimen, however, judging from the figure, is quite perfect, though it may be only the cast], quoique généralement, dans les collections anglaises, les échantillons étiquetés sous ce nom soient identiques avec ceux que je viens de décrire." The shells figured by de Koninck are not very much like Phillips's original figure. They do not possess the straight inferior border or truncate posterior end so characteristic of *P. obtusus*. Two shells figured by de Koninck, pl. xxiv, figs. 19 and 34, are almost quadrate, and, I think, can by no means belong to the species in question. Indeed, the figure of *P. tenuis*, pl. xxiv, fig. 23, is much more like the *P. obtusus* of Phillips than any of the shells figured by de Koninck under that name.

I reproduce the original figure of *Cucullæa obtusa*, Pl. XII, fig. 3, from the drawing, and figures of three others in the Gilbertson Collection, Pl. XIV, figs. 1—3. I have a series of fragmentary specimens from the beds at the top of Thorpe Cloud, Dovedale, Pl. XII, figs. 4, 6, and 9, which have afforded material for the observation of several details in the anatomy of the shell. Most of these have portions of the test preserved; one, Pl. XII, fig. 9, shows the posterior lateral teeth of the hinge-plate in a cast. Pl. VIII, fig. 9, is the cast of a large example in the Museum

of the Geological Survey, Jermyn Street. This specimen is slightly faulted in front, and the contour is therefore not the real one. Posteriorly the teeth on the hinge-plate are shown to terminate at some distance from the posterior end. The pallial line is very well marked in this example.

Pl. XII, fig. 5, shows the anterior part of the hinge-plate, with traces of several oblique short teeth, and the broad ligamental area.

Pl. XII, fig. 2, has the test preserved, and shows the surface of the valve perfectly.

Phillips described his shell very briefly, as follows:—"Twice as wide as long, gibbous, oval, front inflexed, surface undulated; reticulated in the posterior slope near the hinge." In the full-grown specimens the surface at the lower border becomes much less smooth than above; and the cast referred to above, Pl. VIII, fig. 9, shows this characteristic detail. The species seems to be a very rare one, Thorpe Cloud being the only locality where I have obtained it in any quantity.

In casts there are two or three broad irregular concentric sulci, most apparent over the median portion of the shell, Pl. VIII, fig. 9. These are evidently depicted in the original figure, which makes me think that it was drawn from a cast.

This species seems to have attained a very large size. Fig. 1, Pl. XIV, from the Gilbertson Collection of the Natural History Museum, measures 77 mm. antero-posteriorly and 38 mm. in its dorso-ventral diameter. The only other species of the genus which attains to anything like this size is *P. ornatissimus*, which differs, however, from *P. obtusus* in its ornament; further the posterior end is more expanded, the posterior margin more oblique, and the posterior-inferior angle much produced. The ligamental area is very broad and elongate.

PARALLELODON GEINITZI, *de Koninck*, 1885. Plate XI, figs. 17—21; Plate XIII, figs. 10, 10 *a*.

PARALLELODON GEINITZI, *de Koninck*, 1885. Ann. Musée R. Hist. Nat. Belge, vol. xi, p. 159, pl. xxiv, figs. 50, 51.

Specific Characters. — Shell small, transversely oblong, subcylindrical, very narrow in a dorso-ventral direction, but broader behind than in front. The anterior end is small, compressed, and pointed above; the border begins above at a right angle with the hinge-line, and immediately curves downward and backward, passing into the inferior border; this is so very slightly convex downwards as to be almost straight. The posterior border is straight, obliquely truncate from

above downwards, and nearly square with the upper and lower borders. The hinge-line is straight, as long as the greatest transverse diameter of the shell. The umbones are small, narrow, elongate, incurved, hardly raised above the hinge-line, close but not contiguous, and situated in the anterior fifth of the hinge-line. Internal to the umbo is a narrow, elongate, ligamental area, broader in front, and becoming obsolete posteriorly. The valve is evenly swollen, but towards the posterior-superior angle becomes compressed and even hollowed.

Interior.—The anterior adductor scar is normal in position; the posterior one is circular and placed low down and well within the margin. The hinge consists in front of five very small teeth inclined obliquely downwards and backwards, situated on a triangularly expanded plate; but I have not been able to ascertain the existence of posterior lateral teeth, which, if present, must be very short and terminate only just posterior to the umbones.

Exterior.—The surface is smooth, but under the microscope irregularly concentric obsolete lines of growth are seen, which become obscurely sub-imbricating on the posterior slope; and the imbricating edge, under a very high power, is dotted with fine, non-continuous, radiating striæ.

Dimensions.—Pl. XI, fig. 21, measures—

Antero-posteriorly	18 mm.
Dorso-ventrally	7 mm.
Elevation of valve	2 mm.

Locality.—Shale underneath the Linn Limestone in the Upper Limestone series at Linn Spout, Dalry, Ayrshire; Craigenglen, Campsie, Lower Limestone series.

Observations.—This species is found in shale beneath the Linn Limestone at Linn Spout, Dalry, together with *P. semicostata*, *Nucula gibbosa*, *Nuculana attenuata*, and several other Lamellibranchs, &c. Until now it has not been recognised as occurring in Great Britain. It is distinguished from other species by its transverse form and apparently smooth shell, which is seen to be concentrically and radiately striate only under the microscope.

At this locality the shell is comparatively plentiful, but I am at present unaware of its occurrence in other beds.

The interumbonal ligamental area is comparatively of large size. This is also the case in *P. pinguis*, de Koninck.

The fact that the associated fauna with which this species occurs at Dalry does not occur with it in Belgium, makes me somewhat doubtful as to the correctness of my reference, although from de Koninck's description and figures there is good reason to adopt the name *P. Geinitzi* for the Dalry shell.

PARALLELODON THECIFORMIS, *de Koninck*, 1885. Plate XI, figs. 11—16.

PARALLELODON THECIFORMIS, *de Koninck*, 1885. Ann. Musée Roy. Hist. Nat. Belge, vol. ix, p. 158, pl. xxiv, figs. 26, 27 (Thecidiformis in the explanation of plate xxiv.)

Cf. — PINGUIS, *de Koninck*, 1885. Ibid., p. 159, pl. xxiv, fig. 38.

Specific Characters.—Shell of very medium size, transversely elongate, subrhomboidal, moderately gibbose. The anterior end is short, and equal to or greater in its dorso-ventral diameter than the posterior extremity. Its border is almost straight at the anterior-superior angle, which is a right angle, and forms the most anterior portion of the shell; the margin very soon becomes semicircularly curved, and passes into the ventral border. The latter is straight in its middle portion, and curved upwards at each end. The posterior end is truncate, and slightly oblique from above downwards. The posterior-inferior angle is bluntly curved, and the posterior-superior angle is an obtuse angle. The hinge-line is straight, and the cardinal border is the longest part of the shell. The umbones are tumid, slightly raised above the hinge-line, curved forwards and inwards, situated in the anterior quarter of the hinge-line, separated from each other by a well-marked ligamental facet. The valves are evenly and regularly convex, but compressed at the dorsal slope, so as to make this part of the shell slightly hollow. There is no oblique keel or ridge. The interior is quite unknown.

Exterior.—The surface is ornamented with fine concentric lines of growth which may become somewhat separated on the posterior slope. There are no radiating lines; but at times, under the microscope, a fine granulation seems to be the commencement of such an ornament.

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

Antero-posteriorly	18 mm.
Dorso-ventrally	9·5 mm.
Elevation of valve	5 mm.

Locality.—The Carboniferous Limestone of Settle, Yorkshire; Castleton, Derbyshire.

Observations.—I have referred a series of six shells in the Burrow Collection of the Woodwardian Museum, Cambridge, to this species of de Koninck, founded by him on a single specimen from the Limestone of Visé. Only one of the specimens, Pl. XI, fig. 12, approaches the size of the type shell, but I feel satisfied with the correctness of my reference. The absence of radiating striæ, and the greater comparative size of the anterior end in a dorso-ventral direction, I regard as characteristic features.

Of *P. pinguis*, de Koninck, that author says (*op. cit.*), "Cette petite espèce a beaucoup de rapports avec la précédente [*P. theciformis*]; elle s'en distingué par une épaisseur relativement plus considérable, mais surtout par la largeur extraordinaire de sa facette ligamentaire et la convexité de son bord ventral."

P. mytiloides, de Koninck, also seems to closely resemble the species under consideration, but it is narrower in front than behind.

Of British species, *P. Geinitzi* is the one which is most like *P. theciformis*, but it is relatively more transverse, and has very fine but microscopic radiating striæ.

PARALLELODON DIVISUS,[1] *M'Coy*, sp., 1844. Plate XIII, figs. 11—14.

MODIOLA DIVISA, *M'Coy*, 1844. Carb. Foss. Ireland, p. 74, pl. xi, fig. 30.
ARCA DIVISA, *d'Orbigny*, 1850. Prodrome de Paléont., p. 134.
MODIOLA DIVISA, *Morris*, 1854. Cat. Brit. Foss., p. 209.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 309.
AVICULA HENDERSONI, *R. Etheridge, jun.*, 1878. Quart. Journ. Geol. Soc., vol. xxxiv, p. 11, pl. i, fig. 11.
MODIOLA DIVISA, *Kirkby*, 1880. Ibid., vol. xxxvi, p. 589.
AVICULA HENDERSONI, *R. Etheridge, sen.*, 1885. Brit. Foss., pt. 1, Palæozoic, p. 270.
MODIOLA DIVISA, *R. Etheridge, sen.*, 1885. Ibid., p. 285.

Specific Characters.—Shell small, compressed, transversely produced, somewhat oblique. The anterior end is short and moderately tumid, narrow in the dorso-ventral diameter; the anterior-superior angle a right angle. From this point the anterior border curves rapidly downwards and backwards, and passes without a break into the inferior border, which is faintly convex downwards, and descends somewhat downwards and backwards, but curved upwards at the posterior end, and indented in the neighbourhood of the byssal notch. The posterior border descends from the right-angled posterior-superior angle and curves forwards at first, then backwards, so that the upper part of the border is concave from above downwards, but below, and towards the lower part, the border is produced posteriorly, and is acutely rounded into the lower border.

The hinge-line is straight, shorter than the transverse diameter. The umbones are small, tumid, pointed inwards, hardly raised above the hinge-line, non-contiguous, separated by a very narrow, ligamental area, and situated at the junction of the anterior and middle thirds of the hinge-line. A rounded but well-marked ridge extends from the posterior margin of the umbo towards the

[1] This species is not included in the list given on p. 130; for, although I have had the specimens in my possession for some time, I did not recognise the generic characters until the preceding pages were in print.

posterior-inferior angle, becoming gradually less and less conspicuous and finally obsolete. Above the ridge the shell is compressed and expanded so as to become subalate, and the dorsal slope is hollow. The general convexity of the valves is interrupted by a pronounced oblique byssal groove, which starts from the umbo above, and becoming deeper and wider as it crosses the valve, descends obliquely backwards and downwards to the inferior border.

Interior.—The adductor muscle-scars are not apparent. The hinge consists of a few small, microscopic oblique teeth in front, and three to four elongate subparallel teeth behind.

Exterior.—The surface is adorned with fine, regular, subimbricating, concentric lines, which are more widely separated on the dorsal slope where they follow the concavo-convex contour of the border, and near the inferior border they are markedly interrupted by the byssal groove.

Dimensions.—Fig. 11, Pl. XIII, measures—

Antero-posteriorly	12 mm.
Dorso-ventrally	6 mm.

Localities.—Scotland: In a bed of Limestone east of the Caves of Randerstone Castle, Calciferous Sandstone series, Fife; Scorpion Beds, near Langholm, Eskdale, Dumfriesshire; Cyprid Shale, Colinton Road, Craiglockhart Hill, and Woodhall, Water of Leith, near Edinburgh, all in the Cement Stone group, Calciferous Sandstone series. Ireland: Larganmore, Bangor.

Observations.—Described as *Modiola* by M'Coy, and much later as *Avicula* by R. Etheridge, jun. D'Orbigny as long ago as 1850 correctly recognised the true affinities of the species to *Arca*. The discovery of the hinge, several examples of which I have been fortunate enough to expose on a slab from Randerstone, Fife, given me by Mr. J. W. Kirkby, of Leven, shows that this view was substantially correct.

The characteristics of this species are so marked that there can be no doubt as to its identity, no other species of Parallelodon, so far as I am aware, possessing the marked byssal groove or peculiarly cut posterior border.

M'Coy's specimen does not seem to have shown this characteristic of the posterior margin, what is probably due to the imperfect cleaning of his specimen, which I reproduce (Pl. XIII, fig. 13). M'Coy's description of *Modiola divisa* is as follows (*op. supra cit.*): "Transversely ovate, twice as wide as long, gibbous, beaks tumid, close to the anterior end; hinge-margin elevated, rectangular, as long as the shell is wide, anterior end short, rounded; posterior end subtruncate, rounded; a small notch or sinus in the abdominal margin, from whence a deep sulcus extends entirely to the beak; surface very finely wrinkled transversely." The type specimen is on a small block with numerous examples, some of which are casts, and show a longitudinal groove parallel to the hinge-plate behind.

Mr. Etheridge lays stress upon the "byssal sinus extending from the beak as a pronounced groove in each valve" (*op. supra cit.*) in his description of *Avicula Hendersoni*.

Parallelodon divisus is probably the oldest Carboniferous example of the *Arca* family; and, therefore, the peculiar characteristics of the species are of importance as indicating the line of descent of the genus. The contour of the posterior part of the shell is distinctly aviculoid, as is also the deep byssal sinus, which, however, in the species in question, is situated much further backwards than in any member of the Aviculidæ. It is of interest to note that the typical hinge-plate of Parallelodon was already acquired, but that the radiating lines, which are such a marked feature in the ornamentation of the surface of so many species, are conspicuously absent.

Mr. Kirkby places the horizon at which this species occurs on the Fifeshire coast at from 3,000 to 3,800 feet below the Hurlet Limestone. The band of limestone, fifteen inches thick, on the upper surface of which the species occurs, is strewn with shells and débris, and was evidently an old shore. Fourteen species of Gasteropoda and seven species of Lamellibranchs have been recognised in it with crustacea, fish, and plant remains by Mr. J. W. Kirkby. Perhaps the commonest fossil is *Schizodus Pentlandicus*, Rhind, with which *P. divisus* is also associated at Woodhall, Water of Leith; many of the associated fossils also occurring in this other locality.

Lithodomus carbonarius, Hind (see p. 80), occurs both in the Randerstone and Eskdale beds.

The species described by M'Coy as *Byssoarca lanceolata* and *B. clathrata* do not appear in this work, either as species or synonyms. The type specimen of the first is still extant, but I cannot definitely decide on its true generic affinities, and as there are no other specimens at all like it, I have not described it under the genus Parallelodon. The type of *Byssoarca clathrata* has disappeared, and I think it probable that what was described as a new species was only a very well-preserved juvenile form of one of the reticulate species.

Cucullæa arguta, Phillips, retained by M'Coy and others, I do not consider to belong to the genus Parallelodon. The type specimen is preserved in the Gilbertson Collection of the British Museum (Natural History).

Arca faba, de Koninck, is catalogued from the West of Scotland by Armstrong and Young, but I have not been able to identify this species in any Scotch collection. The specimens so named are probably the internal casts of *P. Geinitzi*.

Family NUCULIDÆ, *J. E. Gray.*

Genus Nucula, *Lamarck*, 1799.

Multiarticulate cockle, *Ure*, 1793. Nat. Hist. of Rutherglen, p. 310.
Nucula, *Sowerby*, 1824. Min. Conch., vol. v, p. 117.
— (pars), *Fleming*, 1828. Hist. Brit. Anim., p. 403.
— — *Phillips*, 1836. Geol. Yorks., pt. 2, p. 210.
— — *J. de C. Sowerby*, 1840. Geol. Coalbrookdale, Trans. Geol. Soc., ser. 2, vol. v, explanation of pl. xxxix.
— *Eichwald*, 1840. Bull. Acad. Imp. Sci. St. Pétersbourg, vol. vii, p. 10.
— *Phillips*, 1841. Palæozoic Foss., p. 38.
— (pars), *Morris*, 1843. Cat. Brit. Foss., p. 93.
— — *Portlock*, 1843. Rep. Geol. Londonderry, p. 439.
— — *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 69.
— — *de Verneuil*, 1845. Geol. Russia, p. 311.
— *de Verneuil*, 1846. Bull. Soc. géol. France, tome iii, p. 455.
— *King*, 1849. Permian Fossils, p. 175.
— *Brown*, 1849. Illust. Foss. Conchology, p. 187.
Cypricardia (pars), *d'Orbigny*, 1850. Prodrome Paléontol., p. 129.
Leda (pars), *de Ryckholt*, 1853. Mélanges Paléontol., pt. 2, p. 148.
Nucula (pars), *M'Coy*, 1855. Brit. Pal. Foss., p. 511.
— *Eichwald*, 1856. Bull. Soc. Imp. Nat. Moscou, vol. xxix, part 2, p. 132.
— *Stevens*, 1858. Amer. Journ. of Science, ser. 2, vol. xxv, p. 262.
— *Hall*, 1858. Rep. Geol. Surv. Iowa, vol. i, pt. 2, p. 715.
— *Eichwald*, 1860. Lethæa Rossica, période ancienne, p. 991.
— *Geinitz*, 1861. Carbon. Dyas Nebraska, p. 67.
Non — *Wardle*, 1862. In Sleigh's Ancient Hist. Leek, p. 285.
— *Winchell*, 1862. Proc. Acad. Nat. Sci. Phil., pp. 417, 418.
— — 1863. Ibid., p. 16.
— *Baily*, 1864. Mem. Geol. Surv. Ireland, Expl. of Sheets 192 and 199.
Ctenodonta, *Salter*, 1864. Mem. Geol. Surv. Gt. Brit., Geol. Country round Oldham, p. 65.
— — 1866. Mem. Geol. Surv. Gt. Brit., Geology Country round Stockport, Macclesfield, and Leek, pp. 92, 93.
Nucula, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Appendix, p. 53, pub. separately 1876.
— *Meek*, 1872. Final Rep. Geol. Nebraska, p. 204.
— *Roemer*, 1876. Lethæa Geognostica, pt. i, Lith. Palæont. Atlas, pl. xliv, fig. 13.

Non Nucula, *R. Etheridge, jun.*, 1876. Ann. and Mag. Nat. Hist., ser. 4, vol. xviii, p. 104.
— — 1878. Ibid., ser. 5, vol. ii, p. 33.
— *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 302.
— *White*, 1879. Bull. U. S. Geol. Surv. Territories, vol. v, No. 2, p. 216.
Ctenodonta, *Barrois*, 1882. Asturias et Galice, p. 339.
Nucula, *Walcott*, 1884. Monogr. U. S. Geol. Surv., Pal. Eureka District, p. 241.
— *de Koninck*, 1885. Ann. Musée Roy. Hist. Nat. Belgique, vol. xi, p. 132.
— *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 287.
— *S. A. Miller*, 1889. N. American Geol. Palæontol., p. 494.
— *A. H. Worthen*, 1890. Geol. Surv. Illinois, vol. viii, p. 128.
Non — *G. Wild*, 1892. Trans. Geol. Soc. Manch., vol. xxi, p. 396.
— *Goodchild*, 1892. Proc. Roy. Phys. Soc. Edin., vol. xi, p. 244.
— *Keyes*, 1894. Geol. Surv. Missouri, vol. vi, pt. 2, p. 121.
? Ctenodonta, *Tornquist*, 1896. Fossilführ. Untercarbon. Sudvogesen, p. 74.

Generic Characters.—Shell equivalve, inequilateral, close all round, more or less gibbose. Hinge angular, multidenticulate, hinge-teeth in two sets separated by a small fossa for the ligament, which is internal. Adductor impressions well marked. Pallial line entire.

Observations.—This genus, easily recognised whenever its peculiar hinge characters have been exposed, has not suffered as much as most of the other Carboniferous genera of Lamellibranchs at the hands of palæontologists. The earlier authors generally placed together under the genus "Nucula" those shells now recognised as *Nucula* and *Nuculana*, but Salter referred the Carboniferous examples of both of these genera to his genus *Ctenodonta*.

Mr. Goodchild (*op. cit.*) proposes to return to the former nomenclature, because, as he correctly observes, the Carboniferous shells known as *Nuculana* (*Leda*) do not possess a sinuated pallial sinus. But, on the other hand, they differ from the shells known as *Nucula* in being more transverse, and also possessing an attenuated and pointed posterior end, an oblique more or less marked keel, and a well-marked escutcheon and lunule. In addition the Carboniferous *Nuculanæ* have a curious prominence in the centre of the umbonal hollow, which is seen in casts as a vertical groove, causing the cast of the umbo to appear bifid, which character is absent in the Carboniferous *Nuculæ*. The external ornament in the *Nuculanæ* of Carboniferous age is always regularly linear, a character which does not always obtain in the *Nuculæ* of the same period. I prefer, therefore, to retain the two genera, and consider that the absence of a single character (non-sinuated pallial sinus), not enough to warrant the separation of shells from the genus *Nuculana* which possess all the other special characters of that genus.

Of the six species described as *Nucula* by Phillips, one, *N. cuneata*, cannot any

longer be referred to this genus; two belong to *Nuculana*, and of the three which are correctly referred to *Nucula*, *N. tumida* is synonymous with *N. gibbosa*, Fleming. M'Coy invented eleven species of *Nucula*, four of which do not belong to the family; and the rest, with one exception, *N. oblonga*, should without doubt be placed in the genus *Nuculana*.

Of the three species described by Sowerby in the Appendix to the 'Geology of Coalbrookdale' (1840), only one, *N. æqualis*, belongs to that genus; one other, *N. acuta*, should be referred to *Nuculana*; and *N. accipiens* is evidently the young of the shell described in that Appendix as *Unio Urei*.

The shell figured as *Ctenodonta*, sp.? by Salter, pl. i, fig. 3, in the Memoir on 'The Country round Oldham' should more properly be referred to *Nuculana lævirostrum*, Portlock.

Salter instituted the genus *Ctenodonta* for those nuculiform shells which did not possess a cartilage-pit between the anterior and posterior series of teeth, and had an external ligament. He was under the impression that some of the Carboniferous nuculiform shells (belonging to both *Nucula* and *Nuculana*) possessed these characters, but this has been pointed out by Goodchild, Whidborne, and others to be a mistake. *Tellinomya* of Hall is doubtless a synonym of *Ctenodonta*; but there is some little question of the priority of these names, which is briefly stated thus:

In 1847 Hall invented the name *Tellinomya*, and founded the description on the species *Tellinomya nasuta*.

Salter, in the 'Report of the Geological Survey of Canada,' 1851, dec. 1, p. 34, pl. viii, figs. 1 and 2, proposed the genus *Ctenodonta* for the same species, on the grounds that the term *Tellinomya* gave an altogether wrong view of the genus, which belonged to the *Nuculidæ*. Unfortunately this reason is untenable. Further, Brown had in 1827, in his work on recent 'Conchology,' invented the term "*Tellimya*" for a recent genus of shells, which he considered had characters of the genera *Tellina* and *Mya*. This is now referred by Fischer to *Montacuta*, Turton.

In 1846 Agassiz, seeing the orthography of the word "*Tellimya*" was wrong, altered it to "*Tellinomya*."

Two questions arise: 1st. Does the use of the word "*Tellimya*" preclude the use of "*Tellinomya*" for a totally different genus? 2nd. Is it admissible to amend the name "*Tellimya*" for orthographic reasons to "*Tellinomya*"?

Oehlert sums up ('Bull. Soc. géol. France,' ser. 3, vol. xvi, p. 653) in favour of the retention of *Ctenodonta*, Salter, and considers *Tellinomya*, Hall, preoccupied by *Tellimya*, Brown, though he does not seem to have been aware of the alteration of "*Tellimya*" to "*Tellinomya*" by Agassiz.

NUCULA GIBBOSA, *Fleming*, 1828. Plate XIV, figs. 4—15.

Multiarticulate cockle, *Ure*, 1793. Nat. Hist. Rutherglen, p. 310, pl. xv, fig. 6.
NUCULA GIBBOSA, *Fleming*, 1828. British Animals, p. 403.
— TUMIDA, *Phillips*, 1836. Geol. Yorkshire, p. 210, pl. v, fig. 15.
— — *Portlock*, 1843. Geol. Report Londonderry, &c., p. 439.
— GIBBOSA, *M'Coy*, 1845. Carbonif. Fossils Ireland, p. 69.
— TUMIDA, *de Verneuil*, 1846. Bull. Soc. géol. France, tom. iii, p. 455.
— GIBBOSA, *Brown*, 1849. Fossil Conchology, p. 187, pl. lxxvi, fig. 79.
CYPRICARDIA TUMIDA, *d'Orbigny*, 1850. Prodrome paléontol., p. 130.
LEDA GIBBOSA, *de Ryckholt*, 1853. Mélanges paléontol., part 1, p. 148.
? — SANCTI-ADELINI, *de Ryckholt*, 1853. Ibid., p. 149, pl. xvii, figs. 1 and 2.
NUCULA GIBBOSA, *M'Coy*, 1855. Brit. Pal. Fossils, p. 512.
Non — — *Wardle*, 1863. In Sleigh's Ancient History of Leek, p. 285, pl. iii, fig. 7.
CTENODONTA GIBBOSA, *Salter*, 1866. Mem. Geol. Surv. Great Britain, Geology Country round Stockport, Macclesfield, Congleton, and Leek, pp. 92, 93.
NUCULA GIBBOSA, *Römer*, 1876. Lethæa Geogn., pl. xliv, figs. 13 *a—c*.
CTENODONTA GIBBOSA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 302.
NUCULA PERGIBBOSA, *de Koninck*, 1885. Annales Musée Roy. Hist. Nat. de Belgique, vol. xi, p. 134, pl. xiii, figs. 21—23; pl. xxvi, figs. 55—58.
— GIBBOSA, *Etheridge*, 1886. Brit. Foss., part 1, Palæozoic, p. 287.

Specific Characters.—Shell triangularly and somewhat obliquely ovate-oblong, very regularly gibbose, the greatest gibbosity being about the central point of the valves. The anterior end is very short, and contracted from above downwards, the anterior-inferior angle being somewhat obtusely rounded and produced forwards, thus forming the most anterior part of the valve. The ventral margin is straight at first, and is directed downwards and backwards; a little posterior to its central point it becomes very convex, and arches upwards to pass into the posterior border, which is semi-elliptically rounded. The hinge-line is arcuate.

The umbones are very tumid, raised above the hinge-line, with the beaks contiguous, depressed, incurved, and twisted forwards. They are situated in the anterior third of the shell. The valves are regularly swollen, and there is no defined or flattened posterior slope. There is a well-marked, deep, cordate depression in front of the umbones, occupying the position of the lunule.

Interior.—The hinge-plate is thick, and the hinge consists of two sets of teeth, one anterior and one posterior, separated by a subumbonal hollow for the cartilage. The teeth are smaller towards the centre, and become gradually larger as they recede. They are placed on the hinge-plate vertically, and are V-shaped, the apices of the

angles always pointing inwards, so that the anterior row is set in the opposite direction to the posterior.

The anterior adductor muscle-scar is situated at the anterior-inferior angle, and is marginal, deep, especially above, and relatively large, marked off from the rest of the shell by a ridge. The posterior adductor scar is not so deep as the anterior, but its anterior border is also marked off by a ridge; it is marginal, and situated at the junction of the hinge-line and posterior border. Anterior to and above the latter, and close to the hinge-line, is a small punctate pedal muscle-scar. The pallial line is obscure but entire.

Exterior.—The valves are very thick compared with the size of the shell, and are ornamented with numerous very fine concentric lines of growth, so fine that the greater part of the surface is almost smooth. Towards the ventral border the lines of growth become stronger, and irregularly interrupted by deeper sulci. The valves were closed all round.

Dimensions.—Fig. 4, Pl. XIV, a specimen of average size, measures—

Antero-posteriorly	19 mm.
Dorso-ventrally	11 mm.
From side to side	11 mm.

Localities.—England: The Redesdale Ironstone, Northumberland; Congleton Edge, Cheshire; Penton, Cumberland; in a bed of shale above the Gin Mine Coal, Longton, North Staffordshire Coal-field. Scotland: Upper Limestone series at Gare; Robroystone; in rock under George Square, Glasgow; Orchard; Waulkmill Glen, Thornliebank; Swindridge; and Linn Spout near Dalry. Middle Limestone series: Bishopbriggs; Lingula Ironstone, Carluke. Lower Limestone series: above the Hosie Limestone, Campsie, and Thornton; First and Second Kingshaw and Calmy Limestones, Carluke; High Blantyre; East Kilbride; Craigenglen; Auchenskeoech and Hindog Glen near Dalry; Clonbeith, Kilwinning; Daloch Quarry, Fife; East Barnes, Dunbar.

Observations.—This shell is extremely common in those localities where it does occur, and is to be obtained in all stages of growth. It was unmistakably depicted by Ure, although the drawing is not equal to the work of modern artists; and John Gray refers the specimen preserved in the Ure Collection, now in the Museum of the Royal Society of Scotland (*antea*, p. 17), to *N. gibbosa*. A large number of specimens are present in collections from the original locality, and the identity of the shell is thus placed beyond doubt. The specific name "*gibbosa*," however, is due to Fleming, and dates 1828. Unfortunately Phillips did not recognise this name, and applied the term "*tumida*" to the same species; and it was said to occur at "Bolland, Bowes, Northumberland; Kulkeagh, Ireland." Phillips's figure is typical of the species under discussion; and so also is his short description, "Gibbose, ovate, concentrically striated, beaks tumid."

M'Coy first pointed out the identity of the shells described by Fleming and Phillips, in his work on the Carboniferous Fossils of Ireland. For some reason or other d'Orbigny, in his 'Prodrome Pal.,' removed this species into the genus *Cypricardia*, a reference which M'Coy points out to be erroneous on account of the characteristic Nuculoid hinge.

The type specimen in the Gilbertson Collection (Brit. Mus.) is labelled "Mountain Limestone, Bolland." The condition and matrix of the specimen, however, demonstrate conclusively that it was never embedded in limestone; and I have never yet seen this species from beds of the Carboniferous Limestone. It generally occurs in shales or calcareous ironstones, and ranges from the Calciferous Sandstone Series (Fife) to the Coal-measures (North Staffordshire).

The figure given by Wardle (*op. cit.*) evidently belongs to an entirely different shell, and at present there is no evidence that this species occurs in the Carboniferous Limestone.

De Ryckholt, speaking of the occurrence of *Leda gibbosa* in Belgium, says, "Ce Leda présente en Belgique quelques variétés qui ne different, en général, de la forme normale, que par une largeur moindre." The same author's *Leda Sancti-Adelini* appears from the drawing to represent Fleming's species. De Koninck considered the specimens referred to *N. gibbosa* by de Ryckholt, he did therefore recognise them to be a distinct species. He says of *Nucula pergibbosa*, referring to the difference between that form and *N. gibbosa*, "Elle s'en distingué, néanmoins pas sa taille plus petit, par sa forme plus trapue, aussi que les ornaments de sa surface." The Belgian specimens are certainly as a rule smaller than the British; but the description which de Koninck gives of the surface of his new form, "garnie de plis concentriques d'acroissement peu reguliers surtout aux environs du bord ventral," is characteristic of *N. gibbosa*, Fleming.

Meek states in the 'Final Report on Nebraska,' p. 205, "After comparing good specimens of *N. ventricosa*, Hall, from the Coal-measures of Illinois with examples of a shell sent to Mr. Worthen . . . . from Carluke, Scotland, with the name *N. tumida*, Phillips, attached, no satisfactory differences were observed." I am, however, unable to agree with this opinion. There are essential differences between a series of shells from Illinois, which I possess, and *N. gibbosa*. The American shell is not so oblique, is regularly rounded in front, with no lobe, sharper posteriorly, with a well-marked ridge passing down from the umbo to the posterior border, marking off a broad ovate escutcheon. Anteriorly, too, a slight curved ridge passes from the umbo to the anterior border, forming a well-marked lunule. The shell is also much less swollen at the margins, where it may be said to be compressed. I have figured a specimen of this shell, Pl. XIV, figs. 16 and 16*a*, for comparison.

This species differs from all others of the genus by its short, regularly

gibbose form, and the approach to squareness in the anterior-inferior angle.

The distribution of *N. gibbosa* is of the greatest interest. The lowest occurrence of this species seems to be the Calciferous Sandstone series of Fifeshire, where Mr. J. W. Kirkby[1] estimates that it ranges from 500 to 2300 feet below the horizon of the Hurlet Limestone. The species then seems to range freely at various horizons in the Carboniferous Limestone series of Scotland up to the shales below the Linn Limestone and the shales over the Robringston Limestone, of Lanarkshire, above which the species does not seem to recur.

In England *N. gibbosa* is found in one bed at least, the Redesdale Ironstone, in the Carboniferous Limestone Series of Northumberland; but from this horizon upwards it disappears, and is not found in the great "mass" of limestone of Central England. After this tremendous break it reappears, sporadically, however, in the shales below the third bed of Millstone-grit at Congleton Edge, and in the shale above the Gin Mine Coal of the Middle Coal-measures, North Staffordshire. I figure a specimen from the latter horizon, Pl. XIV, fig. 13, from the cabinet of Mr. John Ward, F.G.S.

Nucula undulata, *Phillips*, 1836. Plate XIV, figs. 28—31; Plate XV, fig. 33.

Nucula undulata, *Phillips*, 1836. Geol. Yorks., part 2, p. 210, pl. v, fig. 16.
— — *Morris*, 1843. Cat. Brit. Foss., p. 95.
— Phillipsii, *M'Coy*, 1845. Carb. Foss. Ireland, p. 70.
Cardiomorpha undulata, *d'Orbigny*, 1850. Prodr. Paléontol., p. 132.
Nucula undulata, *Brown*, 1849. Illust. Foss. Conch., p. 189.
— — *de Ryckholt*, 1851. Mélang. paléont., p. 152, pl. xvii, fig. 7.
Ctenodonta Phillipsii, *Bigsby*, 1875. Thesaur. Devonico-Carboniferus, p. 303.
Nucula undulata, *Etheridge*, 1885. Brit. Foss., part 1, Palæont., p. 287.

Specific Characters.—Shell transverse, ovoid, moderately but regularly convex. The anterior end is somewhat compressed, and its border is regularly rounded, but narrowed from above downwards. The inferior border is very convex downwards, the central point of the convexity being slightly posterior to a vertical line dropped from the umbo. The posterior end is somewhat attenuated, and the border bluntly rounded. The superior border is angular, the posterior limb being longer than the anterior, the two meeting at a very obtuse angle below the umbones, which are small, pointed, contiguous, hardly marked off from the surface of the shell, not raised above the hinge-line, and situated a little posterior to the junction of the anterior and middle thirds of the shell. They

[1] 'Quart. Journ. Geol. Soc.,' vol. xxxvi, p. 589.

form the highest point of the shell. There is no lunule, escutcheon, nor ridge; but an obsolete, broad, oblique constriction at the junction of the anterior and middle thirds of the valve. The greatest dorso-ventral depth is at the umbones, and the greatest convexity at about the centre of the valve.

Exterior.—The surface is almost smooth in the neighbourhood of the umbones; but elsewhere there are irregular concentric lines of growth, which become much more apparent and frequent near the inferior margin.

Dimensions.—The type specimen, fig. 28, Pl. XIV, measures—

Antero-posteriorly	23 mm.
Dorso-ventrally	15 mm.
Elevation of valve	6 mm.

Localities. — England: Bolland? (Phillips); the Redesdale Ironstone, Northumberland; in slate over the Gin Mine Coal, North Staffordshire. Scotland: Craigenglen, Lower Limestone series.

Observations.—The type-specimen of this species is in the Gilbertson Collection, British Museum (Natural History), and I am permitted to refigure it (Pl. XIV, figs. 28, 28 *a*) by the kindness of the authorities. It is not quite complete at the posterior end, and the left valve is unfortunately much distorted by crushing. In the general collection is another fine specimen from Craigenglen, near Glasgow.

M'Coy, re-describing this species, says (*op. cit.*, p. 70), "This is a large depressed species, chiefly remarkable for the obtuse diagonal ridge, which runs from the beak to the front [*sic*] posterior angle." M'Coy substituted the name *N. Phillipsii* for this species, he stating that a shell from some newer strata had already received the same name. It is evident, from the stress laid upon the *obtuse diagonal ridge*, that M'Coy was mistaking a totally different shell for Phillips's *N. undulata*, the type of which has certainly no obtuse diagonal ridge.

I doubt very much if the locality "Bolland," as given by Phillips, is correct; the shells here figured from the Gilbertson Collection were certainly never obtained from a limestone matrix, but have all the appearance of the shells from the Redesdale Ironstone-shales, in which beds I have myself obtained the species, though its occurrence there is very rare. *Nucula undulata* is not likely to be mistaken for any other Carboniferous species of the genus. It is much more transversely ovate, more acutely pointed posteriorly, and larger than any of the others. It appears that this species has nearly as great a vertical range as *N. gibbosa*.

NUCULA LÆVIROSTRUM, *Portlock*, 1843. Plate XV, figs. 32, 34—38, 38 *a*.

NUCULA LÆVIROSTRUM, *Portlock*, 1843. Report Geology Londonderry, p. 439, pl. xxxvi, fig. 12.
— LONGIROSTRIS, *M'Coy*, 1845. Carbonif. Fossils Ireland, p. 70, pl. xi, fig. 19 (figure, not description).
— CLAVATA, *M'Coy*, 1845. Carbonif. Fossils Ireland, p. 69 (description, not figure).
— LONGIROSTRIS, *Brown*, 1849. Fossil Conchology, p. 189.
— LÆVIROSTRIS, *Brown*. Ibid. (not figured).
LEDA LONGIROSTRIS, *d'Orbigny*, 1850. Prodrome Paléont., p. 130.
CTENODONTA, sp. ?, *Salter*, 1864. Geol. Country round Oldham, p. 65, pl. i, fig. 3.
NUCULA CARBONARIA, *Eichwald*, 1860. Lethæa Rossica, p. 994, pl. xxxviii, fig. 12.
LEDA LONGIROSTRIS, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Appendix, p. 52.
NUCULA LÆVIROSTRUM, *Young and Armstrong*, 1871. Ibid., p. 53.
CTENODONTA LÆVIROSTRUM, *Bigsby*, 1875. Thesaur. Devonio-Carboniferus, p. 303.
NUCULA LÆVIROSTRIS, *Etheridge*, 1885. Brit. Foss., part 1, Palæoz., p. 287.
— LONGIROSTRIS, *Etheridge*, 1885. Ibidem.

Specific Characters.—Shell moderately convex, transversely navicular. The anterior end is well developed, and has a rounded border, which descends in a regular curve to about the centre of the inferior border. The latter is very convex, the posterior portion curving upwards, and more nearly straight. The posterior end is produced, compressed, greatly narrowed, with a blunt, short border, more or less acutely pointed, considerably nearer the upper than the lower margin. The hinge-line is arcuate; anterior portion shorter than the posterior. The umbones are small, tumid, incurved, twisted forwards, situated at the junction of the anterior and middle thirds of the shell; contiguous and excavated in front by a cordate lunule. The valves are evenly convex, the greatest convexity being at the centre. Passing downwards from the posterior edge of the umbo is a very obscure ridge, often obsolete, which is directed downwards and backwards to the lower border of the shell, just anterior to the posterior-inferior angle. There is no escutcheon or lunule. The shell is very thin.

Interior.—The adductor scars are extremely shallow and inconspicuous. The anterior is situated at the upper margin, just in front of and below the umbo, and separated from it by a groove. The posterior is high up, and within the posterior slope of the shell. The hinge is multidenticulate, and consists of two portions, an anterior and a posterior, which are slightly inclined to each other at a very

obtuse angle, and separated from each other below the umbo by a very small cavity for the internal cartilage. The teeth in the posterior portion are small and numerous (20); those in the anterior part few (5) and moderately large.

Exterior.—The shell is almost smooth, but under the microscope it is seen to be ornamented with very fine, regular, close lines of growth.

Dimensions.—The type-specimen in the Portlock Collection (Pl. XV, fig. 32) measures—

	Antero-posteriorly.	Dorso-ventrally.	From side to side.
	17 mm.	11 mm.	—
Another specimen (Fig. 34, Pl. XV).	15 mm.	10 mm.	7 mm.

Localities.—England: the Redesdale Ironstone, Northumberland. Below the base of the third bed of Millstone-grit, Congleton Edge, Cheshire; over the Great Mine Coal, Ashton-under-Lyme. Scotland: Upper Limestone series: Linn Spout, Dalry; Orchard. Lower Limestone series: Lickprivick, East Kilbride; Horizon of Hurlet Limestone, Wilkieston, Fifeshire. Ireland: Armagh and Tyrone; in shale at Benburb.

Observations.—The type specimen of Portlock's *N. lævirostrum* is fortunately preserved in the Museum of the Geological Survey, Jermyn Street, and I am permitted to refigure it by the kindness of the authorities (fig. 32, Pl. XV). The fossil is much compressed, but still the peculiar contour is well preserved. Portlock draws attention to the peculiar upward curve of the lower border posteriorly. The original of M'Coy's *Nucula longirostris* is preserved in the Griffith Collection in the Museum of Science and Art, Dublin. In the description M'Coy mistakes the anterior for the posterior end. It runs thus:—"Transversely clavate; width two and a half times the length; anterior side produced into a very long narrow beak, abruptly truncated at the end; posterior side moderate, rounded; surface very finely striated transversely." There seems to be some very considerable discrepancy between this description and the figure to which it is said to refer. The actual measurements of the figure are 17 mm. transversely by 10 mm. from umbo to lower border, which does not agree with "width two and a half times the length;" neither can the posterior border be said to be "produced into a very long narrow beak." On the contrary, the posterior end is far less produced than in other species of the genus.

I believe that the figures and descriptions of *N. longirostris* and *N. clavata* have been accidentally substituted for one another; and that the figure named *N. clavata* refers to the description of *N. longirostris*, and *vice versâ*. I may say that the names on the type specimens in the Dublin Museum are in accordance with this view, being exactly the reverse of those on the plate in M'Coy's work.

Neither of these names, however, will stand, the shell figured as *N. clavata*

being evidently the cast of a young *N. attenuata*, and that figured as *N. longirostris* is synonymous with the *N. lævirostrum* of Portlock, which was described one year previously.

I refigure M'Coy's type of *N. longirostris*, Pl. XV, fig. 16.

There can be no doubt of the identity of the shell figured by Salter as *Ctenodonta*, sp., from the roof of the Great Mine Coal, Ashton-under-Lyme. Salter says of it, "All that can be said about this smooth form, with a few concentric lines of growth, is that it does not belong to either of the common Mountain Limestone species, such as *C. attenuata*, *C. tumida*, *C. brevirostrum*, &c.; but it is too imperfect to name." Seeing that no species of the genus quoted occurs in the Mountain Limestone, this statement is somewhat vague.

This species resembles *Nucula undulata* more closely than any other; but the narrow transverse diameter, and the subacute, lanceolate posterior end, and smaller size of the shell are sufficient to establish the identity of this species.

NUCULA PALMÆ, *Sowerby*, 1825. Plate XIV, figs. 36, 36 *a*.

NUCULA PALMÆ,	*Sowerby*, 1824.	Min. Conch., vol. v, p. 117, pl. 475, fig. 1.
—	— *Fleming*, 1828.	Hist. Brit. Animals, p. 403.
—	— *Morris*, 1843.	Cat. Brit. Foss., p. 95.
—	PALMÆA, *Brown*, 1849.	Illustr. Foss. Conch., p. 185, pl. lxxvi, fig. 39.
—	PALMÆ, *Bigsby*, 1875.	Thesaur. Devonico-Carboniferus, p. 303.
—	— *Etheridge*, 1888.	Brit. Foss., part 1, Palæoz., p. 287.

Specific Characters.—Shell transverse, convex, nuciform, only very slightly inequilateral. The anterior end is comparatively large, with a rounded border. The inferior border is convex in front and behind, but almost straight for the greater part of its extent. The posterior end is bluntly rounded. The hinge-line is angular.

Interior.—The hinge is multidenticulate, with about sixteen anterior teeth and sixteen posterior, separated by a small triangular cartilage-pit, the teeth becoming smaller as they approach the umbo.

Exterior.—The surface is covered with fine concentric lines of growth.

Locality.—Derby.

Dimensions.—The type specimen (Pl. XIV, fig. 36) measures—

Antero-posteriorly	22 mm.
Dorso-ventrally	about 13 mm.

Observations.—Owing to imperfections in the type, and to the fact that I am not able to identify any other shells as belonging to this species, I am not able to give further details. Indeed, I am very doubtful if the species really belongs to

the Carboniferous period at all. It is labelled "Derby, Martin;" but the matrix is unlike anything with which I am acquainted in the Carboniferous series of this county; and it is very possible that the shell was obtained from the drift. The town of Derby is situated on Triassic and not on Carboniferous strata.

The type is preserved in the Sowerby Collection at the British Museum (Nat. Hist.), Cromwell Road; I am indebted to the authorities for permission to refigure the specimen. As I have never seen anything like this shell from Carboniferous beds, I retain the species with great hesitation, and for the simple reason that the type specimen is preserved in the National Collection. Sowerby gives very little information about the specimen, simply stating, "This is probably a rare shell; it is from Mr. Martin's collection of Derbyshire fossils, though not figured by him." Quenstedt refers to this specimen amongst his Liassic shells ('Der Jura,' 1858, p. 110, pl. xiii, fig. 42). Hence, for the present, it is impossible to arrive at an exact conclusion as to the horizon whence this specimen was obtained.

NUCULA LUCINIFORMIS, *Phillips*, 1836. Plate XIV, figs. 17—22.

NUCULA LUCINIFORMIS, *Phillips*, 1836. Illustr. Geol. Yorkshire, pt. 2, p. 210, pl. v, fig. 11.

Non CARDIOMORPHA? LUCINIFORMIS, *de Koninck*, 1842–4. Foss. Carbonif. Belg., p. 107, pl. ii, fig. 10; pl. iii, fig. 13.

NUCULA LUCINIFORMIS, *Morris*, 1843. Catal. Brit. Foss., p. 94.

— — *Brown*, 1849. Illustr. Foss. Conchology, p. 187 (figures wanting).

CARDIOMORPHA AXINIFORMIS, *d'Orbigny*, 1850. Prodr. Paléontol., p. 133.

LEDA LUCINIFORMIS, *de Ryckholt*, 1853. Mélanges Paléontol., 2e partie, p. 150.

NUCULA LUCINIFORMIS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 216.

— — *M'Coy*, 1855. Brit. Palæoz. Rocks and Fossils, p. 512.

— — *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Appendix, p. 53.

CTENODONTA LUCINIFORMIS, *Bigsby*, 1875. Thesaur. Devonico-Carboniferus, p. 303.

NUCULA LUCINIFORMIS, *Etheridge*, 1885. Brit. Foss., part 1, Palæoz., p. 287.

Specific Characters.—Shell somewhat obliquely subovate, short, very moderately gibbose in front, compressed behind. The anterior end is short, and almost limited to the anterior-superior angle by the rapid curvature downwards and backwards of its border. The inferior border is very convex downwards, and its posterior limb, which is shorter than the anterior, meets the posterior border at a rounded obtuse angle. The posterior border is almost straight, transversely cut from above downward and backward. The hinge-line is as long as any transverse diameter, and is almost straight in its posterior and longer portion; the anterior

part very short, and slightly inclined to it. The umbones are tumid, oblique, pointed forwards, contiguous, raised above the hinges, and situated in the anterior quarter of the hinge-line. In front the umbones are excavated by a small cordate lunule. There is a small lanceolate escutcheon behind. The valves are regularly swollen, the greatest convexity being a little above the middle point of the valve; towards the posterior end the shell is compressed and expanded, especially at the obtuse posterior-superior angle. There is an obscure oblique fold and shallow oblique sulcus immediately in front of it, which pass from the umbo downwards and backwards to the posterior-inferior angle.

Interior.—The anterior adductor scar is just within the anterior-superior angle of the shell, and separated from the umbo by a deep sulcus. The posterior adductor scar is very shallow, but its anterior edge is linear and deeper. The pallial line is remote from the margin, and entire. The hinge, according to M'Coy, is normal, but I have not been able to obtain a view of it myself.

Exterior.—The surface is almost smooth, but under a low microscopic power extremely fine concentric striæ, with a few irregular stronger lines of growth, are to be seen.

Dimensions.—The type specimen	Antero-posteriorly.	Dorso-ventrally.	From side to side.
(fig. 18, Pl. XIV) measures—	11 mm.	9·5 mm.	—
Fig. 17, Pl. XIV (an abnormally gibbose specimen) .	13 mm.	12 mm.	8 mm.
Fig. 19, Pl. XIV .	11 mm.	8 mm.	5·5 mm.

Localities.—"Bolland," Yorkshire (Phillips). (The correctness of this I doubt, from the matrix and condition of the shell.) Scotland: the Upper Limestone series; Gare, Robroyston, and Orchard, near Glasgow: Den, Dalry. Middle Ironstone series, Robroyston, and Bishopbriggs. Lower Limestone series, Lingula Ironstone, Carluke: in shale above the Hosie Limestone, Campsie and Thornton: Roscobie, Fife.

Observations.—I re-figure the type specimen of this species, preserved in the Gilbertson Collection (Brit. Mus. Nat. Hist.), Pl. XIV, fig. 18. It is labelled as having been obtained from the Carboniferous Limestone, Bolland, but the nature of the specimen at once shows that it has never been in a bed of limestone. I have been able to study a fine series of this species from the cabinet of Mr. J. Neilson, of Glasgow, and several of these I figure. The majority are more compressed than the type; but fig. 17, Pl. XIV, a shell in the Woodwardian Museum, Cambridge, labelled from the Carboniferous Shale, Glasgow, is quite gibbose. De Koninck (*op. cit.*) thought fit to refer this species to *Cardiomorpha*, but figured shells of a character totally different from the type, and he was therefore wrong in identifying his shells with that described by Phillips. M'Coy (*op. cit.*) states that, to settle the generic character of the shell, he cut down on the hinge-line of a

specimen, saw the hinge, and this proved the correctness of the original determination. M'Coy redescribed the species very carefully, but gave no figure.

The original description by Phillips was very meagre, and no measurements were given; "obliquely ovate, depressed, smooth; posterior slope ridged; posterior end truncate," comprising all that was said of it.

De Ryckholt referred the species to *Leda;* and it is very difficult to say whether or no the shell should be referred to *Nucula* or *Nuculana*. The opinion of observers seems to be more on the side of *Nucula*. This author points out that the shell which De Koninck figured as his type of this species was totally different from that depicted by Phillips. D'Orbigny placed together *Isocardia axiniformis* (*Schizodus*) and *N. luciniformis*, probably confounding them as the young and adult examples of one species, and referred the genus to *Cardiomorpha*.

The shell appears to be fairly common in a few localities in Scotland, but I have not yet seen any example from Yorkshire.

Examples of this shell occur in all stages of growth, from the size of a pin's head to that of the largest specimen here figured (Pl. XIV, fig. 17), which appears to be of the full size attained by the species. It is in the Woodwardian Museum, Cambridge. This species is much more compressed, as a rule, than *N. gibbosa*, the hinge-line being also straighter and comparatively longer.

The range of this species does not appear to have been very great, as it does not occur, as far as I am aware, above or below the Carboniferous Limestone series.

NUCULA OBLONGA, *M'Coy*, 1845. Plate XIV, figs. 23—27.

NUCULA OBLONGA, *M'Coy*, 1845. Synops. Carb. Foss. Ireland, p. 70, pl. xi, fig. 24.
CTENODONTA OBLONGA, *Bigsby*, 1875. Thesaurus Devonico-Carboniferus, p. 303.
NUCULA OBLONGA, *Etheridge*, 1885. Brit. Foss., part 1, Palæoz., p. 287.

Specific Characters.—Shell transversely oblong, compressed; borders subparallel. The anterior end well developed, equal in length to about one fourth of the posterior; very slightly convex, and having an almost semicircular border. The ventral border is very slightly arched, and may be straight in its middle third; posteriorly it curves upwards to join the posterior border. The latter is truncate above and rounded below; and at the extremity slightly narrower in a dorso-ventral direction than the anterior part of the shell. The hinge-line is very slightly arcuate, and as long as the transverse diameter of the shell. The umbones are small, inconspicuous, incurved, contiguous, and situated in the anterior third of the hinge-line. The valves are flattened, the dorso-ventral and antero-posterior curves being very small. The greatest convexity of the shell is at the umbones. There is no oblique swelling nor ridge; no escutcheon nor lunule.

The *interior* is unknown.

Exterior.—The surface is almost smooth; but under the microscope very fine and regular concentric lines, with occasionally, towards the lower margin, a more conspicuous concentric fold or hollow.

Dimensions.—The type specimen	Antero-posteriorly.	Dorso-ventrally.	Laterally.
(Pl. XIV, fig. 23) measures—	17 mm.	6 mm.	—
Pl. XIV, fig. 25 measures—	13 mm.	7 mm.	4 mm.

Localities.—Scotland: Upper Limestone Series of Orchard and Waulkmill Glen, Thornliebank. Ireland: Arenaceous shale, Monaduff, Drumlish.

Observations.—This species, of very characteristic shape, seems to be very rare indeed. I reproduce the type specimen, preserved in the Griffith Collection, Science and Art Museum, Dublin (fig. 23, Pl. XLV); and this, together with a small series from the west of Scotland, collected by Messrs. John Smith and James Neilson, are all that I have yet seen.

M'Coy observes, "This shell is distinguished by its great transverse diameter, subtruncate posterior end, and the parallelism of the hinge-line and abdominal margin, the posterior end being as wide as any other part of the shell."

NUCULA ÆQUALIS, *Sowerby*, 1840. Plate XIV, figs. 32—35.

NUCULA ÆQUALIS, *Sowerby*, 1840. Trans. Geol. Soc., 2nd ser., vol. v, Appendix, Explanation of pl. xxxix, figs. 3, 3 *a*, 3 *b*.
— — *Brown*, 1849. Illustr. Foss. Conch., p. 187 (figure wanting).
— LINEATA, *Armstrong and Young*, 1871. Trans. Geol. Soc. Glasg., vol. iii, Appendix, p. 53.
CTENODONTA ÆQUALIS, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 303.
NUCULA ÆQUALIS, *Etheridge*, 1888. Brit. Foss., part 1, Palæoz., p. 287.
— LINEATA, *Etheridge*, 1888. Ibid., p. 287.

Specific Characters.—Shell only moderately but evenly convex. The greatest convexity is umbonal, regularly compressed into the borders, triangularly ovate; somewhat acute posteriorly. The anterior end is short and deep, and has a regularly rounded border, passing with a regular semicircular curve into the inferior border, which is regularly convex downwards. The posterior end is also rounded, but its curve is more acute, owing to the descent of the posterior portion of the hinge-line. The hinge-line is arcuate, or even angular; a short anterior and longer posterior limb, inclined to each other at a very wide angle, meeting opposite the umbones. The umbones are moderately convex, incurved, twisted forwards, and contiguous.

The Interior.—The hinge-line consists of two series of closely set teeth, one anterior and the other posterior, separated by a small pit or depression; they are inclined to each other at a very obtuse angle; the anterior set small and few; those of the posterior set about six, increasing in size from before backwards.

The anterior adductor scar is comparatively superficial, and is situated at the upper and anterior angle of the shell, and is not marginal. The posterior adductor scar is more conspicuous, deeper anteriorly than behind, and situated a little distance within the posterior-superior angle. Above this scar, and somewhat anterior to it, close to the edge of the valve, is a small punctate scar for one of the pedal muscles, and in the umbonal cavity are two small pits, evidently for the insertion of muscle-bands. The pallial line is remote from the margin, and is entire.

The external surface is ornamented with fine concentric lines of growth.

Dimensions.—Pl. XIV, fig. 34, a cast from Coalbrookdale, measures—

Antero-posteriorly	8 mm.
Dorso-ventrally	6·5 mm.
From side to side	4·5 mm.

Localities.—England: Pennystone Ironstone; Coal-measures, Coalbrookdale; Congleton Edge, some 100 yards below the base of the Millstone-grit; Todmorden, shales below the base of the Millstone-grit. Scotland: Upper Limestone series, Gare; Robroyston; Orchard. Lower Limestone series, Craigenglen: South Hill, Campsie, Thornton, and Rae's Gill; Carluke in shale above the Hosie Limestone.

Observations.—The fossils figured by Sowerby as *N. æqualis* (*op. cit.*) were in the condition of casts, but a portion of the exterior is seen in an impression. I have been fortunate enough to obtain one specimen from the original locality, and this is figured, Pl. XIV, fig. 35.

I have referred to this species a number of little shells labelled *N. lineata*, Phillips, in the collections of Mr. J. Neilson. Messrs. Young and Armstrong reported several localities for *N. lineata*, and I suspect that they are the authority for the determination used by Mr. Neilson, and consequently I have added the list of localities quoted by them for *N. æqualis*.

Phillips's work on 'The Palæozoic Fossils of Cornwall and Devon' was not published until 1841; and consequently, if the species are identical, Sowerby's name will have the precedence. The figures of *N. lineata* given by Phillips ('Pal. Foss. Cornwall,' &c., p. 39, pl. xviii, fig. 64), and later by Whidborne ('Devonian Fauna, South England,' vol. iii, pt. 1, 1896, p. 97, pl. x, figs. 13, 14), differ very much from those of Sowerby, being evidently different in shape and surface markings. Phillips's description is "deltoidal, convex, covered with striæ parallel to the margin, of which every third or fourth is much more prominent; margin plain within."

Sowerby's description is "transversely elongated, convex, marked with concentric ridges; anterior side rounded; posterior separated by a ridge and truncated; beaks nearest the anterior side."

I have not been able to ascertain the presence of the ridge mentioned above.

A small specimen from the shales below the Millstone-grit, Todmorden, in the Manchester Museum, Owens College, from the Gibson Collection, I think without doubt belongs to Sowerby's species.

NUCULA SCOTICA, sp. nov., *Hind.* Plate XIV, figs. 37—39.

Cf. NUCULA TRIVIALIS, *Eichwald.* Lethæa Rossica, pl. xxxviii, fig. 15.

Specific Characters.—Shell small, gibbose, especially above, deltoid, oblique, very inequilateral. The anterior end is short, swollen, and compressed from before backwards, so that a cordiform anterior surface is apparent, bisected by the lower elevation of the extreme edges of the valves. The anterior border descends obliquely downwards and forwards, and is almost straight, joining the inferior border at a marked obtusely rounded angle. The lower border is regularly and almost semicircularly curved. The posterior border is oblique and short, and the posterior-inferior angle is almost acute.

The hinge-line is comparatively extensive, consisting of two parts, which meet at an acute angle beneath the umbones. These are acute, incurved, and twisted forwards, much elevated above the hinge-line, contiguous, and situated in the anterior fourth of the shell. The valves are expanded laterally above, and the dorsal slope is broad and very slightly hollowed. Elsewhere the contour of the shell is regularly convex from above downwards and from before backwards.

Interior.—The adductor scars have not yet been exposed. The hinge consists of two sets of teeth, the posterior being the longer, placed at an acute angle to each other, and separated below the umbo by a wide and deep cartilage-socket; the arrangement of the hinge-teeth themselves is normal.

Exterior.—The surface is ornamented with close, regular, equidistant, concentric, rounded lines and sulci, with here and there an occasional deeper concentric groove.

Dimensions.—Pl. XIV, fig. 37, measures—

Antero-posteriorly	6 mm.
Dorso-ventrally	5 mm.
From side to side	4 mm.

Localities.—Scotland: the Lower Limestone series of Craigenglen, Campsie; the horizon of the Hurlet Limestone, Wilkieston, Fifeshire.

Observations.—This species does not appear to attain to any considerable size, judging from a large number sent me for examination by Mr. Kirkby, of Leven, which were obtained from Wilkieston, Fife.

The only British species which at all resembles *N. Scotica* is *N. æqualis*,

Sowerby; but this has not the twisted umbones, nor is it so regularly triangular in shape.

Eichwald's *Nucula trivialis* (*Lethæa Rossica*, pl. xxxvii, fig. 15), from the Magnesian Limestone near Kazan, is very similar indeed to the species under discussion; in fact, I am not able, from a comparison of the figures and description, to point out a single detail of difference.

There is also a marked similarity to some of the specimens figured as *Tellinomya pusilla* by de Koninck ('An. Mus. Roy. Hist. Nat. Belgique,' tom. xi, p. 139, pl. xxvi, figs. 34—36); but other figures purporting to be of the same species, figs. 37—40, are very different, and in a note de Koninck doubts if they be of Carboniferous age at all.

It seems to me quite possible that the blocking of the cartilage cavity with matrix may have prevented this character from being apparent, and that some of the Carboniferous species of the *Nuculidæ* described as *Tellinomya* (*Ctenodonta*) may really belong to *Nucula*. In some species this cavity is very small, and easily missed when choked with shale, &c.

The shape of *T. pusilla* is described as "peu obliquement subovale oblongue." The species was founded on a single valve of doubtful Carboniferous origin, so that I have for cogent reasons hesitated to refer the Scotch specimens to the Belgian species.

Genus Nuculana, *Link*, 1807.

Multiarticulate cockle, *Ure*, 1793. Nat. Hist. Rutherglen, p. 310.
Nucula (pars), *Fleming*, 1828. Hist. Brit. Anim., p. 403.
— — *Phillips*, 1836. Illust. Geol. Yorks., pt. 2, p. 210.
— — *J. de C. Sowerby*, 1840. Trans. Geol. Soc., ser. 2, vol. v, Appendix, Explanation of pl. xxix.
— — *Morris*, 1843. Cat. Brit. Foss., p. 93.
— — *Portlock*, 1843. Rep. Geol. Londonderry, p. 439.
— — *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 69.
— — *Brown*, 1849. Illustr. Foss. Conchology, pp. 184—188.
Leda (pars), *d'Orbigny*, 1850. Prodrome paléont., p. 129.
Nucula (pars), *M'Coy*, 1855. Brit. Pal. Foss., p. 511.
Leda, *Stevens*, 1858. American Journ. Sci., ser. 2, vol. xxv, p. 261.
— *Hall*, 1858. Rep. Geol. Surv. Iowa, vol. i, pt. 2, p. 715.
— *M'Chesney*, 1859. Trans. Acad. Sci. Chicago, vol. i (see above, p. 30).
Yoldia, *Meek and Worthen*, 1860. Proc. Acad. Nat. Sci. Philadelphia, p. 457.
Nucula, *Geinitz*, 1861. Carb. u. Dyas in Nebraska, p. 22.
Leda, *Baily*, 1862. Mem. Geol. Surv. Ireland, Expl. Sheet 127, p. 9.
— *Winchell*, 1862. Proc. Acad. Nat. Sci. Phil., p. 419.
— — 1863. Ibid., p. 16.
Ctenodonta, *Salter*, 1864. Mem. Geol. Surv. Gt. Brit., Geol. Country round Oldham, p. 65.

NUCULANA ?, *Meek and Worthen*, 1866. Geol. Surv. Illinois, vol. ii, p. 283.
YOLDIA, *Meek and Worthen*, 1866. Ibid., p. 282.
LEDA, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Appendix, p. 51; and 1876, Cat. Carb. Foss. West. Scotl., p. 54.
YOLDIA, *Meek*, 1872. U. S. Geol. Surv., Final Report Nebraska, p. 205.
NUCULANA, *Meek*, 1872. Ibid., p. 206.
LEDA, *R. Etheridge, jun.*, 1873. Mem. Geol. Surv. Scotland, Expl. Sheet 23, pp. 57, 64, &c.
— — 1873. Geol. Mag., vol. x, p. 347.
YOLDIA, *Meek*, 1875. Rep. Geol. Surv. Ohio, vol. ii, pt. 2, p. 335.
LEDA, *R. Etheridge, jun.*, 1876. Ann. Mag. Nat. Hist., ser. iv, vol. xviii, p. 100.
NUCULA, *R. Etheridge, jun.*, 1876. Ibid., p. 104.
LEDA, *Roemer*, 1876. Lethæa Geognostica, Atlas, pl. xliv, fig. 11.
NUCULANA, *R. Etheridge, jun.*, 1877. Quart. Journ. Geol. Soc., vol. xxxiv, p. 15.
— — 1878. Ann. Mag. Nat. Hist., ser. v, vol. ii, p. 33.
CTENODONTA (pars), *Bigsby*, 1878. Thesaur. Devonico-Carboniferus, p. 303.
NUCULANA (pars), *Bigsby*, 1878. Ibid., p. 310.
— *White*, 1879. Bull. U.S. Geol. Surv. Territories, vol. v, No. 2, p. 216.
ARCA (pars), *von Koenen*, 1879. Neues Jahrbuch f. Min., &c., p. 336.
NUCULANA, *de Koninck*, 1885. Ann. Musée R. H. N. Belgique, tome xi, p. 136.
— (LEDA), *Etheridge*, 1885. Brit. Foss., pt. 1, Palæozoic, p. 288.
— *Keyes*, 1888. Proc. Nat. Sci. Philadelphia, p. 233.
— *Waagen*, 1888. Pal. Indica, set xiii, vol. i, Salt Range Foss., p. 248.
— *Miller*, 1889. N. American Geol. Palæontol., p. 495.
NUCULA, *Goodchild*, 1892. Proc. Roy. Phys. Soc. Edin., vol. xi, p. 244.
NUCULANA, *Keyes*, 1894. Geol. Surv. Missouri, vol. v, pt. 2, p. 122.
YOLDIA, *Keyes*, 1894. Ibid., p. 123.
NUCULANA, *Tornquist*, 1896. Fossil-fürhend. Unter carbon Südvogesen, p. 81.

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 in two sets, which do not extend very far on each side of the umbo, numerous. A fossa for the ligament, 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 Carboniferous shells which I refer to the genus *Nuculana* have been at times included in the genera *Ctenodonta, Nucula*, and *Yoldia* by various authors. Although they do not possess a sinuated pallial line, and in this respect agree with *Nucula*, yet the general shape, the attenuated and rostral form of the posterior end, the possession of lunule and well-developed escutcheon, and the concentric linear surface-markings are all important characteristics of the genus *Nuculana*. It is interesting to note the absence of a sinuated pallial line in shells which have so many characters in common with recent shells, but yet differ

so materially in one character which has been considered by systematic conchologists to be of sufficient importance that a twofold division of the Lamellibranchiata has been based on the presence or absence of this one character. American palæontologists have latterly referred several species to *Yoldia* from external characters only. This genus, however, possesses a very deep pallial sinus; and I have preferred to retain these forms with *Nuculana*, because a comparison of British and American forms has convinced me that they are often generically and specifically identical. In Great Britain a fair number of interiors have been obtained and studied, especially in the Scotch collections, which show no traces of a pallial sinus. I think, therefore, the reference to *Yoldia* should no longer be accepted.

Meek observes in his remarks on *Yoldia subscitula*, 'U.S. Geol. Surv., Final Report on Nebraska,' p. 206, "Of course it is only placed provisionally in the genus *Yoldia*, its internal characters being unknown."

I have exposed the cast of *Yoldia Knoxensis* from the calcareous iron-ore between coals "2 and 3," Knox Co., Illinois, and find that the pallial line is entire, and that the two small protrusions on the umbo in casts, with a hollow between, are present as in British forms (Pl. XV, figs. 8—10, 10*a*).

Two of the six shells described by Prof. Phillips as *Nucula* (*op. cit.*) belong to the genus *Nuculana*, namely, *N. claviformis ?* and *N. brevirostris*. The latter species only is retained, the former being without doubt synonymous with *N. attenuata* of Fleming.

Of the species described by M'Coy (*op. cit.*) as *Nucula*, five certainly must be placed under *Nuculana*. One, *N. birostrata*, has disappeared. I believe that the figures and descriptions of *N. clavata* and *N. longirostris* have been interchanged, and that these names are synonymous with shells previously described by Fleming and Portlock. *N. leiorhynchus*, I think, is probably the young of *N. attenuata*, but the original specimens are so poor and badly preserved that it is difficult to speak with certainty in the matter. *N. stilla* is therefore the only species of M'Coy's which is here placed under *Nuculana*.

M'Coy curiously confounded the anterior end of the shell with the posterior in most of his descriptions of the species of this genus, and notice must be taken of this fact when reading his descriptions; in the description of *N. clavata* this, however, is not the case.

Mr. R. Etheridge, jun., has described four species of *Nuculana* as new,—*N. Sharmani*, *N. Traquairi*, *N. intermedia*, and *N. Youngi*. I am able to retain the first only, though possibly this may be synonymous with the lost *N. birostrata*, M'Coy. The second species is no doubt identical with *N. stilla*, M'Coy. The third is the young of *N. brevirostris*, Phillips; and *N. intermedia* is undistinguishable from the *N. lævistriata* of Meek and Worthen, whose name, therefore, takes precedence.

One of the three specimens described by Sowerby as *Nucula* in the Appendix to Prestwich's 'Geology of Coalbrookdale' as *N. acuta* should more correctly be referred to *Nuculana;* the *Nucula accipiens*, an elongate shell, is the young of that author's *Unio Urii.*

Koenen's *Arca Ritterhauseni* is, I think, identical with *Nucula lævistriata*, Meek and Worthen; but the figures make it perfectly plain that the shell belongs to *Nuculana.*

As a rule, the genus is found only in beds of shale in British localities. I have specimens, however, from Pittenween, Fife, which were in a limestone matrix.

NUCULANA ATTENUATA, *Fleming*, sp., 1825. Plate XV, figs. 1—16.

Multiarticulate cockle, *Ure*, 1793. Nat. Hist. of Rutherglen, p. 310, pl. xv, fig. 5.
Non NUCULA CLAVIFORMIS, *Sowerby*, 1824. Mineral Conchology, vol. v, p. 119, pl. cccclxxvi, fig. 2.
— ATTENUATA, *Fleming*, 1828. Hist. Brit. Animals, p. 403.
— CLAVIFORMIS ?, *Phillips*, 1836. Geol. Yorkshire, p. 210, pl. v, fig. 17.
— ATTENUATA, *Morris*, 1843. Catal. Brit. Foss., p. 94.
— — *M'Coy*, 1844. Synops. Carbonif. Foss. Ireland, p. 68.
? — BIROSTRATA, *M'Coy*, 1844. Ibid., p. 68, pl. xi, fig. 23.
— CLAVATA, *M'Coy*, 1844. Ibid., pl. xi, fig. 25 (figure, not description).
— LONGIROSTRIS, *M'Coy*, 1844. Ibid., p. 70 (description, not figure).
? — LEIORHYNCHUS, *M'Coy*, 1844. Ibid., p. 69, pl. xi, fig. 27.
— CLAVIFORMIS, *Brown*, 1849. Illustr. Foss. Conch., p. 185, pl. lxxvi, fig. 38.
LEDA CLAVIFORMIS, *d'Orbigny*, 1850. Prodrome paléont., p. 129.
— BIROSTRATA, *d'Orbigny*, 1850. Ibid., p. 129.
— CLAVATA, *d'Orbigny*, 1850. Ibid., p. 129.
? — LEIORHYNCHA, *d'Orbigny*, 1850. Ibid., p. 129.
NUCULA ? ATTENUATA, *M'Coy*, 1855. Brit. Palæoz. Foss., p. 511.
LEDA ATTENUATA, *Baily*, 1862. Mem. Geol. Surv. Ireland, Expl. Sheet 127, p. 9, figs. 2 *a—c*.
Non NUCULANA BELLISTRIATA, var. ATTENUATA, *Meek*, 1872. U.S. Geol. Surv., Final Report Nebraska, p. 206, pl. x, figs. 11 *a*, *b*.
CTENODONTA ATTENUATA, *Bigsby*, 1878. Thesaur. Devonico-Carb., p. 303.
LEDA ATTENUATA, *Römer*, 1876. Lethæa Palæoz., Atlas, pl. xliv, figs. 11 *a*, *b*.
NUCULANA ATTENUATA, *Etheridge*, 1885. Brit. Fossils, pt. 1, Palæoz., p. 288.

Specific Characters.—Shell moderately gibbose, produced and attenuated posteriorly almost to a point. The anterior end is of moderate size, and has a regularly rounded margin. The inferior or ventral border is gently convex for

the anterior four fifths; it then may become straight. The posterior border is very narrow, and is acutely rounded. The dorsal border is rounded and short in front, produced and straight behind, the latter portion being at a lower level than the anterior.

The umbones are small and inconspicuous, incurved and non-contiguous. They are situated at about the junction of the anterior and middle thirds of the hinge-line. In front of the umbones is a small elongate elliptical lunette, and posterior to them is an elongated, comparatively broad escutcheon, which is marked off by an acutely edged fold arising from the apex of the umbo; and, curving at first outwards and backwards, soon passes inwards and below the level of the hinge edge, terminating at the extreme posterior point of the shell. The escutcheon is divided into two parts by obscure lines, which arise from the edge of the ridge, and pass obliquely inwards and backwards to meet in the middle line. The portion in front of these lines is diamond-shaped and concave; posterior to them the upper edge of the valve rises in the middle line, so that this part is roof-shaped, but slightly hollow at the sides. The valves are gently and evenly convex; the greatest convexity is at a point midway on the vertical line which passes from the umbo to the ventral border.

Interior.—The hinge-plate is thickened, and consists of two portions, anterior and posterior, separated by a pit for the internal cartilage, situated immediately beneath the umbones. The anterior portion is curved, convex upwards, and is set with a number of vertical V-shaped teeth having the apex of the V directed towards the umbo. The anterior teeth are larger in front, and diminish in size as they approach the centre. The posterior portion also consists of numerous similarly shaped teeth, but arranged with their apices pointed forwards. They are larger in the middle than at either end, and do not occupy the whole of the posterior part of the hinge-plate, the hinder half being edentulous. This part is gradually thinned and twisted upwards to form a very thin and delicate edge to the produced portion of the valve.

The scar of the anterior adductor muscle is shallow and not very conspicuous; it is situated at the anterior-superior angle of the shell, and is marginal, and extends some little way backwards along the side of the hinge-plate. It is marked off from the umbo by a slight ridge which runs forwards and downwards. The posterior adductor muscle-scar is narrow and transversely elongate, and situated just below the hinge-line near the posterior end. A ridge extends downwards from the interior of the umbo, shown as a well-marked hollow in casts. On the anterior portion of this are two pit-like hollows, probably from the insertion of the pedal muscles. The pallial line is not sinuated.

Exterior.—The surface is for the most part ornamented with fine, regular, concentric lines of growth, which terminate behind abruptly at the acute edge

which forms the boundary of the escutcheon. At the posterior end the lines are bent upwards and twisted forwards over this ridge, and are less well marked, giving rise to a wavy appearance. Here and there on the surface of the valve the regularity of the marking is interfered with by deeper lines, especially near the ventral margin. The valves are closed all round.

Dimensions (Pl. XV, fig. 3).—An average-sized specimen from Thornton, in my Collection, measures—

Antero-posteriorly	28 mm.
Dorso-ventrally (at umbo) . . .	12 mm.
From side to side	6·5 mm.

The measurements of the type have not been given, as this specimen (Pl. XV, fig. 1) is imperfect posteriorly.

Localities.—England: Shales in Belling-burn, Lewis-burn, above Plashetts Coal, Falstone-burn, the Redesdale Ironstone and Shales, Northumberland; Carboniferous Shales, Penton, Cumberland. Scotland: Upper Limestone Series: Gare; Robroyston; Orchard; Williamswood; and Waulk Mill Glen, near Glasgow; Dalry at Swindridge and Linn Spout, below the Linn Limestone. Lower Limestone Series: Craigenglen; shale above Hosie Limestone, Campsie, and Thornton; Lingula Ironstone, 1st Kingshaw and 1st Calmy Limestones, Carluke, Newfield, High Blantyre; East Kilbride in the Calderwood Cement and Limestone Shales; also at Lickprivick, Daloch Quarry, Fife. Calciferous Sandstone series: in Calcareous bands east and west of Pittenween Harbour, Fife. Ireland: Lower Limestone Shale of the Townland of Ballyduff, river Bunnow, King's Co.; East of Fair Head, Ballycastle; in Arenaceous shale at Larganmore, Bangor; Yellow Sandstone, Bruckless, Dunkineely.

Observations.—This species has the widest distribution both vertically and horizontally of all the genus, of which it is the largest form. It is fairly common in the neighbourhood of Glasgow, and nearly always occurs with *Nucula gibbosa*. Figured by Ure as one form of "multiarticulate cockle," Fleming gave the shell a specific name. As in the case of *Nucula gibbosa*, Phillips appears to have been unaware that the species had been described, and identified it with *N. claviformis* of Sowerby's 'Mineral Conchology,' which is a Jurassic species, the figured specimen being stated to have come from Northamptonshire, but other specimens are said to have been found "in rounded masses of grey limestone in the alluvial deposits so common in many parts of Norfolk and Suffolk." Phillips's shell evidently belongs to the genus *Nuculana*, but the specific name *claviformis* cannot be retained for it.

I have examined the type specimens of *N. claviformis* in the Sowerby Collection of the British Museum (Nat. Hist.), Cromwell Road, and am bound to admit a very close similarity between the Liassic and Carboniferous forms. The former,

however, differs in the following points from *N. attenuata*. The anterior end is comparatively shorter, the inferior border more curved. The umbones are more elevated, more acute and non-contiguous, and the escutcheon is much excavated, thus forming a narrow ridge on its outer border. It would appear that the Liassic form is intermediate in shape between *N. attenuata*, Fleming, and *N. stilla*, M'Coy.

M'Coy seems to have been of the opinion that Phillips's reference to Sowerby's species was erroneous; for in his remarks on *N. clavata* he says, "This species is easily distinguishable from *N. attenuata*, Fleming; . . . . . in general appearance it comes nearest to *N. claviformis*, Sowerby, but that is a Lias species," &c.

I have doubtfully placed the *N. birostrata*, M'Coy, as a synonym of *N. attenuata;* but the original specimen of the former seems to have disappeared, and the shell now labelled with that name in the Griffith Collection of the Science and Art Museum, Dublin, is that of a species quite different from the original figure. *N. leiorhynchus*, M'Coy, is probably the young of the species under discussion; it has exactly the form of the young shells of *N. attenuata*, found with full-grown examples in the Scottish localities. Of these I have depicted a series, Pl. XV, figs. 12—15.

The original of *N. leiorhynchus*, M'Coy, is shown in Pl. XV, fig. 16, and is evidently a young shell.

M'Coy's description of *N. leiorhynchus* is "transversely ovate, width rather more than twice the length, convex. Posterior [anterior] end rounded, gibbose; anterior end [posterior] produced into a long narrow beak, rounded at the point; surface marked with strong, regular, equal, transverse striæ, which disappear as they reach the anterior [posterior] end, leaving the long beak-like anterior [posterior] extremity smooth."

The original shell was not very perfect, and the typical large escutcheon is not seen, therefore it cannot be stated with absolute certainty whether it is the young form of *N. attenuata* or of *N. Sharmani*, R. Etheridge, jun.

The descriptions of *N. clavata* and *N. longirostris*, M'Coy, do not in any way correspond with the figures; and I am of opinion that the references to the figures were accidentally transposed in each case, and that the figure of *N. clavata* is described as *N. longirostris*, and *vice versâ*. I have therefore given the description of *N. clavata* and the figure of *N. longirostris* in the synonyms of *N. attenuata*. The other shell is, I consider, a synonym of *N. lævirostrum*, Portlock, so that fortunately no question of nomenclature will arise.

The original specimen from which the figure of *N. longirostris* was drawn seems to have disappeared, and a very poor example is on the tablet bearing that name in the Griffith Collection in the Science and Art Museum, Dublin. The original description is meagre, and does not mention the escutcheon:

"Transversely clavate, width two and a half times the length; anterior [posterior] side produced into a very long narrow beak, abruptly truncated at the end; posterior [anterior] side moderate, rounded, surface very finely striated transversely." It is therefore impossible, as in the case of *N. leiorhyncha*, to say whether this species really is a small specimen of *N. attenuata* or of *N. Sharmani*.

Unfortunately Meek has given the varietal name "*attenuata*" to a form of *N. bellistriata*, Stevens, occurring in Nebraska ('U.S. Geol. Surv., Final Rep. Nebraska,' p. 206, pl. x, figs. 11 *a*, *b*, *c*,). This very little shell is quite distinct from *N. attenuata*, Fleming, measuring less than half an inch antero-posteriorly, and about one-fifth inch dorso-ventrally; comparatively the posterior end is very much less attenuated than in the British species.

The type-specimen of "*N. claviformis ?*" (*attenuata*) in the Gilbertson Collection is labelled "Carboniferous limestone, Bolland." From the matrix, I cannot think that it was found in limestone; Phillips gives Harelaw and Otterburn, Northumberland, as well as Bolland, as the localities of this species, and I suspect that the type specimen came from one of the first two of these localities. This species is distinguished by its transverse form and produced posterior end from *N. Sharmani*, to which it approaches most closely in form; the well-marked escutcheon distinguishes it at once. *N. stilla* is much shorter in the antero-posterior diameter.

NUCULANA SHARMANI, *R. Etheridge, jun.*, 1878. Plate XV, figs. 17—22.

NUCULANA SHARMANI, *R. Etheridge, jun.*, 1878. Quart. Journ. Geol. Soc., vol. xxxiv, p. 15, pl. ii, fig. 18.
— — *Etheridge*, 1885. Brit. Fossils, pt. 1, Palæoz., p. 288.

Specific Characters.—Shell transversely produced, slightly clavate, attenuated posteriorly, very moderately convex. The anterior end, of moderate size, shorter, but much deeper than the posterior, has a rounded border passing with a gradual curve into the inferior border, which is gently convex, sloping upwards posteriorly. The posterior border is very narrow and bluntly rounded. The superior border consists of two portions, inclined at an obtuse angle, which meet at the umbo. The anterior part is convex, the posterior concave upwards. The umbones are small, just anterior to the central point; pointed backwards; hollowed behind by the concave slope of the shell; and forming the highest point of each valve. The escutcheon is narrow and not deep; not marked off from the rest of the valve by a ridge, but the upper and posterior umbonal border is rounded from above downwards.

Interior.—The anterior adductor scar is small and marginal; the posterior, inconspicuous, is situated within the dorsal slope. The pallial line is very slightly marked, and no sinus can be seen. There is an internal subumbonal, shallow, and narrow ridge, extending from the umbo downwards to the inferior border. The hinge has as yet not been observed.

Exterior.—The surface is ornamented with very fine, regular, concentric striæ, hardly visible to the naked eye. These become somewhat coarser near the inferior border. At the posterior end the striæ disappear, and the markings assume the form of fine waves and fluctuations.

Dimensions.—Fig. 17, Pl. XV, measures—

Antero-posteriorly	13 mm.
Dorso-ventrally	7·5 mm.
Elevation of valve	2 mm.

Localities.—Scotland: Upper Limestone Series, Garngad Road, Glasgow. Calciferous Sandstone series in Black Shale, Woodhall, Water of Leith.

Observations.—This species, described from the Calciferous Sandstone series of the neighbourhood of Edinburgh by Mr. R. Etheridge, jun., appears to come midway between *N. attenuata*, Fleming, and *N. lævistriata*, Meek and Worthen, possessing the attenuated posterior end of the former, and the compressed form and narrow escutcheon of the latter. From *N. attenuata*, *N. Sharmani* is easily separated by the narrow escutcheon and less produced and rostrated posterior end. Of all figured shells, *N. birostrata*, M'Coy, approaches most nearly to the species under discussion, but unfortunately the type specimen has disappeared, and I am unable to trace that shell. Mr. Neilson of Glasgow has discovered in the neighbourhood of Glasgow a few specimens which I refer to this species, and some of these I figure, Pl. XV, figs. 17 and 18.

Mr. Etheridge compared his specimens with several of M'Coy's figured specimens. He says that "from *Nucula* (or *Leda ?*) *birostrata*, M'Coy, it is distinguished by its straighter posterior end and larger antero-ventral development; from *Nucula* (or *Leda ?*) *clavata*, M'Coy [figure only], by the more central position of the beaks, and longer anterior end. From *Nucula* (or *Leda ?*) *leiorhyncha*, M'Coy, the ornamentation of the posterior end will at once distinguish it." My own observations lead me to think that this last distinction is an error, and that, in common with other Carboniferous *Nuculanæ*, both *N. Sharmani* and *N. leiorhynchus* have similarly ornamented posterior ends, the concentric striæ terminating abruptly as in *N. attenuata*, Figs. 2—4, 6, and 7, Pl. XV. M'Coy distinctly shows this to be the case in his enlarged figure of *N. leiorhynchus*; and whether or no M'Coy's species is synonymous with the species under discussion depends on the size of the escutcheon, which I have not been able to get at, the type specimen being a small and very poor example. For the present I have doubtfully placed

M'Coy's shell as a synonym of *N. attenuata*. Similarly it is impossible to tell, from the specimen of *N. longirostris*, M'Coy, preserved in Dublin, whether or no this shell really belongs to *N. attenuata* or to *N. Sharmani*, as nothing is to be seen of the escutcheon, and no mention is made of this part of the shell in the description. Under the circumstances, therefore, the name *N. Sharmani*, R. Etheridge, jun., is retained. It is curious, however, when contrasting his shell with several others from M'Coy's work, that Mr. Etheridge did not perceive any similarity between his shell and *N. longirostris*.

NUCULANA STILLA, *M'Coy*, sp., 1844. Plate XV, figs. 23—25, 44—46, 46 *a*.

NUCULA STILLA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 71, pl. xi, fig. 18.
LEDA STILLA, *d'Orb.*, 1850. Prodrome paléontologie, p. 129.
— TRAQUAIRI, *R. Etheridge, jun.*, 1876. Ann. Mag. Nat. Hist., ser. 4, vol. xviii, p. 100, pl. iv, fig. 4.
CTENODONTA STELLA, *Bigsby*, 1878. Thesaur. Devonico-Carb., p. 303.
NUCULA STELLA, *Etheridge*, 1885. British Fossils, part 1, Palæoz., p. 287.
NUCULANA TRAQUAIRI, *Etheridge*, 1885. Ibid., p. 288.

Specific Characters.—Shell clavate, gibbose, short, and arcuated. The anterior end forms the greater portion of the shell, though in a transverse direction the posterior portion of the shell is slightly longer than the anterior. The anterior border is broad and rounded, passing with a gradual curve into the inferior border, which is convex downwards; the posterior portion rises rapidly, and is almost straight. The superior border consists of two portions, inclined at a very obtuse angle, which meet under the umbo. The posterior portion is often hollowed and depressed, so that the posterior border is very narrow and bluntly pointed. The umbones are just anterior to the centre of the shell, and directed backwards; they are small, tumid, and elevated. Proceeding downwards and backwards from the upper edge of the umbo to the apex is a sharp ridge, concave in outline upwards, which marks off the surface of the shell from the broad escutcheon. The valves are equally and regularly swollen for the greater part, but compressed posteriorly.

Interior.—Unknown.

Exterior.—The surface is ornamented with regular, equal, flattened, concentric striæ, which terminate abruptly near the narrow posterior end, which has much finer markings.

Dimensions.—Fig. 25, Pl. XV, measures—	Antero-posteriorly.	Dorso-ventrally.	Elevation of valve.
	16 mm.	9 mm.	5 mm.
The type, fig. 23, Pl. XV	12 mm.	7 mm.	—

Localities.—England: Shales below the Millstone Grits, Pule Hill, Marsden. Scotland: Upper Limestone series; Horizon of the Robroyston or Gare Limestone in rock under George Square, Glasgow. Cement-stone group of the Calciferous Sandstone series; Brown Sandstone of Knockhill Quarry, Strathkiness, near St. Andrews. Ireland: Arenaceous Shale, Dromard, Draperstown, co. Londonderry.

Observations.—I have little or no hesitation in referring *Leda Traquairi*, R. Etheridge, jun., to M'Coy's *Nucula stilla*, although the type specimen of the latter species is very poor. M'Coy's description is as follows:—"Transversely clavate, gibbose, beak nearly central; posterior [*anterior*] side obtusely rounded. Anterior [*posterior*] side suddenly contracted, forming a short mucronate beak, rounded at the extremity; surface very finely striated concentrically."

It is curious that while Mr. R. Etheridge, jun., contrasted his shell with some American forms, and with *Leda attenuata*, Fleming, and *claviformis*, Sowerby, he seems to have ignored the large number of species described and figured by M'Coy (*op. cit.*). I am not myself at all sure of the specific value of this species, and think it very probable that the collection of a larger number of specimens might demonstrate that it is only a variety of *Nuculana attenuata*. The surface markings are identical in both forms; and while the anterior portions of the shells of both are similar, they only differ in the length of the attenuated posterior extremity.

My opinion seems to be somewhat borne out by observations by Mr. Baily on a series of *N. attenuata* from Ballyduff, river Bunnow, King's Co., Geological Survey, Ireland, Expl. Sheet 127, p. 9, where he figures two forms of this shell, figs. *a* and *b*, the normal shape; fig. *c*, "a shorter variety of the same shell:" the latter strongly resembles *N. stilla* of M'Coy and R. Etheridge, jun.

Mr. R. Etheridge compared his shell with *Nucula Kazanensis*, de Verneuil, and *Leda bellistriata*, Stevens. Mr. Meek considers that the *N. Kazanensis* of Geinitz, 'Carbon and Dyas in Nebraska,' p. 20, pl. i, figs. 33 and 34, should be referred to the latter species; *Nuculana bellistriata*, Stevens, is a very small shell, one specimen which I have examined measuring 5 mm. transversely, 3 mm. dorso-ventrally, and 2 mm. from side to side, and is altogether different from the species under discussion in shape and comparative dimensions.

I refigure M'Coy's type specimen of *N. stilla*, Pl. XV, fig. 23.

The only American species which has any similarity to *N. stilla* is *Nuculana? curta*, Meek and Worthen, from the St. Louis group of the Lower Carboniferous of Illinois, described in the 'Proceed. Acad. Nat. Sci. Philadelphia' for 1861;

redescribed and figured in vol. ii, 'Geol. Surv. Illinois,' p. 283, pl. xx, figs. 6 *a*, 6 *b*. In the absence of American specimens for comparison, I hesitate at present to place this species as a synonym of the species under discussion.

A series of shells which I refer to this species has been obtained from the shales below the base of the Millstone-grit in tunnelling through Pule Hill, near Marsden, by Messrs. Barnes and Holroyd. I am able to figure a series of these specimens, Pl. XV, figs. 44—46; fig. 46 is a perfectly preserved specimen. At this locality the shell appears to be very rare indeed, probably being confined to a very narrow horizon.

NUCULANA BREVIROSTRIS, *Phillips*, sp., 1836. Plate XV, figs. 26—31.

NUCULA BREVIROSTRIS, *Phillips*, 1836. Illustr. Geol. Yorkshire, part 2, p. 210, pl. v, fig. 11 *a*.
— — *Morris*, 1843. Catal. Brit. Foss., 1st edit., p. 94.
— — *M'Coy*, 1845. Synops. Carbonif. Foss. Ireland, p. 68.
— — — — Ibid., p. 70, pl. xi, fig. 19.
— BREVIROSTRA, *Brown*, 1849. Illust. Foss. Conchology, p. 187 (figure wanting).
LEDA BREVIROSTRIS, *d'Orb.*, 1850. Prodrome paléontol., p. 130.
— CUNEATA, *de Ryckholt*, 1851. Mélanges paléontol., p. 147, pl. xvii, figs. 32—35.
Non — ? BREVIROSTRIS, *Hall*, 1870. Prelim. Notice Lamellibranchiata, ii, p. 6.
NUCULA YOUNGI, *R. Etheridge, jun.*, 1876. Ann. Mag. Nat. Hist., ser. iv, vol. xviii, p. 104, pl. iv, figs. 11—13.
Non LEDA (NUCULANA) BREVIROSTRIS, *Hall*, 1883. Pal. New York, vol. v, pt. 1, pl. xlvii, figs. 38, 39 (40, 41 ?).
— — BREVIROSTRIS, *Hall*, 1885. Ibid., vol. v, pt. 1, Lamellibranchiata, ii, p. 329, pl. xlvii, figs. 38—41.
NUCULA BREVIROSTRIS, *Etheridge*, 1885. British Fossils, part 1, Palæoz., p. 287.

Specific Characters.—Transversely ovate, moderately convex. The anterior end is produced, and the posterior, though narrowed and contracted to form a spur, is still the shorter portion of the shell; it is encroached upon above by a large escutcheon. The anterior border is elliptically rounded. The ventral and inferior margin is convex in the anterior two thirds, but straight and directed upwards and backwards in the posterior third. The posterior border is blunt, very short and truncated, meeting the upper and lower margins at rounded obtuse angles. The hinge-line is rounded in front, straight behind, the posterior portion being depressed.

The umbones are obtuse, small, incurved, and contiguous; not marked off in front from the rest of the shell; encroached upon behind by the escutcheon.

They are situated a little way posterior to the middle vertical diameter of the shell. The escutcheon is divided into two equal longitudinal portions behind by the thin margins of the edges of the valves, which are in contact and extended upwards. It is bounded on either side by a well-marked, sharply defined ridge, springing from the umbo (giving the latter the appearance of pointing backwards), which passes downwards and backwards to the lower angle of the posterior extremity.

Interior.—The anterior adductor muscle-scar is long and deep, situated low down and near the margin. The posterior is situated just within the narrow posterior end. The hinge-plate is in two portions, separated by a subumbonal cartilage-cavity. The anterior teeth are larger than the posterior, and are situated in the hinge-plate for a short distance anterior to the umbo. They are only about six in number. The posterior are also about six, and do not extend far behind the umbo. The pallial sinus is entire and remote from the margin.

Exterior.—The surface is ornamented with well-defined, regular, concentric striæ, with here and there towards the ventral margin a deeper sulcus. These become lost soon after passing over the ridge forming the border of the escutcheon, and leave the immediate posterior extremity almost smooth.

Dimensions.—Pl. XV, fig. 26, measures—

Antero-posteriorly	19 mm.
Dorso-ventrally	12·5 mm.
From side to side	11 mm.

Localities.—England : Redesdale Ironstone, Northumberland. Scotland : Upper Limestone series; Gare, Orchard, Garngad Road, Glasgow ; Lower Limestone series ; Lingula Ironstone and first Kingshaw Limestone, Carluke ; Campsie and Thornton in shale above the Hosie Limestone ; Eastbarns, Dunbar ; Wilkieston, Fife, about the horizon of the Hurlet Limestone.

Observations.—This species has always been referred to *Nucula* except by d'Orbigny, who more correctly referred it to *Leda*, but upon what grounds it is difficult to understand. Strangely enough also, Phillips, M'Coy, and R. Etheridge, jun., have described the typically characteristic posterior end as anterior. Phillips's description is very curt : " ovate, anterior side attenuated, obtuse ; surface neatly striated across." It is clear which end he had in mind when he described it as " attenuated." M'Coy states that the species has its " anterior side produced, contracted, rounded ; " and lays further emphasis on this feature in his remarks. The specimen described by Mr. R. Etheridge, jun., as *N. Youngi* is evidently only a very young example of *Nuculana brevirostris*, in which condition the linear concentric markings are very finely shown, being comparatively much better marked than in the adult state. His specimen was obtained from

Orchard Quarry, Upper Limestone series, a locality in which the species under description also occurs. This author, too, has mistaken the anterior for the posterior extremity. In his description he says, "anterior side short, much smaller than the posterior, bluntly attenuated; posterior side elongated, inclined to become square, but with the margin uniformly rounded." He points out that his shell resembles *N. brevirostris*, but says "it has a much straighter dorsal margin anteriorly, and a less constricted anterior end." He is quite right in this observation, because this is the condition which obtains in the young shell. Mr. Bennie has kindly sent me several specimens of all stages of growth, and these illustrate well the changes which take place in the shape of the shell during adolescence. Pl. XV, fig. 31, is from the quarry whence the type of *N. Youngi* was obtained. I have figured a series of shells of this species, Pl. XV, figs. 26—31, to show the different stages of growth and the identity of *N. Youngi*, Eth., and *N. brevirostris*, Phill. The well-marked escutcheon shows distinctly the real affinity of this species with *Nuculana*, and also indicates the posterior end.

The figures referred to *N. cuneata*, Phillips, by de Ryckholt (as *Leda*) belong distinctly to the species under discussion. I am of the opinion that *N. cuneata*, Phillips, does not belong to the genus *Nucula*, from an examination of the type specimen preserved in the Gilbertson Collection in the Brit. Museum (Nat. Hist.).

Unfortunately Hall gave the name "*brevirostris*" to a shell from the Hamilton group (Devonian) of New York, which has no specific similarity to the British form; and as Hall quotes himself as the author of the specific term, he was evidently unaware of the previous use of the name. Hall's shell closely resembles *N. stilla*, M'Coy, in general shape.

NUCULANA LÆVISTRIATA, *Meek and Worthen*, 1860. Plate XV, figs. 39—43.

LEDA (YOLDIA?) LÆVISTRIATA, *Meek and Worthen*, 1860.	Proc. Acad. Nat. Sci. Philadelphia, p. 457.
YOLDIA? LÆVISTRIATA, *Meek and Worthen*, 1866.	Geol. Surv. Illinois, vol. ii, p. 282, pl. xx, figs. 7 *a*, *b*.
LEDA INTERMEDIA, *R. Etheridge, jun.*, 1873.	Geol. Mag., vol. x, p. 347, pl. xii, fig. 3.
— — — —	Mem. Geol. Surv. Scotland, Expl. Sheet 23, p. 105 (no figures).
Cf. YOLDIA STEVENSONI, *Meek*, 1875.	Geol. Surv. Ohio, vol. ii, p. 335, pl. xix, figs. 4 *a*, *b*.
— LÆVISTRIATA, *Bigsby*, 1878.	Thesaur. Devonico-Carboniferus, p. 314.

Arca Ritterhauseni, *von Koenen*, 1879. Neues Jahrbuch für Min., p. 336, pl. vi, fig. 9.

Nuculana (Leda) intermedia, *Etheridge*, 1885. Brit. Foss., part 1, Palæoz., p. 288.

Specific Characters.—Shell transversely elongate, lenticular, compressed, and flattened. The most tumid portion of the valves is at the umbo, and even here very slightly convex. The anterior end is well developed, and comprises the greater extent of the valve. The anterior border is regularly rounded, and passes with a gradual curve into the inferior. This is convex anteriorly and then almost straight in the greater part of its extent, but inclined upwards posteriorly. The posterior end is narrowed in a dorso-ventral direction; its border is bluntly subtruncate, and small in extent. The superior border has its anterior portion gently convex upwards, and at a much higher level than the posterior, for immediately behind the umbones the valve becomes cut away in a curved line, making the umbones the highest part of the shell, and giving them the appearance of pointing backwards. These are situated a little anterior to the middle line, and are subcentral, small, contiguous, and pointed. The line marking off the escutcheon is very obscure; but there is a small elongated hollow which lies between the elevated superior edge of the shell and the curved line descending from the umbones, which corresponds to it.

Interior.—The adductor muscle-scars are very shallow and inconspicuous. There is an internal umbonal vertical ridge, very narrow, almost linear. The hinge is normal as shown by the impressions in a cast. Pallial line faint and entire.

Exterior.—The surface is almost smooth, but under the microscope is seen to be ornamented with close, regular, concentric striæ.

Dimensions.—Fig. 39, Pl. XV, measures:

Antero-posteriorly	19 mm.
Dorso-ventrally	8 mm.
From side to side	4 mm.

Localities. — Scotland: Upper Limestone series — Orchard Muirfoot Burn, New Cummock, Den, Dalry. Lower Limestone series — Craigenglen, Campsie, Brockley, Leshmahagow. Calciferous Sandstone series — Spymill, Water of Leith.

Observations.—This species is a flattened and compressed form, and is easily distinguished from all other British forms by its almost central umbones and short, blunt posterior extremity.

As Mr. Etheridge, jun., points out in his remarks on *Leda intermedia* (*op. cit.*, p. 347), "of all the published descriptions of Carboniferous *Ledæ* within my reach, *L. intermedia* approaches nearest to *L.* (*Yoldia ?*) *lævistriata*, Meek and

Worthen, from the upper part of the St. Louis group of the Carboniferous Limestone Series of Illinois." He did not attempt to point out any details of difference, and, indeed, I am of opinion that the species are identical. On comparison, the descriptions of the two species are found to be very strikingly similar:

Yoldia lævistriata.	*Leda intermedia.*
Shell.—Transversely subovate.	Transversely elongate.
Ventral margin.—Semi-ovate curved, most prominent part being a little in advance of the middle.	Convex, most so on the anterior side.
Anterior side.—Rounded.	Rounded.
Posterior side.—Compressed, narrower than the other, and narrowly rounded at the extremity.	Compressed, narrower than the anterior, with blunt rounded termination.
Beaks.—Depressed and located centrally.	Nearly central, depressed.
Dorsal outline.—Declining slightly, and somewhat concave behind the beaks; a little convex in front.	Slightly convex on the anterior side, concave and inclined downwards on the posterior side.
Surface.—Apparently smooth, but showing under a good lens extremely fine, regular, closely arranged, concentric striæ.	Close, regular, concentric striæ.
Dimensions.—·6 : ·2 : ·14 inch.	·7 : ·3 : ·18 inch.

In their observations on *Yoldia? lævistriata*, Meek and Worthen state, "This shell is apparently so very closely allied to *L. subscitula* of Meek and Hayden from Kansas, that we would scarcely have ventured to regard it as a new species were it not for the widely different geological positions occupied by the two shells. The Kansas species, however, is a little more convex, while its dorsal slope behind the beaks is rather more concave in outline."

Yoldia Stevensoni, Meek (*op. cit.*), should probably be added to the synonyms of *N. lævistriata*. The descriptions and figures agree very closely, the chief difference noticeable being that the concentric striæ are shown in the figure as quite visible to the naked eye. The dimensions (length ·7 in., dorso-ventral ·3 in., lateral ·16 in.) agree exactly with the specimens figured here in Pl. XV, figs. 39—41, from the Collection of Mr. J. Neilson, of Glasgow, obtained from the Lower Limestone series of Brockley.

NUCULANA ACUTA, *Sowerby*, sp., 1840. Plate XV, fig. 47, 47 *a*.

NUCULA ACUTA, *Sowerby*, 1840. Trans. Geol. Soc., ser. 2, vol. v, Appendix, pl. xxxix, fig. 4.
— — *Morris*, 1843. Cat. Brit. Foss., p. 93.
— — — 1854. Ibid., 2nd edit., p. 216.
CTENODONTA ACUTA, *Bigsby*, 1875. Thesaurus Devonico-Carboniferus, p. 305.
NUCULA ACUTA, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 287.

Specific Characters.—Shell small, transversely ovate, acutely pointed behind. The anterior end is shorter than the posterior, but is the deepest portion of the shell in a dorso-ventral diameter, and its border is semicircularly curved. The inferior border is curved, with its convexity downwards. The posterior border is very short and pointed. The hinge-line is arched; the two limbs (of which the anterior is the shorter and less obliquely set, and the posterior the longer, rapidly depressed) meet at an angle beneath the umbo. The umbones are small, pointed, and incurved, raised and situated in front of the middle line of the shell. The valves are evenly convex, with a slight angle on the posterior slope.

Interior.—The arrangement of the muscle-scars and hinge appears to be normal as observed in casts.

Exterior.—The surface is adorned with regular concentric lines, most apparent at the lower margin of the shell.

Dimensions.—The type, Pl. XV, fig. 47, measures—

Antero-posteriorly	5 mm.
Dorso-ventrally	3 mm.

Locality.—The Pennystone Ironstone, Coalbrookdale.

Observations.—I have been able to study only a single specimen of this species, which I believe to be the type figured by Sowerby (*op. cit.*). It is preserved in the British Museum (Nat. Hist.), and was acquired from the Collection of the late Sir Joseph Prestwich.

The specimen is very small. I am unable to identify any other shells with it, and unfortunately there is at present not sufficient material to speak with any certainty on the affinities of the species. I fear that, owing to the smallness of the shell, few specimens will be preserved.

In the original drawing the figure of a hinge-plate is also given (fig. 5 *a*).

The original description is—"Transversely ovate, convex, concentrically striated; anterior extremity rounded; posterior extremity produced, pointed. Length $1\frac{1}{2}$ lines, width $2\frac{1}{2}$ lines."

PLATE III.

Fig. 1.—*Myalina Redesdalensis.* Portion of a right valve. My Collection. (Page 109.)

Fig. 1 *a*.—The same specimen showing shelf for anterior adductor muscle, striated hinge-plate, terminal umbo, and deep umbonal cavity. (Page 109.)

Fig. 1 *b*.—The same specimen, showing the extent and size of the hinge-plate, and its relation to the shelf (×) for the anterior and adductor muscle. (Page 109.)

Fig. 2.—*Myalina Redesdalensis.* Viewed from above and behind. The only specimen which has been obtained from Redesdale in a fairly perfect condition. Found by Mr. John Dunn, and now in the possession of Mr. R. Howse, of Newcastle-on-Tyne. (Page 109.)

Fig. 3.—*Myalina Redesdalensis.* Portion of a left valve, showing the extensive flat anterior surface. My Collection. (Page 109.)

Fig. 4.—*Myalina Redesdalensis.* Profile view, with anterior side much foreshortened to show the angular ridge. (Page 109.)

Fig. 5.—*Myalina Redesdalensis.* The anterior portion of a left valve. (Page 109.)

Fig. 6.—*Myalina Verneuilii.* A cast of the interior, showing pallial line, posterior adductor scar, and the non-terminal umbo seen in all casts. Collection of Mr. J. Neilson. (Page 115.)

Fig. 7.—*Myalina Redesdalensis.* A fragment, to show the thickness and contour of the valve. My Collection. (Page 109.)

Fig. 8.—*Myalina Redesdalensis.* Fragment of a valve, showing at × the byssal aperture. My Collection. (Page 109.)

Fig. 9.—*Myalina Redesdalensis.* A fragment, showing the distance of the pallial line from the edge of the valve. My Collection. (Page 109.)

Fig. 10.—*Myalina Redesdalensis.* A fragment, showing the imbrication of the lines of growth as they pass over the lower portion of the ridge. My Collection. (Page 109.)

Fig. 11.—*Myalina Redesdalensis.* Portion of a right valve, showing the details of the anterior part of the shell; × marking the anterior adductor scar. My Collection. (Page 109.)

Fig. 12.—*Myalina Redesdalensis.* A fragment about the centre of the hinge-line, showing (×) the pit-like scars for the pedal muscles. My Collection. (Page 109.)

Figs. 13 and 13 *a*.—*Myalina Redesdalensis.* Two views of the central portion of the hinge-plate, with the pedal muscle scars at ×. My Collection. (Page 109.)

Fig. 13 *b*.—The same specimen shown in contour, to show the angle at which the hinge-plate joins the rest of the shell, and its relative thickness. (Page 109.)

With the exception of Fig. 6, all the specimens are from the Redesdale Shales, in connection with the Redesdale Ironstone, and probably the upper portion. The specimens were all obtained by Mr. John Dunn, who kindly presented them to me.


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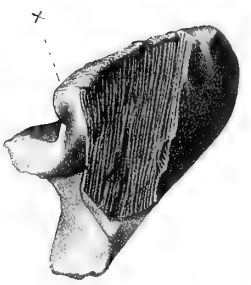
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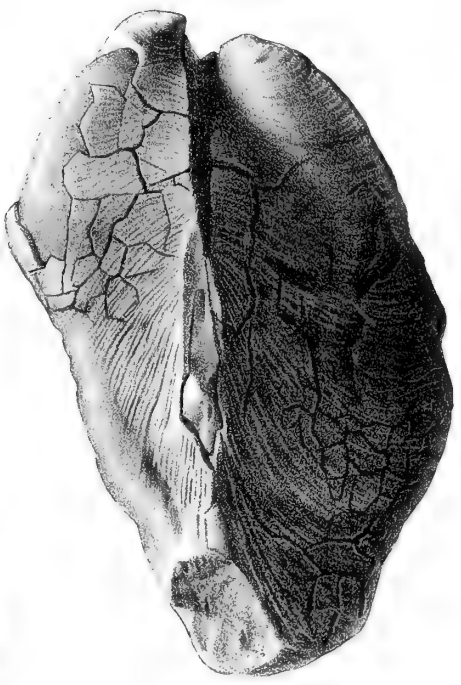
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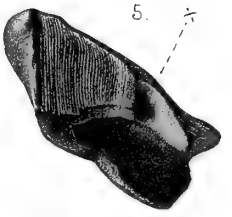
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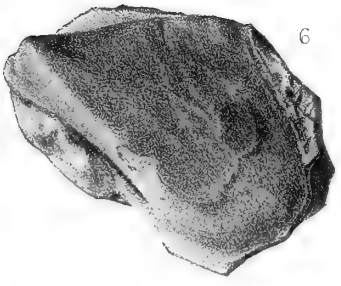
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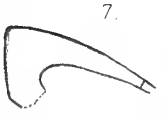
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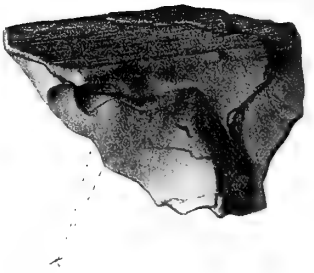
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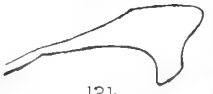
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PLATE IV.

Fig. 1.—*Myalina pernoides.* A fragmentary specimen obtained from the Lower Carboniferous Beds of Redesdale by Mr. John Dunn. My Collection. (Page 117.)

Fig. 1 *a*.—The cast of the exterior of the same specimen, showing the surface ornaments. (Page 117.)

Fig. 2.—*Myalina pernoides.* The original of Portlock's *Inoceramus pernoides*, now preserved in the Museum of Geological Survey, Jermyn Street. (Page 117.)

Fig. 3.—*Myalina Verneuilii.*—The original of M'Coy's figure of *Modiola Verneuilii*, preserved in the Griffith Collection of the Museum of Science and Art, Dublin. (Page 115.)

Fig. 4.—*Myalina Verneuilii.* The exterior of a right valve from the Lower Carboniferous of Glasgow. Mr. J. Neilson's Collection. (Page 115.)

Figs. 5, 5 *a*.—*Myalina Verneuilii.* Two views of a well-preserved specimen in the Collection of the Geological Survey, Jermyn Street. (Page 115.)

Figs. 6, 7, and 8.—*Myalina Verneuilii.* Three specimens from the Upper Limestone series, Bankend, Lesmahagow. In the Braidwood Collection of Dr. Hunter. (Page 115.)

Fig. 9.—*Myalina Flemingi.* The original of M'Coy's *Mytilus Flemingi*, now preserved in the Griffith Collection of the Museum of Science and Art, Dublin. (Page 112.)

Fig. 10.—*Myalina Flemingi.* A typical specimen from the Lower Carboniferous of the neighbourhood of Glasgow. My Collection. (Page 112.)

Fig. 10 *a*.—The same specimen viewed from behind. (Page 112.)

Fig. 10 *b*.—The same specimen viewed from the front, showing the flat anterior surface. (Page 112.)

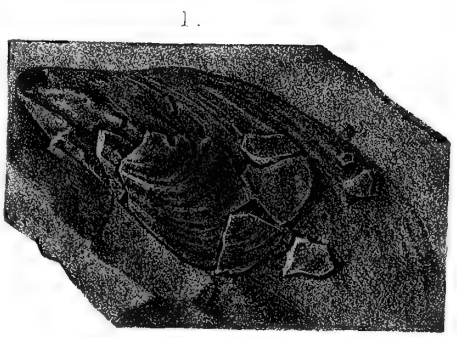
Fig. 11.—*Myalina peralata.* A cast of the left valve, showing all the details of the interior. From the Mountain-limestone of Bolland. In the Collection of the Geological Survey, Jermyn Street. (Page 119.)

Fig. 12.—*Myalina peralata.* A specimen of a left valve from the Lower Carboniferous Shales of Eskdale. My Collection. (Page 119.)

Fig. 13.—*Myalina lamellosa.* Portion of a left valve from the Mountain-limestone of Bolland. In the Collection of the Geological Survey, Jermyn Street. (Page 124.)

Figs. 14, 14 *a*, 14 *b*.—*Myalina lamellosa.* Three views of a specimen from the same locality; in the same Collection. (Page 124.)

Fig. 15.—*Myalina sublamellosa.* A left valve from the Lower Carboniferous of Abden, Fife. My Collection. (Page 121.)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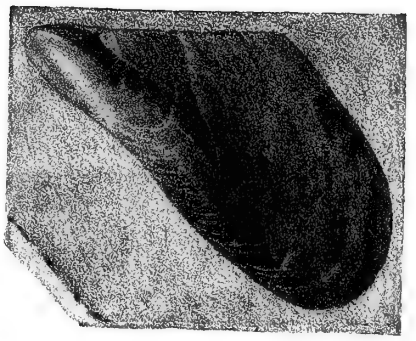
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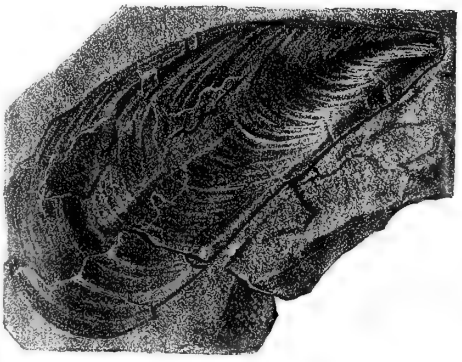
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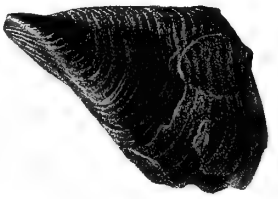
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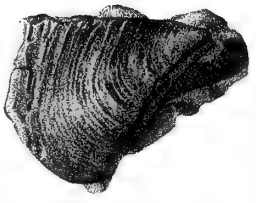
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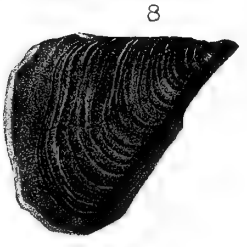
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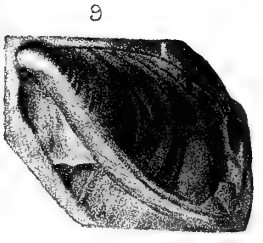
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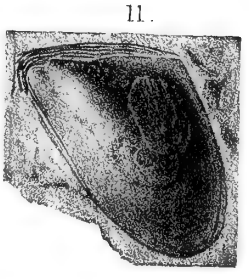
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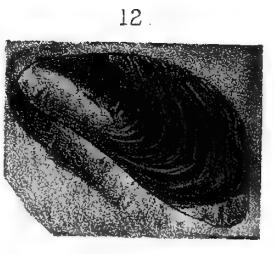
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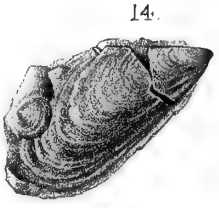
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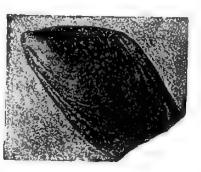
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PLATE V.

Fig. 1.—*Myalina Redesdalensis.* A crushed specimen showing the curvature of the posterior border, from Swaledale. In the Collection of Miss Jane Donald. (Page 109.)

Figs. 2 and 3.—*Myalina compressa.* Two specimens from the Coal-measures, South Staffordshire. In the Collection of Mr. Johnson of Dudley. (Page 123.)

Figs. 4 and 5.—*Myalina sublamellosa.* Two impressions on a slab of calcareous Sandstone from Swaledale. In the Collection of Miss Jane Donald. (Page 121.)

Figs. 6, 7, 8.—*Myalina sublamellosa.*—From the locality where the type-specimens were obtained, Craiglockhart Hill Quarry, near Edinburgh. Calciferous Sandstone series. In the Collection of the Geological Survey of Scotland. (Page 121.)

Fig. 9.—*Posidoniella vetusta.* A right valve, of medium size, from the Carboniferous Limestone (upper beds) of Cavedale, Castleton. My Collection. (Page 84.)

Figs. 10, 10 *a*, 11, 11 *a*.—*Posidoniella vetusta.* Two left valves seen from the side and in profile from behind. Same locality and Collection. (Page 84.)

Fig. 12.—*Posidoniella gibbosa.* A specimen showing both valves from the Carboniferous Limestone of Thorpe Cloud. My Collection. (Page 91.)

Figs. 13 and 14.—*Posidoniella gibbosa.* Two left valves from the same locality. My Collection. (Page 91.)

Fig. 15.—*Posidoniella elongata.* A left valve from the Carboniferous Limestone, Axton, Flintshire. In the Collection of Mr. G. H. Morton. (Page 88.)

Fig. 16.—*Posidoniella elongata.* A left testiferous example from the Carboniferous Limestone of Settle. In the Collection of the Woodwardian Museum, Cambridge. (Page 88.)

Fig. 17.—*Posidoniella elongata.* A fairly perfect example from the Coombes Limestone. Collected by Mr. John Dunn. My Collection. (Page 88.)

Figs. 18, 18 *a*.—*Posidoniella elongata.* The cast of a left valve showing the position of the anterior adductor scar. From the Carboniferous Limestone of Settle. In the Collection of the Woodwardian Museum, Cambridge. (Page 88.)

Figs. 19, 19 *a*.—*Posidoniella elongata.*—Two views of a fairly perfect example, the second figure being the view of the anterior surface. Same locality and Museum. (Page 88.)

Fig. 20.—*Posidoniella pyriformis.* A left testiferous valve of full size from the same locality and Museum. (Page 86.)

Fig. 21.—*Posidoniella pyriformis.* The cast of a right valve showing the pallial line and posterior adductor muscle-scar. Same locality and Museum. (Page 86.)

Fig. 22.—*Posidoniella pyriformis.* A left valve. Same locality and Collection. (Page 86.)

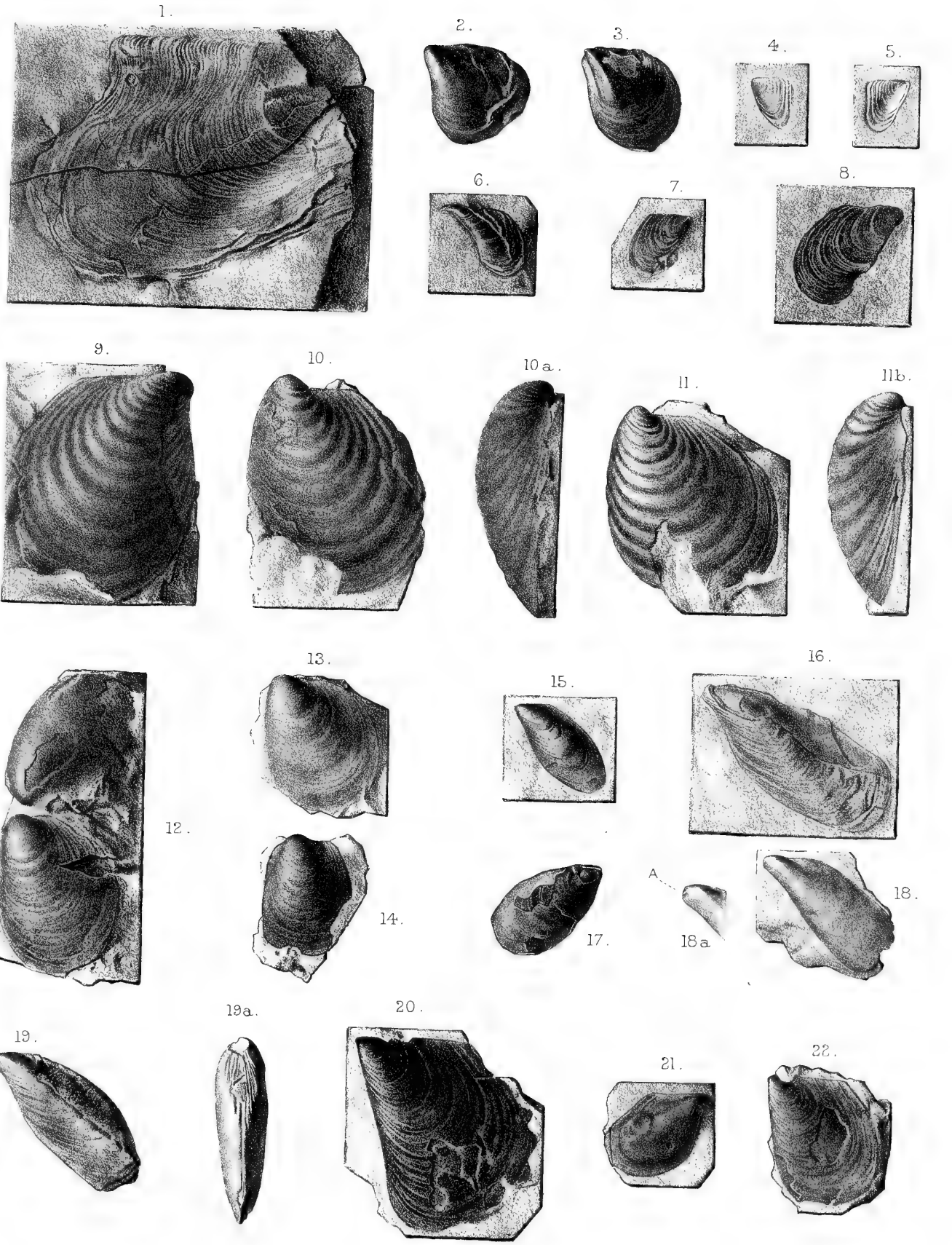

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PLATE VI.

Figs. 1—3.—*Posidoniella pyriformis.* Three specimens from the Carboniferous Limestone of Settle. In the Collection of the Woodwardian Museum, Cambridge. (Page 86.)

Fig. 3 *a.*—*Posidoniella pyriformis.*—A view of the anterior edge of Fig. 3. (Page 86.)

Fig. 4.—*Posidoniella pyriformis.* The specimen which Phillips referred to Perna (?) from the Carboniferous Limestone of Bolland. In the Gilbertson Collection of the Natural History Museum, South Kensington. (Page 86.)

Fig. 5.—*Posidoniella pyriformis.* A larger example from the same locality in the same Collection.

Fig. 6.—*Posidoniella elongata.* A specimen from the Carboniferous Limestone of Bolland. Same Collection. (Page 88.)

Figs. 7 and 8.—*Posidoniella semisulcata.* A left and a right valve from the shales below the Millstone Grits, Congleton Edge. My Collection. (Page 92.)

Figs. 9—11.—*Posidoniella semisulcata.* Three specimens showing the hinge-line and anterior adductor muscle-scar. Same locality. My Collection. (Page 92.)

Fig. 12.—*Posidoniella lævis.* The type specimen of Brown's *Catillus lævis,* from the shales below the Millstone Grits of High Green Wood, Todmorden. Owens College Museum. (Page 94.)

Fig. 13.—*Posidoniella lævis.* A testiferous example from the roof of the Bullion coal, Colne. Same Collection. (Page 94.)

Fig. 14.—*Posidoniella lævis.* A left valve figured by Mr. George Wild as *Posidonomya Gibsoni* ('Trans. Manch. Geol. Soc.,' 1892, vol. xxi, p. 400, pl. ii, fig. 8). From the roof of the Bullion Coal, Sholver, near Oldham. Same Collection. (Page 94.)

Fig. 15.—*Posidoniella minor.* A left valve, showing overlapping of the periostracum. In the Geological Collection, Owens College. (Page 98.)

Fig. 16.—*Posidoniella Kirkmani.* The type of Brown's *Catillus Kirkmani* from the shales of High Green Wood, Todmorden. Same Collection. (Page 96.)

Figs. 17 and 18.—*Posidoniella minor.* Two specimens on a slab covered with examples from the roof of the Bullion coal, near Trawden. Same Collection. (Page 98.)

Figs. 19—21.—*Posidoniella Kirkmani.* The originals of Brown's *Catillus obliquatus* and *C. costatus* from the black shales of High Green Wood, Todmorden. Same Collection. (Page 96.)

Figs. 22, 23.—*Posidoniella minor.* Originals (?) of some of Brown's species. Same locality and Collection. (Page 98.)

Fig. 24.—*Posidoniella lævis.* A piece of fossil wood with specimens of this species in all stages of growth attached by the byssus. Same Collection. (Page 94.)

Fig. 25.—*Posidoniella subquadrata.* A left valve from the roof of the Bullion Mine, Dearnley, Rochdale. My Collection. (Page 101.)

Fig. 26.—*Myalina peralata.* A left valve from a quarry on Congleton Edge, Cheshire, below the Millstone Grits. My Collection. (Page 119.)

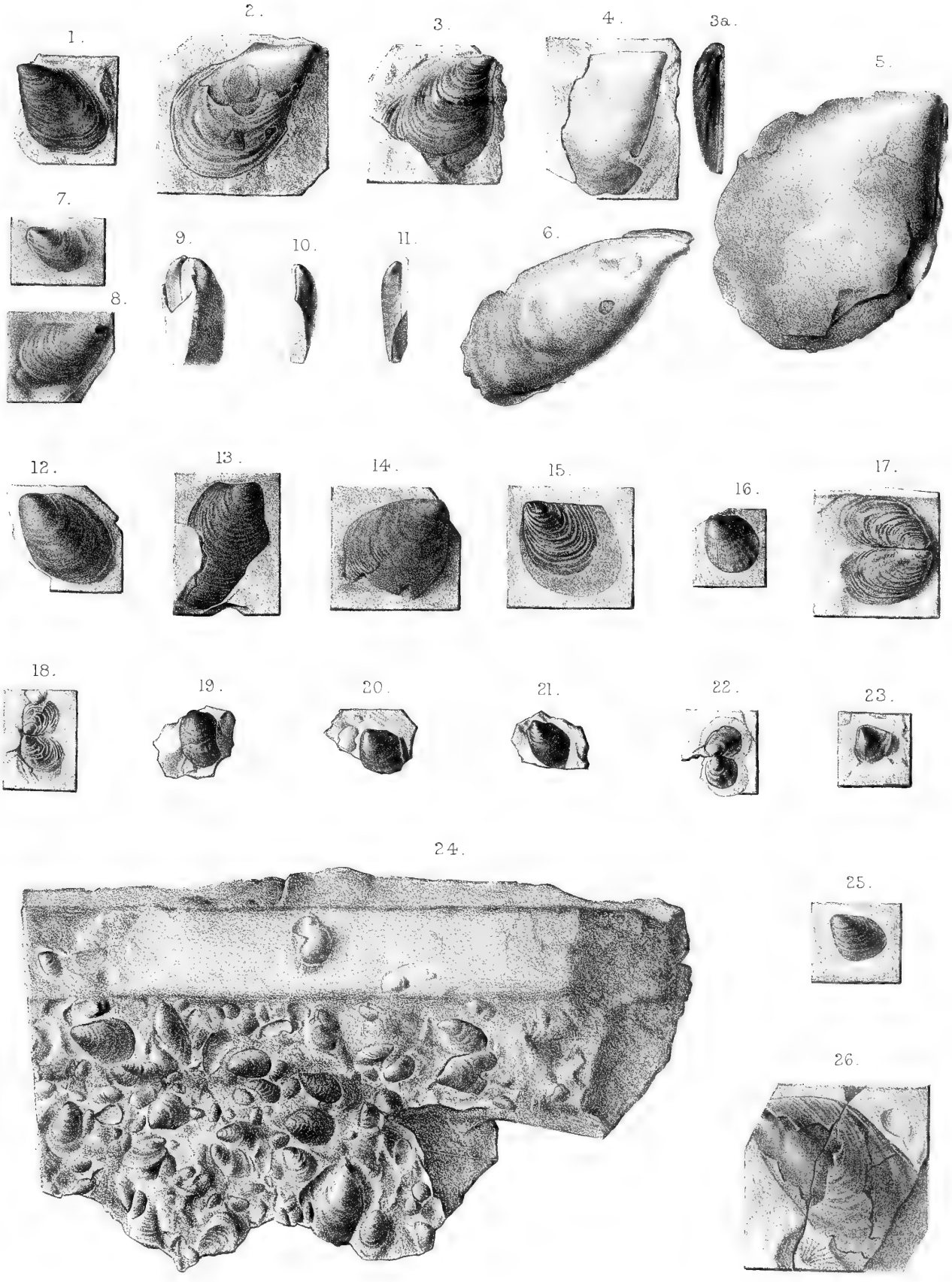

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PLATE VII.

Figs. 1, 1 *a*.—*Myalina Redesdalensis*. Two views of a cast of a fine specimen from the Carboniferous Limestone of Derbyshire. In the York Museum. (Page 109.)

Figs. 2, 2 *a*.—*Posidoniella vetusta*. Two views of a very fine example from the Limestone of Trey Cliff, Castleton, showing, 2 *a*, the anterior edge of the shell with the anterior lobe *x* and the byssal notch. In the Collection of Mr. J. Barnes, of Manchester. (Page 84.)

Fig. 3.—*Myalina peralata*. A testiferous example from the Carboniferous Limestone of Settle. In the Collection of the Woodwardian Museum, Cambridge. (Page 119.)

Fig. 4.—*Posidoniella lævis*. A fine pyritised example from the roof of the Bullion seam, Lancashire coal-field. In the Collection of Owens College. (Page 94.)

Figs. 5 and 6.—*Modiola ligonula*. Two specimens from the highest bed of the Calciferous Sandstone series, St. Monan's, Fife. My Collection. (Page 69.)

Fig. 5 *a*.—*Modiola ligonula*. Viewed from above. (Page 69.)

Figs. 7—9.—*Posidoniella variabilis*. From the black shales below the Millstone Grits, Todmorden. In the Collection of Owens College. (Page 100.)

Fig. 10.—*Posidoniella subquadrata*. A fine specimen from the roof of the Bullion coal, New Hey, near Rochdale. In the Collection of Professor Boyd Dawkins. (Page 101.)


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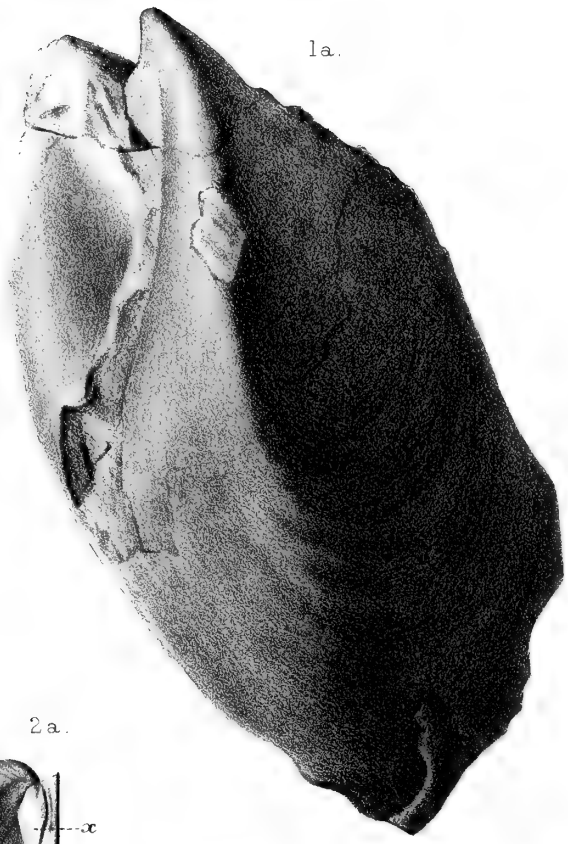
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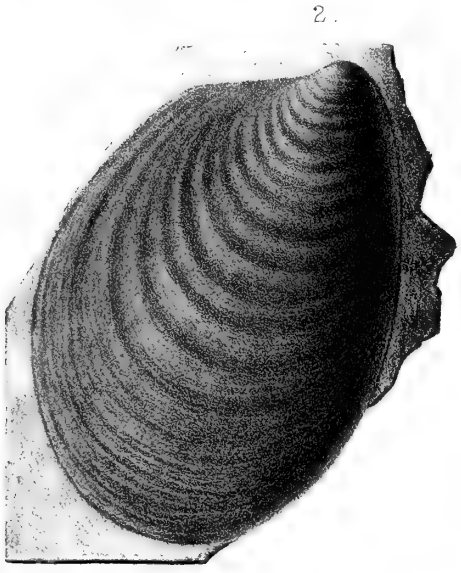
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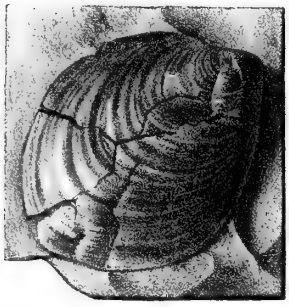
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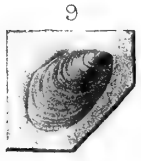
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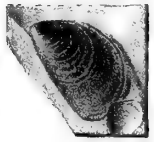
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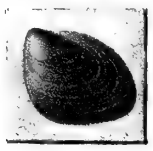
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PLATE VIII.

Fig. 1.—*Modiola Jenkinsoni.* The type specimen of M'Coy's *Lithodomus Jenkinsoni*, from the Limestone of Lowick, Northumberland. In the Woodwardian Museum, Cambridge. The shell is almost entirely absent. (Page 71.)

Figs. 1 *a*, 1 *b*.—The same specimen viewed from above and from the front.

Fig. 2.—*Modiola Jenkinsoni*, another specimen from the same locality, showing the adductor scar and the pallial line. (Page 71.)

Fig. 3.—*Modiola Jenkinsoni.* A testiferous example from the Carboniferous Limestone of Killogunra, Killala, Ireland. Same collection. (Page 71.)

Fig. 4.—*Parallelodon squamifer.* A perfect example from the Carboniferous Limestone of Settle. In the Burrow Collection of the Woodwardian Museum, Cambridge. (Page 130.)

Figs. 4 *a*, 4 *b*.—The same specimen viewed from above and in front. (Page 130.)

Fig. 5.—*Parallelodon squamifer.* The type specimen of *Modiola squamifera*, Phillips, from Bolland. In the Gilbertson Collection of the British Museum (Natural History), South Kensington. (Page 130.)

Fig. 6.—*Parallelodon squamifer.* A left valve from the Carboniferous Limestone of Settle. Collection of Geological Survey, Jermyn Street. (Page 130.)

Fig. 6 *a*.—The same valve, showing the elongate teeth of the posterior parts of the hinge-plate. (Page 130.)

Fig. 7.—*Parallelodon squamifer.* A right valve, in the same Collection, from Settle, showing the posterior part of the hinge-plate. (Page 130.)

Fig. 8.—*Parallelodon squamifer.* A left valve, from the Burrow Collection of the Woodwardian Museum, Cambridge, from the same locality, showing radiating marking towards the posterior inferior part of the shell. (Page 130.)

Fig. 9.—*Parallelodon obtusus.*—A cast of the interior of a right valve, showing the posterior part of the hinge. From the Carboniferous Limestone of Park Hill, near Longnor, in the Collection of the Geological Survey, Jermyn Street. (Page 167.)

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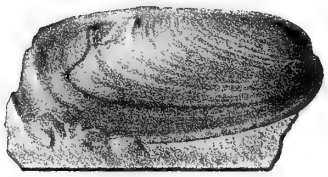

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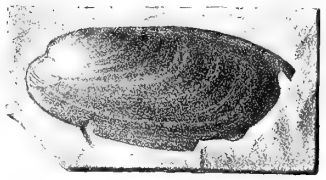

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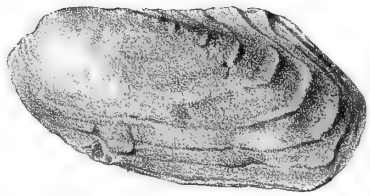

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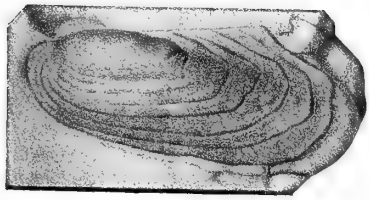

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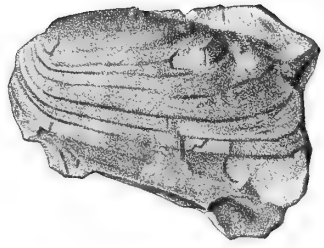

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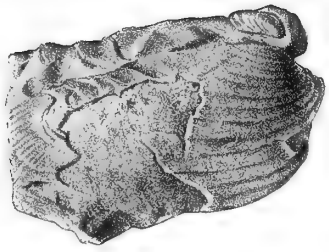

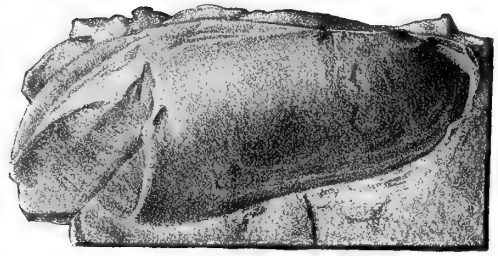

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PLATE IX.

Fig. 1.—*Parallelodon cingulatus.* Showing the convex right valve, from the Carboniferous Limestone of Castleton. In the Collection of Mr. J. Barnes, of Manchester. (Page 137.)

Fig. 1 *a.*—The left valve of the same specimen.

Fig. 1 *b.*—The same specimen viewed from above, showing it to be inequivalve.

Fig. 2.—*Parallelodon cingulatus.* The flattened left valve. Same locality. My Collection. (Page 137.)

Fig. 2 *a.*—The right valve of the same specimen.

Fig. 3.—*Parallelodon cingulatus.* A right valve. Same locality. My Collection. (Page 137.)

Fig. 4.—*Parallelodon cingulatus.* The type specimen figured by M'Coy. In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 137.)

Fig. 5.—*Parallelodon bistriatus.* A fairly perfect specimen from the Carboniferous Limestone of Park Hill, Derbyshire. My Collection. (Page 134.)

Fig. 5 *a.*—A portion of the same specimen, magnified to show the ornament. (Page 134.)

Figs. 6, 7.—*Parallelodon bistriatus.* Two examples of the left valve, Fig. 7 being semi-decorticated, and showing no striæ. Same locality. My Collection. (Page 134.)

Fig. 8.—*Parallelodon bistriatus.* A right valve. Same locality. My Collection. (Page 134.)

Figs. 9 and 10.—*Parallelodon bistriatus.* Two perfect examples of adult specimens. Same locality. Collection of Mr. J. Barnes, Manchester. (Page 134.)

Fig. 9 *a.*—The ornament shown on Fig. 9, magnified. (Page 134.)

Fig. 9 *b.*—The same shell viewed from above, showing it to be equivalve. (Page 134.)

Fig. 11.—*Parallelodon bistriatus.* Said to be the original of M'Coy's figure of the species in his 'Synopsis of the Carb. Foss. Ireland.' In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 134.)

Fig. 12.—*Parallelodon bistriatus.* The type of Portlock's figure. In the Collection of the Geological Survey, Jermyn Street. (Page 134.)

Fig. 13.—*Parallelodon Verneuilianus.* A fairly perfect example, showing the right valve, from the Carboniferous Limestone of Trey Cliff, Castleton. In the Collection of Mr. W. F. Holroyd, Manchester. (Page 132.)

Figs. 14—17.—*Parallelodon Verneuilianus.* A series from the Carboniferous Limestone of Little Island, Cork. In the Collection of Mr. J. Wright, of Belfast. (Page 132.)

Fig. 17 *b.*—The shell represented by Fig. 17, seen from above. (Page 132.)

Figs. 17 *a*, 17 *c.*—The same shell enlarged. (Page 132.)

Fig. 19.—*Parallelodon squamosus.* A right valve from the Carboniferous Limestone of Wetton. In the Collection of the Geological Survey, Jermyn Street. (Page 138.)

Figs. 18, 20, 21.—*Parallelodon squamosus.* A series from the Carboniferous Limestone of Settle. In the Burrow Collection of the Woodwardian Museum, Cambridge. (Page 138.)

Figs. 22, 22 *a.*—*Parallelodon squamosus.*—A specimen showing the details of the hinge of a left valve. Same locality and Collection. (Page 138.)

Fig. 23.—*Parallelodon reticulatus.* A full-grown example of the left valve. From the Carboniferous Limestone of Trey Cliff, Castleton. My Collection. (Page 142.)

Fig. 24.—*Parallelodon reticulatus.* A bivalve example, showing the anterior teeth of the hinge of the right valve. Same locality. My Collection. (Page 142.)

Fig. 25.—*Parallelodon reticulatus.* A fairly perfect example with both valves. Same locality. My Collection. (Page 142.)

Fig. 25 *a.*—The same specimen, viewed from above. (Page 142.)

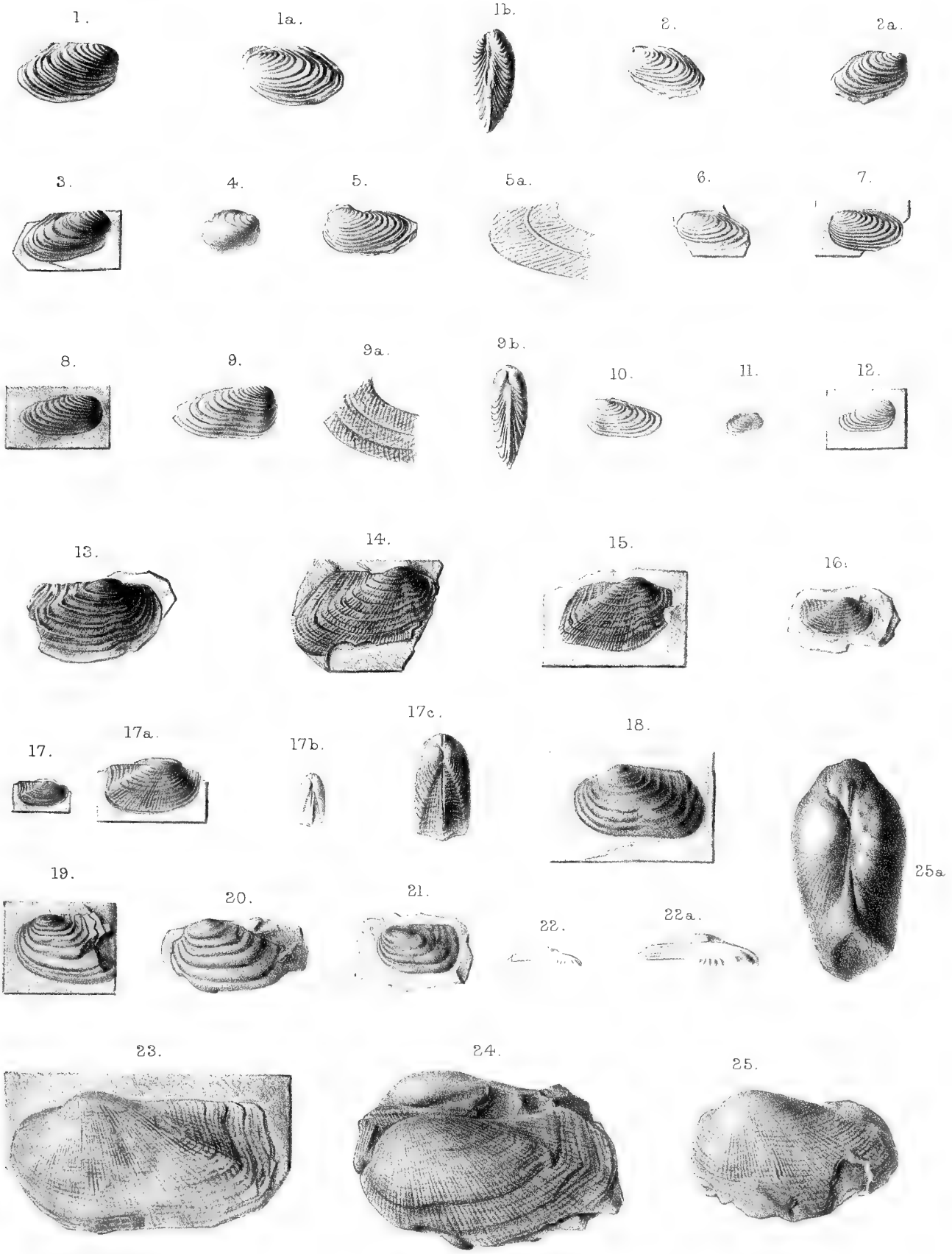

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PLATE X.

Fig. 1.—*Parallelodon reticulatus.* A right valve, having the test very finely preserved. From the Carboniferous Limestone of Castleton. My Collection. (Page 142.)

Figs. 2, 3.—*Parallelodon reticulatus.* The casts of a right and left valve, showing the adductor muscle-scars and pallial line, Fig. 2, having a small portion of test preserved. Same locality. My Collection. (Page 142.)

Fig. 4.—*Parallelodon reticulatus.* A beautifully marked example with finer radiating lines than the Castleton specimens, from the Carboniferous Limestone of Settle. In the Burrow Collection of the Woodwardian Museum, Cambridge. (Page 142.)

Fig. 5.—*Parallelodon cancellatus.* A testiferous example of a left valve, beautifully preserved, from the Carboniferous Limestone of Settle. My Collection. (Page 144.)

Fig. 6.—*Parallelodon cancellatus.* The cast of a right valve, showing the posterior teeth, from the Carboniferous Limestone of Park Hill. My Collection. (Page 144.)

Fig. 7.—*Parallelodon cancellatus.* A left valve, the type specimen of Sowerby's, and probably also of Martin's, *Arca cancellata*, from the Carboniferous Limestone of Derbyshire. In the Sowerby Collection, British Museum (Natural History), South Kensington. (Page 144.)

Fig. 8.—*Parallelodon cancellatus.* The cast of a very large example, left valve, from the Carboniferous Limestone of Park Hill. In the Collection of the Geological Survey, Jermyn Street. (Page 144.)

Fig. 9.—*Parallelodon cancellatus.* The cast of the right valve, showing the impressions of the posterior teeth of the hinge. Fig. 9 *a*, an enlarged view. Same locality and Collection. (Page 144.)

Fig. 10.—*Parallelodon Lacordairianus.* A fine example of the left valve, from the Carboniferous Limestone of Castleton. My Collection. (Page 147.)

Figs. 11, 12, and 15.—*Parallelodon Walciodorensis.* A series of right valves, from the Carboniferous Limestone of Settle. In the Burrow Collection of the Woodwardian Museum, Cambridge. (Page 149.)

Fig. 13.—*Parallelodon Walciodorensis.* A full-grown example of the right valve, from the Carboniferous Limestone of Castleton. My Collection. (Page 149.)

Fig. 13 *a.*—*Parallelodon Walciodorensis.* The same shell, showing a small portion of the anterior part of the hinge of oblique teeth exposed. (Page 149.)

Fig. 14.—*Parallelodon Walciodorensis.* The cast of a right valve, showing the adductor muscle-scars and the pallial line. Fig. 15, showing shell surface. Same locality. My Collection. (Page 149.)

Fig. 16.—*Parallelodon corrugatus.* A left valve, with a portion of the test preserved, showing the peculiar and characteristic ornament, and also exposing the posterior adductor scar and the pallial line. From the Carboniferous Limestone of Settle. In the Burrow Collection of the Woodwardian Museum, Cambridge. (Page 140.)

Fig. 17.—*Parallelodon corrugatus.* A rolled specimen of the left valve, showing the broad ligamental area and thickened hinge-plate, but no details are preserved. Same locality and Collection. Fig. 17 *a*, another view of the wide area of the same specimen. (Page 140.)

Fig. 18.—*Parallelodon corrugatus.* The portion of a specimen having the test preserved figured to show the transversely corrugated ornament. Same locality and Collection. (Page 140.)

Fig. 19.—*Parallelodon corrugatus.* A testiferous example of the left valve, from the Carboniferous Limestone of Castleton. My Collection. (Page 140.)

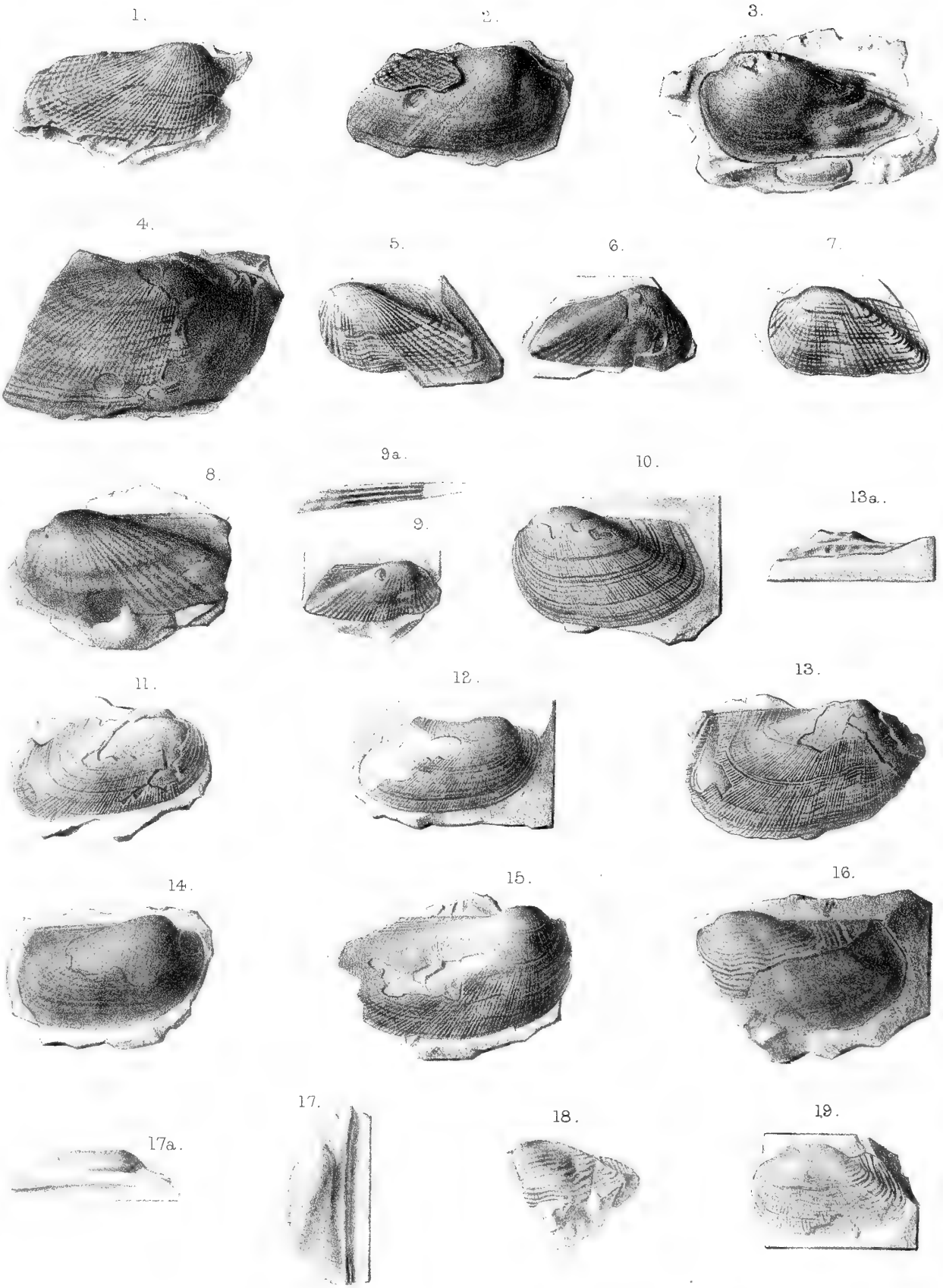

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PLATE XI.

Fig. 1.—*Parallelodon tenuistria.* A testiferous example. From the Carboniferous Limestone of co. Meath. In the Collection of the Geological Survey of Ireland, Dublin. (Page 151.)

Fig. 2.—*Parallelodon tenuistria.* A cast of the left valve. From the Limestone of Garrahies, co. Kerry. Same Collection. (Page 151.)

Fig. 3.—*Parallelodon tenuistria.* A right valve, with portion of the test preserved. Same locality and Collection. (Page 151.)

Fig. 4.—*Parallelodon tenuistria.* The type specimen figured by M'Coy, from the Lower Limestone of Cregg, Nobber. From the Griffith Collection of the Museum of Science and Art, Dublin. (Page 151.)

Fig. 4 *a.*—*Parallelodon tenuistria.* The type specimen, viewed from above.

Fig. 5.—*Parallelodon semicostatus.* The type specimen figured by M'Coy, from the Calp series of Manor Hamilton. Same Collection. (Page 157.)

Fig. 6.—*Parallelodon semicostatus.* A left valve, from the Shale below the Linn Limestone of Linn Spout, Dalry. My Collection. (Page 157.)

Figs. 7 and 8.—*Parallelodon semicostatus.* Two right valves, showing variations in shape. Same locality. My Collection. (Page 157.)

Fig. 9.—*Parallelodon semicostatus.* A left valve, of a less transversely produced form. Same locality. My Collection. (Page 157.)

Fig. 10.—*Parallelodon semicostatus.* The cast of a left valve, which shows some details of the hinge, but these are too deep in the hollow behind the umbo to be shown in the drawing. Same locality and Collection. (Page 157.)

Fig. 11.—*Parallelodon theciformis.* A well-preserved left valve, from the Carboniferous Limestone of Settle. In the Burrow Collection of the Woodwardian Museum, Cambridge. (Page 171.)

Fig. 12.—*Parallelodon theciformis.* A large example of the right valve, from the Carboniferous Limestone of Thorpe Cloud, Derbyshire. My Collection. (Page 171.)

Figs. 13—16.—*Parallelodon theciformis.* A series of examples, from the Carboniferous Limestone of Settle, Yorkshire. In the Burrow Collection of the Woodwardian Museum, Cambridge. (Page 171.)

Figs. 17—20.—*Parallelodon Geinitzi.* A series of left valves, from the Shale below the Limestone of Linn Spout, Dalry. My Collection. (Page 169.)

Fig. 21.—*Parallelodon Geinitzi.* A right valve of a transversely elongated specimen. Same locality. My Collection. (Page 169.)

Fig. 22.—*Parallelodon decussatus.* A left valve. The original shell, figured by M'Coy, from the Lower Limestone, Little Island, Cork. In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 159.)

Fig. 23.—*Parallelodon fallax.* A right valve, from the Carboniferous Limestone of Settle. In the Burrow Collection of the Woodwardian Museum, Cambridge. (Page 161.)

Fig. 24.—*Parallelodon fallax.* The cast of a left valve, showing the anterior and posterior hinge-teeth, adductor muscle-scars, and pallial line, from the Carboniferous Limestone of Narrowdale, Staffordshire. In the Collection of the Geological Survey, Jermyn Street. (Page 161.)

Figs. 25, 26.—*Parallelodon fallax.* Two very perfect examples, from the Carboniferous Limestone of Settle, Yorkshire. In the Burrow Collection of the Woodwardian Museum, Cambridge. (Page 161.)

Fig. 25 *a.*—*Parallelodon fallax.* Fig. 25 viewed from above.

Fig. 27.—*Parallelodon fallax.* A left valve, from the Carboniferous Limestone of Hill Bolton, Yorkshire. My Collection. (Page 161.)

Fig. 27 *a.*—*Parallelodon fallax.* The same example, showing the hinge-line.

Fig. 27 *b.*—*Parallelodon fallax.* The same example viewed from above, showing the area.

Fig. 28.—*Parallelodon Haimeanus.* A cast, showing the hinge and adductor muscle-scars. From the Carboniferous Limestone at the entrance to the Odin Mine, Castleton. My Collection. (Page 163.)

Fig. 28 *a.*—A magnified view of the posterior hinge-teeth of Fig. 28.

Fig. 29.—*Parallelodon Haimeanus.* A testiferous right valve, from the Carboniferous Limestone of Trey Cliff, Castleton. In the Collection of the Geological Survey Museum. (Page 163.)

Fig. 30.—*Parallelodon Haimeanus.* A fine example of left valve, from the same locality. My Collection. (Page 163.)

Fig. 30 *a.*—*Parallelodon Haimeanus.* A portion of the test magnified, showing the fine lines of growth between the more marked concentric transverse striations.

Fig. 31.—*Parallelodon Haimeanus.* The cast of a left valve, from the Carboniferous Limestone of Narrowdale, Staffordshire. In the Collection of the Geological Survey, Jermyn Street. (Page 163.)

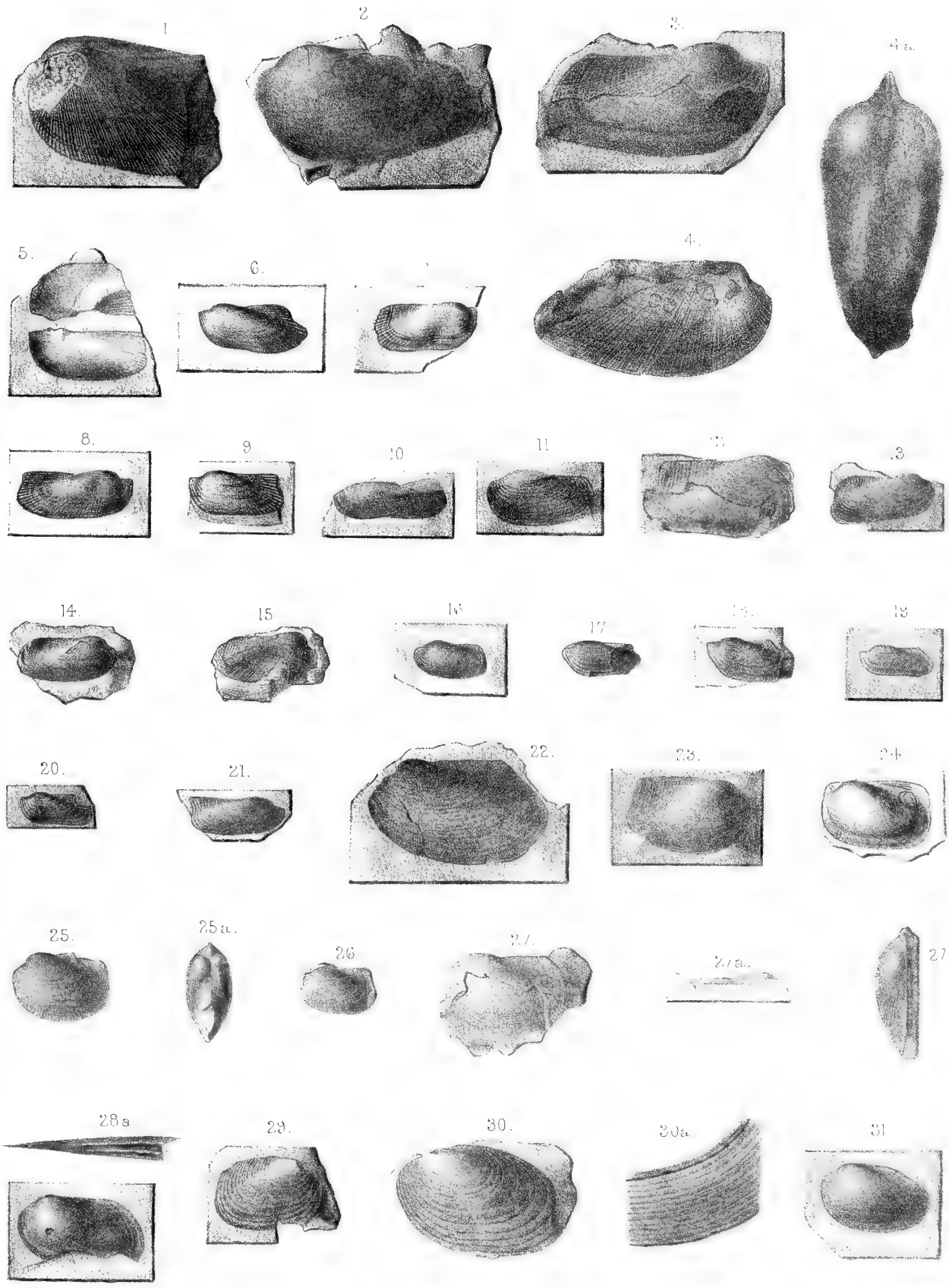
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PLATE XII.

Fig. 1.—*Parallelodon reticulatus.* The type specimen, figured by M'Coy, from the Lower Limestone of Millicent. In the Griffith Collection in the Museum of Science and Art, Dublin. (Page 142.)

Fig. 2.—*Parallelodon obtusus.* A fine testiferous example from the Carboniferous Limestone of Graigue, co. Limerick. In the Collection of the Geological Survey, Dublin. (Page 167.)

Fig. 3.—*Parallelodon obtusus.* A reproduction of the drawing of the type specimen in Phillips's 'Geology of Yorkshire.' (Page 167.)

Fig. 4.—*Parallelodon obtusus.* Portion of a left testiferous valve from the Carboniferous Limestone of Thorpe Cloud, Derbyshire. My Collection. (Page 167.)

Fig. 5.—*Parallelodon obtusus.* A right valve of large size. Same locality. My Collection. (Page 167.)

Fig. 6.—*Parallelodon obtusus.* Portion of a very large example, showing the sinuations of the lines of growth in the neighbourhood of the byssal sinus. Same locality. My Collection. (Page 167.)

Fig. 7.—*Parallelodon ornatissimus.* A young testiferous example. Same locality. My Collection. (Page 155.)

Fig. 8.—*Parallelodon Fraiponti.* A right valve, from same locality. My Collection. (Page 165.)

Fig. 9.—*Parallelodon obtusus.* The cast of a right valve, showing the posterior hinge-teeth. Same locality. My Collection. (Page 167.)

Fig. 10.—*Parallelodon Fraiponti.* A right valve, from the Carboniferous Limestone of Settle. In the Geological Collection of the York Museum. (Page 165.)

Fig. 11.—*Parallelodon decussatus.* Castleton. (Page 159.)

Fig. 12.—*Parallelodon decussatus.* A full-grown right valve, from the Upper Beds of the Carboniferous Limestone, Trey Cliff, Castleton. My Collection. (Page 159.)

Fig. 13.—*Parallelodon Fraiponti.* A right valve, from the Carboniferous Limestone of Castleton. My Collection. (Page 165.)

Fig. 14.—*Parallelodon fallax.* The left valve, showing the posterior hinge-teeth, from the Carboniferous Limestone of Narrowdale. In the Collection of the Geological Survey, Jermyn Street. (Page 161.)

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Fig. 16.—*Parallelodon concinnus.* The type specimen of M'Coy's *Modiola concinna*, from the Arenaceous Limestone of Townparks, Killeshandra. In the Griffith Collection of the Science and Art Museum, Dublin. (Page 153.)

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Fig. 22 *a*.—*Parallelodon concinnus.* An enlarged view of the hinge-teeth of the above specimen. (Page 153.)

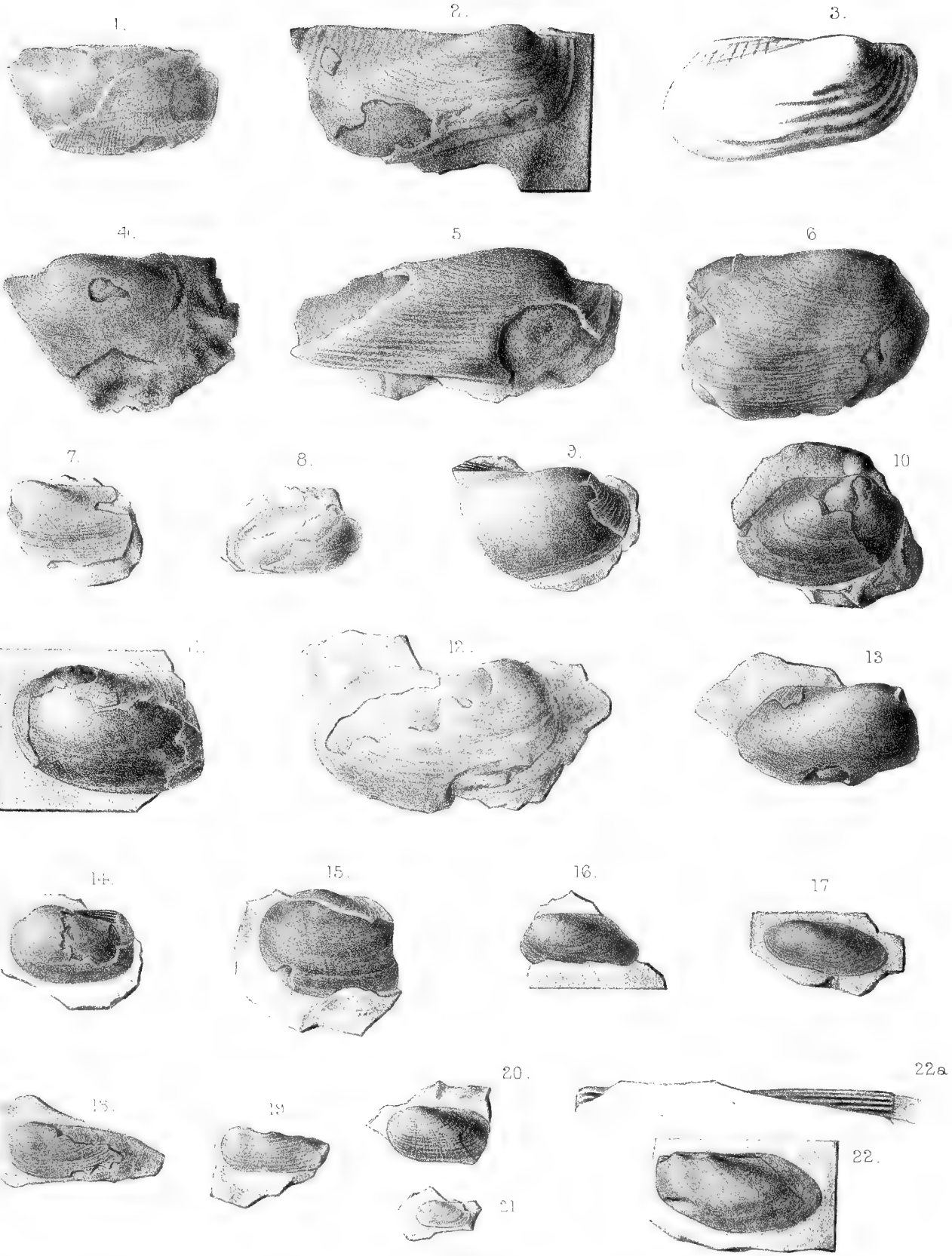
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PLATE XIII.

Fig. 1.—*Parallelodon ornatissimus.* A full-grown, decorticated right valve, from the Carboniferous Limestone of Thorpe Cloud. My Collection. (Page 155.)

Fig. 2.—*Parallelodon ornatissimus.* A right valve, with portion of the test preserved, showing in front the anterior adductor muscle-scar and pallial line. Same locality. My Collection. (Page 155.)

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Fig. 12.—*Parallelodon divisus.* The hinge-plate of a left valve. Same locality. My Collection. (Page 172.)

Fig. 12 *a.*—*Parallelodon divisus.* An enlarged view of the hinge-plate.

Fig. 13.—*Parallelodon divisus.* An example labelled *Modiola divisa* in the Griffith Collection, Dublin. (Page 172.)

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Fig. 15.—*Parallelodon semicostatus.* A fragment showing the anterior portion of the right hinge-plate. Fig. 15 *a.*—The same, magnified. My Collection. (Page 157.)

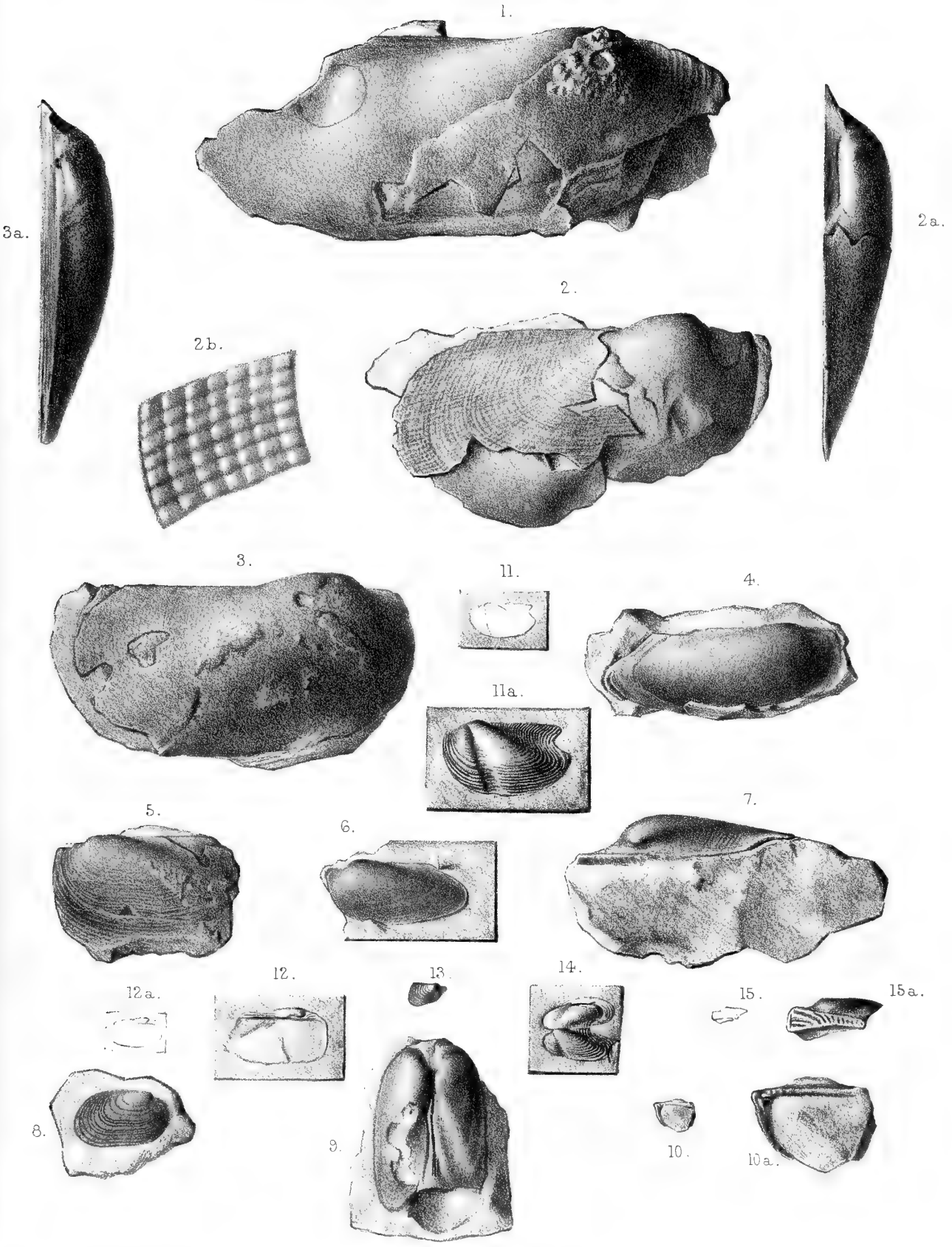

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PLATE XIV.

Fig. 1.—*Parallelodon obtusus.* A large example possessing both valves. In the Gilbertson Collection, Natural History Museum, South Kensington. (Page 167.)

Fig. 2.—*Parallelodon obtusus.* A specimen showing part of the hinge-plate. Same Collection. (Page 167.)

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Fig. 12.—*Nucula gibbosa.* A perfect example from the shale below the third millstone grit, Congleton Edge. My Collection. (Page 178.)

Fig. 13.—*Nucula gibbosa.* From the roof of the Gin-mine Coal, North Staffordshire coal-field. Collection of Mr. J. Ward, of Longton. (Page 178.)

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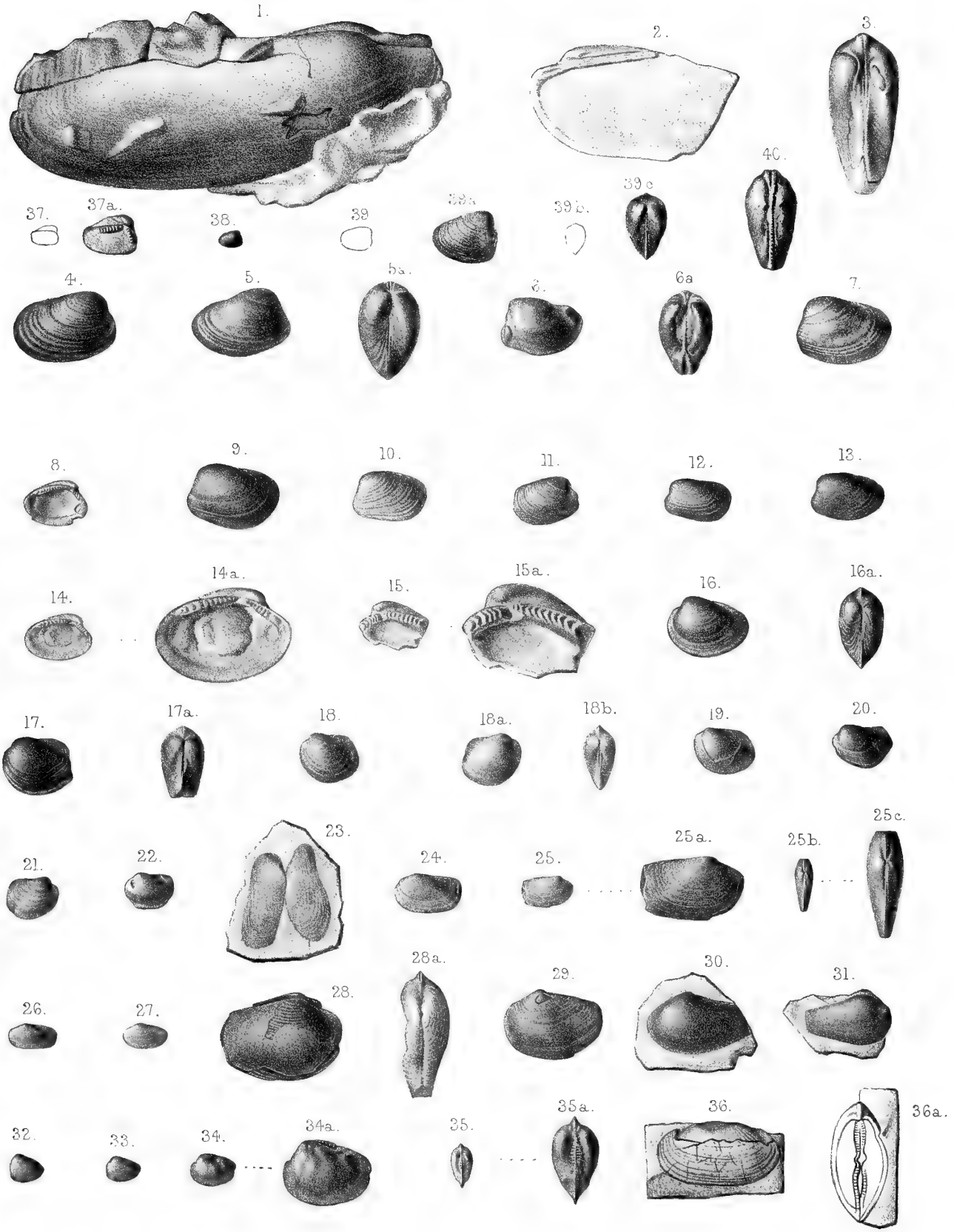

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PLATE XV.

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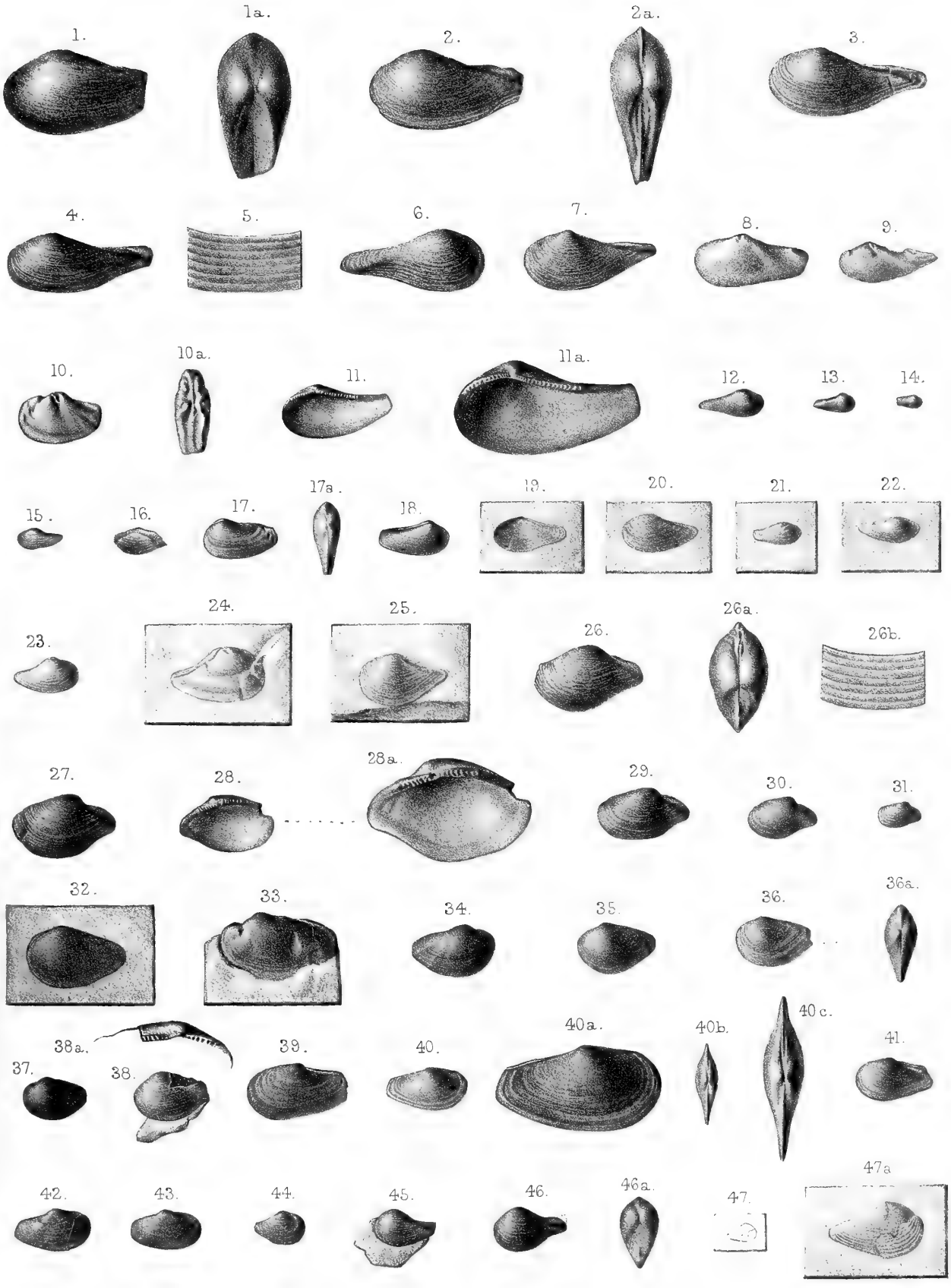
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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1897.

LONDON:

MDCCCXCVII.

MONOGRAPH

ON THE

CARBONIFEROUS CEPHALOPODA

OF

IRELAND.

BY

ARTHUR H. FOORD, PH.D. (MÜNCH.), F.G.S.

PART I.

FAMILY ORTHOCERATIDÆ (IN PART).

PAGES 1—22; PLATES I—VII.

LONDON:

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1897.

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MONOGRAPH

ON THE

CARBONIFEROUS CEPHALOPODA OF IRELAND.

Sub-order NAUTILOIDEA.

Family Orthoceratidæ.

A. Longicones.

I. *Group* Lævia.

Sub-group *Cylindriformes* (*siphuncle cylindrical*).

Genus Orthoceras, *Breyn*, 1732.

Orthoceras Leinsterense, *A. H. Foord.* Plate I, figs. 1 *a*—*c*.

1896. Orthoceras Leinsterense, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 13.

Description.—Shell somewhat elongate, straight, tapering at the rate of about 1 : 7. Section elliptic, perhaps partly by pressure, the ratio of the greater to the lesser diameter being as 7 : 6. Body-chamber of moderate length, about 120 mm., which probably represents not more than one-fourth of the entire length of the shell; the specimen, however, is not perfect enough towards the apex to supply material for accurate measurement. There is a small, well-marked constriction on the cast of the body-chamber, just below the aperture, but this

can only be seen when the test has been removed. The edge of the aperture is preserved in one place. Septa somewhat oblique, crowded together in the younger part of the shell, making the chambers here very shallow, their depth being less than one-fifth of their diameter. Nearer the body-chamber, however, the septa rapidly widen their distance, so that within a space of 75 mm. their distance apart is nearly doubled. Siphuncle, as determined by the necks of the septa, lies at a distance of about three-eighths across the diameter of the shell, probably cylindrical; the tube itself has, however, been destroyed by crystallisation within the chambers, which are filled with crystalline calcite. Test rather thick, especially that of the body-chamber; its surface marked with obscure lines of growth, which are more conspicuous upon the body-chamber than upon the rest of the shell. The shell may, nevertheless, be regarded as essentially smooth.

Size.—Length of the largest specimen 347 mm., but a considerable part of the apical end is broken off. Greatest diameter 62 mm., least 30 mm.

Affinities.—A comparison between this species and *Orthoceras variabile* is made under the description of the latter, but I am not acquainted with any other species with which it may be compared.

Remarks.—The most noteworthy feature in this species is the rapid transition from the closeness of the septa in the apical and central parts of the shell to their wide separation towards the body-chamber.

Locality.—Clane, county of Kildare.

ORTHOCERAS VARIABILE, *A. H. Foord.* Plate I, figs. 2 *a*—*d*.

1896. ORTHOCERAS VARIABILE, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 19.

Description.—Shell moderately elongate, tapering at the rate of 1 : 6. Section elliptic, the ratio of the two diameters as 11 : 9. Body-chamber slightly inflated, the apertural end not preserved; therefore its length relative to that of the entire shell cannot be computed. Septa extremely numerous in the apical and central portions of the shell, gradually increasing in width apart until the body-chamber is reached; thus in a section of the shell measuring 15 mm. in diameter the septa are only 3 mm. apart, and where the diameter has increased to 30 mm. they

are 5 mm. distant, while the last two septa are separated by an interval of 10 mm. The septa, as seen in a longitudinal section, are somewhat displaced by mineralisation, but they preserve on the whole their normal form. Siphuncle excentric by about its own diameter; cylindrical, rather wide. Test smooth.

Size.—Length of the largest specimen about 360 mm. Diameter of the base of the body-chamber 55 mm., that of the apex 12 mm.

Affinities.—This species is evidently related to *Orthoceras Leinsterense*, from which, however, it differs in its higher rate of tapering and closer septa. In its very numerous septa it is comparable also with *Orthoceras princeps*, de Koninck, but the latter has a much more rapidly tapering shell, and more evenly spaced septa.

Remarks.—This beautiful species appears to be rare; I have met with only two or three examples of it. The most marked feature in it consists of the very numerous septa, which greatly exceed in number those of most species of Orthoceras of this size. Their original structure has been considerably modified by crystallisation; the necks of the septa are often pushed out of place, as in the example figured, which only shows a small portion of the siphuncle proceeding downwards from the penultimate septum.

Locality.—Clane, county of Kildare.

ORTHOCERAS COLEI, *A. H. Foord*. Plate II, figs. 1 *a*—*c*.

1896. ORTHOCERAS COLEI, *A. H. Foord*. Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 18.

Description.—Shell elongate, tapering at the rate of about 1 : 6. Section normally circular, but elliptic by pressure, as is proved by the distortion of the septa at the sides (Pl. II, fig. 1 *b*). Body-chamber about 155 mm. in length in a specimen measuring about 600 mm., or about one-fourth of the whole length of the shell.[1] There is a well-marked constriction on the cast below the aperture, which constriction is as usual covered by a thickening of the test when the latter is present. Septa very deeply concave, distant from each other about one-third of the longer uncompressed diameter of the shell. Siphuncle cylindrical, wide, being from one-eighth to one-ninth of the diameter of the shell near the body-

[1] The specimen is preserved nearly to the apical point, but there is an intermediate piece lost which must have measured about 80 mm.; this has been added in computing the total length.

chamber ; excentric, situated at a point which is about two-fifths of the distance across the longer diameter of the shell. Test smooth.

Size.—Length of the largest specimen met with about 600 mm. ; greatest diameter 67 mm., least 6 mm.

Affinities.—*Orthoceras Leinsterense* most nearly resembles this species, but the two are very easily distinguished. In *O. Leinsterense* the septa are remarkably approximate in the earlier and middle portions of the shell ; in *O. Colei*, on the other hand, the septa are more regularly spaced, their distance apart increasing gradually with the growth of the shell. The rate of tapering in the present species is also higher than in *O. Leinsterense*. I find none of de Koninck's species comparable with the present one.

Remarks.—Only two or three specimens of this species have been obtained up to the present time, but they present constant characters, which may be easily recognised when suitable means are taken to develop them. These consist in the preparation of sections, longitudinal and transverse, the former being of special importance, as it is necessary to ascertain the structure of the siphuncle and its relation to the septa, as well as the characters of the latter. My experience has taught me that very few species of these straight-shelled cephalopods can be determined by the external characters alone, except in cases where there is a well-marked ornamentation. The species is named after Professor G. A. J. Cole, F.G.S., of Dublin.

Locality.—Clane, county of Kildare.

ORTHOCERAS NOLANI, *A. H. Foord.* Plate III, figs. 1 *a*—*f*.

1896. ORTHOCERAS NOLANI, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 20.

Description.—Shell straight, elongate, tapering at the rate of 1 : 7. Body-chamber about one-fourth of the length of the entire shell, with a well-marked constriction posterior to the aperture. Section elliptic, partly if not wholly by compression, the ratio of the two diameters being as 4 : 3. The septa are moderately distant, being 10 mm. apart where the shell diameter reaches 32 mm., this distance increasing to 15 mm. where the diameter is 42 mm. The chambers are deep, but not so deep as they appear to be, owing to the compression of the shell, which has pushed the septa inwards, bringing part of them nearly parallel

in some places with the siphuncle. The septa are otherwise well preserved. Their short "necks" are easily seen in longitudinal sections, a slight expansion of the siphuncle marking their termination (Pl. III, fig. 1 *d*). The siphuncle is slightly excentric and of moderate breadth, being about 4 mm. in diameter, or about one-eighth of the diameter of the shell. This proportion, however, would be reduced were the shell uncompressed. The surface of the test is quite smooth.

Size.—The largest example is 520 mm. in length, with an apertural diameter of 70 mm., the apical diameter (almost the extreme apex) being only 5 mm.

Affinities.—This species bears some resemblance to *Orthoceras fandum*, de Kon., but the septa are wider apart, and the rate of tapering is slower. The specimen figured by de Koninck,[1] which I examined when in Brussels in 1893, consists of parts of two individuals, the body-chamber not belonging to the same one as the septate part. From *Orthoceras Colei* the present species is distinguished by its slower rate of tapering and more nearly central siphuncle.

Remarks.—This species is represented by two fine specimens, one of which is nearly complete, wanting only a small part of the apical end. The septa and siphuncle are well preserved in both individuals, though the spaces between the septa are filled with crystalline calcite. Some of the septa are pushed out of shape by rock pressure against the walls of the shell.

I have named this species after Mr. J. Nolan, of the Geological Survey of Ireland, to whom I am much indebted for the kind help he has rendered me in giving me access to works relating to the literature of the subject of this Monograph.

Locality.—Clane, county of Kildare.

ORTHOCERAS SANCTI-DOULAGHI, *A. H. Foord.* Plate I, figs. 3 *a*—*e*.

1896. ORTHOCERAS SANCTI-DOULAGHI, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 17.

Description.—Shell elongate, tapering at the rate of 1 : 9. Section circular when uncompressed. Body-chamber of moderate length, but its proportion to the whole length of the shell cannot be ascertained in any of the specimens collected, as there is none perfect enough to supply the necessary data. The

[1] 'Calc. Carb. Belg.,' 1880, pt. ii, p. 65, pl. xlii, fig. 1.

aperture has an undulating outline, and there is a constriction in the cast of the body-chamber just below the aperture (Pl. I, fig. 3 *d*). Septa exceedingly numerous, undulating, varying very little in their distance apart, this regularity being a marked feature in the species. Siphuncle small, cylindrical, central. Test quite smooth.

Size.—The largest specimen, a cast, entirely septate, and imperfect at both extremities, has a length of 240 mm., the greatest diameter being 38 mm., the least 13 mm.; thus the apical end wants but little to make it complete. It may be added that about 25 mm. of the larger end of the specimen are omitted in the figure to save space.

Affinities.—In general shape, multitude of septa, and position of siphuncle the present species resembles *Orthoceras inopinatum*, de Kon.,[1] but the latter tapers more rapidly, and has still more numerous septa. *O. Nerviense*, de Kon.,[2] has also closer septa than *O. Sancti-Doulaghi*.

Remarks.—The salient character in this species is the great regularity and equality of the septation. The slight ellipticity of the adult portion of the shell is a feature of common occurrence in straight-shelled Orthoceratites, the apical part being usually either circular or much less elliptic than the older part. The specimen figured has its surface roughened by chemical erosion, but the sutures though obscured have not been obliterated, nor are the septa as seen in a section injured. The siphuncle has, however, been destroyed by the formation of small crystals of calcite, which entirely fill the chambers.

Locality.—St. Doulagh's,[3] county of Dublin.

ORTHOCERAS ACRE, *A. H. Foord.* Plate II, figs. 2 *a*—*d*.

1896. ORTHOCERAS ACRE, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 12.

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[1] Faune Calc. Carb. Belgique ('Ann. Mus. Roy. d'Hist. Nat. Belgique, sér. Paléont.,' vol. v), pt. 2, p. 63, pl. xl, fig. 1; pl. xlii, fig. 2.

[2] Loc. cit., p. 57, pl. xl, figs. 2, 3.

[3] A village about six miles from Dublin, where extensive quarries in the Carboniferous Limestone have long been worked. The parish church of St. Doulagh's, giving its name to the village, is of considerable antiquity, dating probably from the latter end of the thirteenth century; it is reputed to be the smallest church in Ireland. There is a description and picture of it in W. F. Wakeman's 'Archæologia Hibernica.'

Description.—Shell long, very slender, tapering at the rate of 1 : 10. Section nearly circular. Body-chamber too imperfect for description. Septa very oblique, approximate, from 4 to 5 mm. apart, where the diameter of the shell is about 20 mm. Siphuncle excentric, seen only at the apical extremity. The test is quite smooth.

Size.—The most complete specimen measures 280 mm. in length, the greatest diameter being 33 mm., the least 5 mm.

Affinities.—This species bears some resemblance to *Orthoceras Nerviense*, de Kon., especially in the slenderness of its form, but the differences separating it from that species are constant and well defined. These consist in the obliquity of its septa and the excentric position of its siphuncle.

Remarks.—The septal chambers, as is usually the case with the Cork specimens, are filled with crystalline calcite, which has destroyed or distorted the septa and siphuncle. The apical extremity of one of the specimens (Pl. II, fig. 2 *b*) is obliquely truncated, and shows the position of the siphuncle in the shape of a small depression or cicatrix, which was originally covered by the shell, the latter having been here broken off in removing the specimen from the rock (Pl. II, fig. 2 *c*). The initial point of these shells is so rarely preserved that I have given a figure of it from a drawing I made under a camera lucida. The extremely slender habit and other characteristic features have led to the ready identification of several examples of this graceful species among the specimens of *Orthoceras* obtained from the great quarries of Little Island, near Cork.

Locality.—Little Island,[1] near Cork.

ORTHOCERAS CYLINDRACEUM, *J. Fleming.*

1815.	ORTHOCERA CYLINDRACEA,		*J. Fleming.*	Annals of Philosophy, vol. v, p. 202, pl. xxxi, fig. 3. (Not of Sowerby.)
? 1844.	ORTHOCERAS CYLINDRACEUM,		*F. M'Coy.*	Synopsis Carb. Foss. Ireland, p. 7.
1855.	—	—	—	British Pal. Foss., fasc. 3, p. 569.
1888.	—	—	*A. H. Foord.*	Cat. Foss. Cephal., British Museum (Natural History), pt. 1, . . . p. 102.

[1] This is no longer an island, the stream to the north that made it one having been filled up ; it is therefore a peninsula, and is situated in the fine waterway leading from the city of Cork to Cork harbour.

1896. Orthoceras cylindraceum, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 15.

This species, identified by M'Coy (loc. cit.), has come under my notice, there being examples of it in the Museum of Science and Art, Dublin ("Griffith Collection"), and others in the general collection. It is a small species, remarkable for the closeness and regularity of its septa. The siphuncle is cylindrical and central, the test smooth.

Locality.—Clane, county of Kildare. It is recorded from several places in Ireland in Griffith's localities of Carboniferous fossils (M'Coy's 'Synopsis,' 1862), but I have not seen any specimens except from Kildare.

Orthoceras Nerviense, *L. G. de Koninck.*

1880. Orthoceras Nerviense, *L. G. de Koninck.* Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, sér. Paléont., vol. v), pt. 2, p. 57, pl. xl, figs. 2, 3.

1896. — — *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 15.

Up to the present time only one specimen of this species has been identified. The characters can be satisfactorily made out, and I have no doubt as to the accuracy of the reference.

Locality.—St. Doulagh's, county of Dublin.

Orthoceras amabile (?), *L. G. de Koninck.*

1880. Orthoceras amabile, *L. G. de Koninck.* Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, sér. Paléont., vol. v), pt. 2, p. 57, pl. xxxix, figs. 7, 8; pl. xl, fig. 4; pl. xlii, fig. 3.

1896. — — ?, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland.

. . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 16.

I have identified a specimen from St. Doulagh's with this species with some doubt; it agrees best with de Koninck's figures on pls. xl and xlii of his work. The figure on pl. xxxix, fig. 7, represents a shell with a more rapid rate of tapering than is seen in the figures on the other plates, or in the specimen from St. Doulagh's.

ORTHOCERAS CALAMUS, *de Koninck*.

1880. ORTHOCERAS CALAMUS, *L. G. de Koninck*. Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, sér. Paléont., vol. v), pt. 2, p. 52, pl. xxxviii. fig. 6.

1896. — — *A. H. Foord*. Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 16.

This species is easily recognised by its great length and slenderness, and by its proportionately wide-apart septa. Two specimens have occurred, both of which are from St. Doulagh's, county of Dublin. The most complete of these is 155 mm. in length, 16 mm. at the widest, and 2·5 mm. at the narrowest extremity.

ORTHOCERAS PORTERI, *A. H. Foord*. Plate IV, figs. 1 *a*—*d*.

1896. ORTHOCERAS PORTERI, *A. H. Foord*. Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 14.

Description.—Shell elongate, slender, tapering at the rate of 1 : 9. Section elliptic, the ratio of the greater to the lesser diameter as 4 : 3. Body-chamber slightly exceeding one-fourth of the entire length of the shell in a specimen of

which the estimated length, including a portion of the apical end, which is broken off, amounts to 385 mm. Septa oblique, 8 mm. apart where the shell has a diameter of about 38 mm., 6 mm. where the diameter is 25 mm. Siphuncle cylindrical, rather wide, central or nearly so. Test perfectly smooth.

Size.—The length of a compressed example which is only preserved up to the base of the body-chamber, and of which the apex is wanting, amounts to 270 mm.; the diameter at the anterior end being 35 mm., at the apical end 13 mm. The body-chamber of another example has anteriorly a diameter of 43 mm., posteriorly one of 36 mm. (Pl. IV, fig. 1 *c*).

Affinities.—The greater distance of the septa from each other, the slower rate of tapering, and the cylindrical siphuncle separate this species from *Orthoceras subclavatum*. From *Orthoceras multistriatum* it is distinguished by its smooth shell, and from *Orthoceras acre* by its much less slender form and less numerous septa. None of the species described by Phillips, M'Coy, and de Koninck approach the present one nearly enough to make a comparison useful.

Remarks.—Crystallisation within the chambers has caused either total destruction of the septa and siphuncle, or their distortion and shifting out of position in a greater or less degree. The section, Pl. IV, fig. 1 *d*, exhibits them with the least amount of displacement.

Mr. James Porter, formerly of Queen's College, Cork, after whom this species is named, gave me much assistance in the Cork district, and I have great pleasure in here thanking him for his kind offices.

Locality.—Little Island, near Cork.

ORTHOCERAS VENABULUM, *A. H. Foord.* Plate IV, figs. 3 *a*—*d*.

1896. ORTHOCERAS VENABULUM, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 22.

Description.—Shell rather long, straight, tapering at the rate of 1 : 8. Section elliptic, owing perhaps partly or even entirely to pressure in the rock. Body-chamber long, somewhat less than one-third of the whole length of the shell. Septa slightly oblique, somewhat approximate in the greater part of the shell, but wider apart towards the body-chamber; here, where the shell has a diameter of 50 mm., they are 20 mm. distant from one another. The septal necks are very

short. Siphuncle central, cylindrical, rather wide, but scarcely increasing in width between the septa. Test smooth. The largest example is 520 mm. in length, in which measurement is included a small portion of the extreme apex, which is broken off. The greatest diameter is 65 mm., the least 12 mm.

Affinities.—This species may be distinguished from *Orthoceras acre* by its less slender proportions and wider septa; from *Orthoceras Porteri* by its slower rate of tapering, and more distant and more horizontal septa. None of the Belgian species make any near approach to the one here described.

Remarks.—The interiors of the chambers of the specimens of which sections have been made are filled with calc-spar, which has in some places distorted, and in others destroyed the septa; the siphuncle, however, is intact throughout the whole length of the specimens examined.

Locality.—Clane, county of Kildare.

ORTHOCERAS PERAPPROXIMATUM, *A. H. Foord.* Plate II, fig. 3.

1896. ORTHOCERAS PERAPPROXIMATUM, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 22.

Description.—Shell very small, tapering at the rate of 1 : 5. Section circular. Body-chamber about one-third of the length of the whole shell, therefore long. Septa somewhat oblique, very numerous, about 2 mm. apart. Siphuncle cylindrical, excentric. Test covered with extremely fine, thread-like lines.

Size.—An example in which the greater part of the body-chamber is wanting measures 75 mm. in length; the greatest diameter amounting to 16 mm., the least to 3 mm.

Affinities.—In its closely-set septa this species resembles *Orthoceras cylindraceum*, J. Fleming;[1] it is, however, distinguished from the latter by its more rapid rate of increase, the obliquity of its septa, and the excentricity of its siphuncle.

Remarks.—There is always a certain measure of doubt as to whether very small specimens, such as those here under description, may not have been young

[1] 'Annals of Philosophy,' vol. v, Jan.—June, 1815; 'Observations on the Orthoceratites of Scotland,' p. 199, pl. xxxi, fig. 3. See above, page 7.

shells; but in the absence of a gradational series from young to adult this point would be very difficult to determine. In the present case, at least, I have not been able to identify the form above described with any of the larger species in their young stage of growth, hence there was no alternative but to regard it as a distinct species.

Locality.—St. Doulagh's, near Dublin.

Sub-group *Moniliformes* (*siphuncle moniliform*).

Orthoceras Hindei, *A. H. Foord.* Plate V, figs. 4 *a*—*c*.

1896. Orthoceras Hindei, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 23.

Description.—Shell moderately elongate, straight, tapering rapidly. Section elliptic, this form being due partly to pressure, as it is present in a lesser degree in one of the specimens. The diameters of the ellipse are in the ratio of about 4 : 3. Rate of tapering of the greater diameter estimated for the septate part of the shell 1 : 5. Body-chamber not complete in any specimen; an imperfect one measures 65 mm. in length, is 28 mm. in diameter at its base, and 46 mm. at the anterior end. Septa very concave, oblique to the longitudinal axis of the shell, distant 7 mm. where the larger diameter of the shell measures 27 mm. The siphuncle is large and considerably expanded between the septa, thus presenting a characteristic moniliform appearance. It is markedly excentric in position. Test quite smooth.

Size.—The largest specimen, which is all septate (the extreme apex wanting), measures 200 mm. in length. The other specimens are more or less fragmentary.

Affinities.—The differences which serve to distinguish this species from its congeners, *Orthoceras subclavatum* and *O. pilum*, are not difficult to recognise; the large size of its beaded siphuncle, and its high rate of tapering are sufficient guides, though it must be remembered that the former is not generally to be seen without the aid of the lapidary's wheel.

Remarks.—I have named this species after Dr. G. J. Hinde, F.R.S.

Locality.—Little Island, near Cork.

ORTHOCERAS SUBCLAVATUM, *A. H. Foord.* Plate IV, figs. 2 *a*—*c*.

1896. ORTHOCERAS SUBCLAVATUM, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 24.

Description.—Shell rather short, increasing at the rate of 1 : 6. Section elliptic. Ratio of the two diameters 4 : 3. Body-chamber nearly one-third of the length of the whole shell, somewhat fusiform, its base oblique to the longitudinal axis of the shell. Septa oblique, very numerous, about 4 mm. apart where the diameter of the shell is 25 mm. Siphuncle inflated between the septa in a bead-like manner. Shell smooth, its thickness on the body-chamber amounting to about 1·5 mm.

Size.—The length of the only example known amounts to 215 mm.; the greatest diameter to 38 mm., the least to 6 mm.

Affinities.—This species is distinguished from *Orthoceras Hindei* by its more slender form, much closer septa, and smaller siphuncle. From *Orthoceras Breynii*, de Kon. (not Martin), it differs in its more rapid tapering and wider septation.

Remarks.—This form reminds one at first sight of a *Poterioceras* in the straightness of one side and the curvature of the other, the close and very oblique septa, beaded siphuncle, and the slightly fusiform outline. On the other hand, the almost central position of the siphuncle and the want of any contraction of the body-chamber near the aperture, added to its slender proportions, dispel the idea at first conceived of its affinities.

Locality.—Little Island, near Cork.

ORTHOCERAS PILUM, *A. H. Foord.* Plate V, figs. 3 *a*, *b*.

1896. ORTHOCERAS PILUM, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 24.

Description.—Shell straight, somewhat rapidly increasing, the ratio being about 1 : 6. Section elliptic. The ratio of the two diameters nearly as 4 : 3. Body-

chamber unknown. Septa somewhat oblique, deeply concave, somewhat widely separated from one another—that is, 8 mm. apart where the diameter of the shell amounts to 30 mm., 3·5 mm. from each other towards the apical extremity, where the shell measures 15 mm. in diameter. The distance between these two measurements is 75 mm. Test quite smooth.

Affinities.—This species differs from *Orthoceras Hindei* and from *O. subclavatum* by the horizontality of its septa, and it is also distinguished from the former by its smaller siphuncle. Its septa are much wider apart than those of *O. subclavatum*. These differences seemed to justify the distinctness of the present species, of which only one has up to the present time been recognised.

Locality.—Little Island, near Cork.

II. *Group* Annulata.

Orthoceras lævigatum, *F. M'Coy*. Plate V, figs. 1 *a*—*e*.

1843. Orthoceras annulatum, *L. G. de Koninck*. Précis élém. de Géologie, par J. J. d'Omalius, p. 515. (Not of Sowerby.)

1842–4. — dactyliophorum, *L. G. de Koninck*. Descrip. Anim. Foss. Belgique, p. 318, pl. xlvii, fig. 2; pl. xlviii, figs. 7 *a*, *b*.

1844. Cycloceras lævigatum, *F. M'Coy*. Synopsis of the Char. of the Carb. Limest. Foss. of Ireland, p. 10, pl. i, fig. 3.

1850. Orthoceras dactyliophorum, *A. d'Orbigny*. Prodr. de paléont. stratigr., vol. i, p. 113.

1851. — — *C. G. Giebel*. Fauna der Vorwelt, Bd. iii, Abth. 1, p. 255.

1860. Cycloceras lævigatum, *R. Griffith*. Journ. of the Geol. Soc. of Dublin, vol. ix, p. 55.

1880. Orthoceras lævigatum, *L. G. de Koninck*. Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, sér. Paléont., vol. v), pt. 2, p. 70, pl. xli, fig. 4.

? 1880. Cyrtoceras dactyliophorum, *L. G. de Koninck*. Ibid., p. 30, pl. xxxiv, fig. 1.

1896. Orthoceras lævigatum, *A. H. Foord*. Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 25.

Description.—Shell straight, or slightly curved in the apical region; tapering very slowly, viz. at the rate of 1 : 26. Section circular. Body-chamber

(according to de Koninck) occupying about one-fourth of the total length of the shell; the last portion free from annulations. Septa numerous, slightly oblique, occurring in the centre of the furrows between the annulations, very shallow. Siphuncle small, subcentral. Ornaments consisting of regular, prominent, rounded annulations, undulating as they encircle the shell, almost as strong upon the cast as they are where the test is present. The latter is thin, and is covered with regular transverse lines, somewhat less than 1 mm. apart, so that about eight of them cover the space occupied by one of the annulations and the furrow next to it. In a specimen measured there were in a length of 75 mm. eighteen annulations, six of which occupy, at the narrower part of the shell, 25 mm.

Affinities.—*Orthoceras cyclophorum*, Waagen,[1] from the "Productus Limestone" of the Salt Range in India, resembles the present species very closely, so far as the fragmentary specimens representing it will allow of a comparison being made. The two fragments consist only of three and four annulations respectively. The septa are described as "somewhat oblique," the siphuncle excentric, "removed from the centre a little more than its own thickness." The general aspect of the two forms is strikingly similar, but until more complete examples of the Salt-Range species are found it is no doubt wiser to keep the latter separate from the European species. There is very little resemblance in either of them to *Orthoceras undatum* of Fleming.[2] The latter tapers rapidly (about 1 : 4); the annulations are very numerous, being only 3 mm. apart where the diameter of the shell is from 12 to 20 mm., and they are at a very slightly varying distance from each other. *Orthoceras oblique-annulatum*, Waagen,[3] is a small fragment exhibiting five or six oblique annulations. It may have been the younger portion of a shell, or, on the other hand, a fragment of a small species. The siphuncle is described as central. Its rate of tapering (about 1 : 18) greatly exceeds that of *Orthoceras lævigatum*, though falling far short of that of *O. undatum*. *Cyrtoceras dactyliophorum*, de Kon.,[4] appears to be only a curved example of the present species; the siphuncle is small, cylindrical, and central, and therefore essentially different from that of *Cyrtoceras*, in which it is large, marginal, and beaded. The curvature is thus the only character which this species has in common with *Cyrtoceras*.

Remarks.—This is a somewhat rare species. I have collected it at Clane and St. Doulagh's, but the specimens figured, kindly lent to me for that purpose by Mr. J. Nolan, of the Geological Survey of Ireland, are from Ardlaman, in the

[1] 'Mem. Geol. Surv. India;' 'Palæontologia Indica,' ser. xiii; Salt-Range Fossils,' vol. i; 'Productus Limestone Fossils,' 1887, p. 68, pl. vi, figs. 7, 8.

[2] 'Annals of Philosophy,' vol. v, Jan.—June, 1815 ("Observations on the Orthoceratites of Scotland"), p. 199, pl. xxxi, fig. 12.

[3] 'Mem. Geol. Surv. India;' 'Pal. Ind.,' ser. xiii, Salt-Range Fossils, vol. i; 'Productus Limestone Fossils,' 1887, p. 68, pl. vi, figs. 7, 8.

[4] 'Calc. Carb. Belg.,' 1880, pt. 2, p. 30, pl. xxxiv, fig. 1.

county of Limerick. They are here for the first time figured, and it may be mentioned that they are the specimens which passed through the hands of de Koninck at the time that he was writing his well-known work on the Carboniferous Limestone of Belgium ('Faune du Calc. Carb.,' &c.). This species is recorded by Sir Richard Griffith in his 'Localities of the Irish Carboniferous Fossils,' arranged as an appendix to M'Coy's 'Synopsis' (1862), from Shrule, near Ballymahon, in the county of Londonderry.

M'Coy's type specimen is in the Museum of Science and Art, Dublin, (Geological Survey Collection).

Localities.—St. Doulagh's, county of Dublin; Clane, county of Kildare; Ardlaman, county of Limerick; Shrule, near Ballymahon, county of Londonderry.

III. *Group* Angulata.

Orthoceras Wrightii, *S. Haughton.* Plate V, figs. 2 *a*—*e*.

1859. Orthoceras Wrightii, *S. Haughton.* On some New Orthocerata from the Carboniferous Limestone of the Neighbourhood of Cork and Clonmel, Journ. Roy. Dublin Society, vol. ii, 1858–9, p. 241, pl. v, fig. 2.

1896. — Puzosianum ?, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 26. (Not of de Koninck.)

Description.—Shell rather small, tapering at the rate of 1 : 9. Section very slightly elliptic. Body-chamber incomplete; its proportions cannot, therefore, be given. Septa oblique, making an angle of about 15° with the transverse axis of the shell, shallow; the distance between them cannot be stated, as only the last septum is visible, owing to the body-chamber having become separated from the septate part of the shell. Siphuncle central. The ornamentation consists of numerous (about twenty-four to twenty-seven) longitudinal ribs, strong enough to mark the cast quite distinctly; these are not equally spaced, varying from 1·5 to 2 mm. apart. Between these coarser ribs are four or five finer ones, and over the whole surface of the test are seen innumerable fine and regular transverse lines crossing the ribs and the spaces between them (Pl. V, fig. 2 *c*).

Size.—Length of the Clonmel example 103 mm.; greatest diameter 19 mm., least 6 mm.

Affinities.—This species in its ornamentation roughly resembles *Cyrtoceras Puzosianum*, de Koninck,[1] but it is more elaborate in character in this respect. Thus in de Koninck's species the fine and multitudinous transverse lines are wanting, and there is only one longitudinal ridge between two of the larger ones, —in short, the sculpture is much more simple. De Koninck's species, it may be added, is distinctly curved, hence its assignment to *Cyrtoceras* by its author, for which, however, there appears to be no warrant in the internal structure of the shell.

Remarks.—For a long time *Orthoceras Wrightii* was represented, so far as I am aware, by one specimen only. I have since found an example of it at Clane, which is here figured for comparison with the type specimen. The Clane specimen is not so well preserved as the one from Clonmel, but it nevertheless shows in places all the details of ornamentation which characterise the species. I am indebted to the kindness of my friend Mr. Joseph Wright, F.G.S., of Belfast, for the loan of the type specimen described by Dr. Haughton.

Localities.—Clonmel, county of Tipperary; Clane, county of Kildare.

IV. *Group* Lineata.

Orthoceras Kildarense, *A. H. Foord.* Plate VI, figs. 3 *a*—*d*.

1896. Orthoceras Kildarense, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 26.

Description.—Shell small, straight, tapering at the rate of 1 : 6. Section circular. Body-chamber about one-third of the length of the whole shell. Septa horizontal, distant, being about 7 mm. apart where the diameter of the shell is 15 mm.; varying in distance from 6 mm. to 8 mm. in a length of 32 mm. Siphuncle central, cylindrical. Test covered with exceedingly fine, acute, regular, transverse, thread-like lines, of which eight or nine are contained in the space of 1 mm.; they are therefore scarcely visible without a lens.

Affinities.—This distinct and beautiful species seems to be very rare. I obtained only one example of it, which is now in the Museum of Science and Art,

[1] 'Calc. Carb. Belg.,' pt. 2, p. 34, pl. xxxiii, figs. 10, 11.

Dublin. Another was already in that Collection, and both are figured. The distance of the septa, which is very considerable proportionately to the size of the species, and the character of the ornamentation make this species readily distinguishable from all others. The most nearly related species are the following :— *Orthoceras discrepans*, de Koninck, in which the septa are closer together than they are in the present species; and the ornamentation differs in having two series of transverse lines, the one coarser than the other; while *O. conquestum*, *O. salvum* (described below), and *O. salutatum*, all of de Koninck, have very crowded septa, and the transverse lines ornamenting the surface are distinctly undulating.

Locality.—Clane, county of Kildare.

ORTHOCERAS SALVUM, *L. G. de Koninck.* Plate VI, figs. 4 *a*, *b*.

1880. ORTHOCERAS SALVUM, *L. G. de Koninck.* Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. nat. Belgique, sér. Paléont., vol. v), pt. 2, p. 67, pl. xli, fig. 6.

1896. — — *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 27.

Description.—Shell small, straight, tapering at the rate of 1 : 10. Section slightly elliptic, the ratio of the longer to the shorter diameter being as 5 : 4. A fragment of the body-chamber shows upon the cast a slight constriction near the aperture. Septa numerous, slightly oblique, distant from each other about one-fifth of their own diameter. Siphuncle apparently slightly excentric. Test covered with extremely minute, regular, wavy, transverse lines, eight or nine of which occupy the space of 1 mm. Faint transverse depressions occur at rather regular intervals, giving an appearance of serial arrangement to the lines.

Size.—The most complete specimen obtained is 72 mm. in length (Pl. VI, fig. 4 *a*).

Affinities.—This species resembles *O. discrepans*, de Koninck, in its form, but it is distinguished therefrom by the fineness and the wavy character of its ornamentation. From *O. salutatum* it differs in its more rapid rate of tapering and central siphuncle.

Locality.—Doohyle, near Rathkeale, county of Limerick.

ORTHOCERAS HIBERNICUM, *A. H. Foord*. Plate VI, figs. 1 *a*—*e*.

1896. ORTHOCERAS HIBERNICUM, *A. H. Foord*. Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 28.

Description.—Shell slightly curved in the younger part of it; compressed, making the transverse section elliptic, the ratio of the two diameters being as 7 : 5. Rate of tapering about 1 : 4. Only a fragment of the body-chamber is preserved, so that its form and size cannot be determined. The septa are remarkably numerous, the last two being only 5·5 mm. apart, while in the earlier part of the shell they are about 7 mm. distant, thus conforming to the usual habit of Cephalopod shells in approaching nearer in the vicinity of the body-chamber. Siphuncle rather large, excentric, about its own width from the centre of the septa; lying on the concave side of the curvature of the shell; considerably inflated between the septa. Test very thin; the surface-ornaments consist of numerous fine, longitudinal, parallel, nearly equal, straight, raised but flattened striæ, about three of which occupy the space of 1 mm.; they are therefore visible to the naked eye.

Affinities.—In the closeness of its septa and in its ornamentation this species resembles *Orthoceras pulcherrimum*, but it is easily distinguished from the latter by its much higher rate of tapering, by its rather finer ornamentation, and the excentric position of the siphuncle. From *Orthoceras* (*Actinoceras*) *striatum*, J. Sowerby, it differs by its more rapid rate of increase, much closer septation, and finer ornament.

Remarks.—Only one example of this fine species has hitherto been found; there is therefore no material for the study of the variations to which the species may be subject.

Locality.—Clane, county of Kildare.

ORTHOCERAS PULCHERRIMUM, *A. H. Foord*. Plate VI, figs. 2 *a*—*c*.

1896. ORTHOCERAS PULCHERRIMUM, *A. H. Foord*. Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 29.

Description.—Shell probably elongated, tapering at the rate of about 1 : 9. Section elliptic in the ratio of 6 : 5. Body-chamber incomplete; it shows a well-marked constriction towards the anterior extremity, indicating the proximity of the aperture. The septa are slightly oblique, approximate, and arranged with great regularity. They are 6 mm. distant where the diameter of the shell is 43 mm.; they are therefore about one-seventh of this diameter apart. Only four or five of the septa are seen, as the test covers the rest of the shell. The siphuncle has been destroyed by the deposit of crystalline calcite filling the chambers. It was doubtless cylindrical. The ornaments of the test consist of a multitude of fine longitudinal, parallel, nearly equal, straight striæ, two or two and a half of which occupy the space of 1 mm. When looked at through a pocket-lens of low power, they are seen to be not perfectly straight, but slightly wavy, though they preserve on the whole a very even course, parallel to each other and to the longitudinal axis of the shell. A broad and shallow groove runs the whole length of the specimen; on each side of this groove there is a slight swelling, upon which the transverse lines of growth stand out prominently, the longitudinal ornaments being here scarcely perceptible.

Affinities.—In its ornamentation this species may very well be compared with *Orthoceras* (*Actinoceras*) *striatum* of J. Sowerby,[1] but here the comparison ceases; the septa in the former are twice as numerous as they are in Sowerby's species, the shell is of a more slender habit, and the siphuncle is cylindrical. From *O. lineale*, de Koninck[2] (probably identical with *O. striatum*, J. Sowerby), it is distinguished by the same characters.

Remarks.—The present species is represented only by a fragment (Pl. VI, fig. 2 *a*). Longitudinally striated species are apparently of rare occurrence; only two have come into my hands during five years of collecting in Ireland, and Sowerby's species (from Black Rock, near Cork) makes the third Irish one. The species described by de Koninck under the name of *Orthoceras lineale*, if valid, makes a fourth species. I am not acquainted with any species from the English or Scotch Carboniferous rocks having this kind of ornament.

Locality.—Clane, county of Kildare.

[1] 'Min. Conch.,' vol. i, p. 129, pl. lviii.

[2] 'Calc. Carb. Belg.,' 1880, pt. 2, p. 79, pl. xli; pl. xliii, fig. 8.

V. *Group* Imbricata.

Orthoceras Clanense, *A. H. Foord.* Plate VII, figs. *a*—*g*.

1896. Orthoceras Clanense, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. Inaugural-Dissertation Kgl. bayer. Universität München, p. 33.

Description.—Shell moderately elongate, straight; tapering at the rate of about 1 : 6. Section circular in a fragment of a large adult shell, slightly elliptic in a smaller one, the greater and lesser diameters in the latter being nearly as 6 : 5. Body-chamber slightly fusiform, attaining nearly one-third of the length of the shell; outline of the aperture somewhat undulating, as is also the base of the body-chamber. Septa distinctly oblique (Pl. VII, fig. 1 *c*), the sutures, as seen on the cast of a shell of medium size, making an angle of about 10° with the longitudinal axis of the shell. Chambers very concave, moderately deep, about four times as wide as they are high. Siphuncle slightly excentric, beaded in the young shell, as seen in a natural fracture of the apical part of a specimen (Pl. VII, fig. 1 *g*), but tending to become cylindrical as the shell increases in size. Test varying in thickness from ·75 mm. to 1·5 mm., the thickest part being upon the body-chamber of the adult shell. Surface ornamented with multitudinous, fine striæ, imbricating upwards; these are generally arranged with great regularity over the surface of the test, this regularity being only here and there a little disturbed by the striæ being more crowded together. Thus, for the most part, four of the striæ may be counted in the space of 1 mm., but in some places not more than two. But on the body-chamber of an adult shell the striæ are 1 mm. apart. Towards the middle of the body-chamber of the adult shell the striæ become wider apart, and generally disappear before the aperture is reached, leaving the shell quite smooth.

Size.—The length of the most complete specimen is 255 mm., the body-chamber being nearly perfect, but the apical part broken (Pl. VII, figs. 1 *a*, 1 *b*). The greatest diameter of this specimen is 57 mm., the least 22 mm. A large fragment collected measures 220 mm. in length, with a diameter at the posterior end of 70 mm. and at the anterior end of 85 mm. This specimen consists of part of the body-chamber and a few of the septa, with portions of the test attached. It is in the Museum of Science and Art, Dublin.

Affinities.—A species named by de Koninck[1] *Orthoceras vicinale*, of which only part of the body-chamber was known to the author, came under my notice at Brussels. A comparison with the Irish form showed a general similarity in the ornamentation, but as this is the only character available for comparison I do not feel justified in uniting the two forms upon this ground alone. De Koninck's *Orthoceras Morrisianum*, which that author describes from specimens found at Visé, Belgium, and alleges to have been found at Rathgillen and Kilgrogan in the county of Limerick, has an ornamentation consisting of very fine thread-like lines, about their own width apart, and which towards the anterior part of the body-chamber divide into two or three finer lines between coarser ones. These are manifestly different from the imbricating lines ornamenting the shell of *Orthoceras Clanense*. The two species are also distinguished by the position of the siphuncle and the direction of the sutures, oblique in *O. Clanense*, horizontal in *O. Morrisianum*. I examined a specimen of the latter in the Brussels Museum, and I think I recognise this species in a fragment in the Museum of Science and Art, Dublin, from Kilgrogan (Limerick), whence Baily's figured specimen named *Orthoceras cinctum*[2] came. The latter, drawn in a very sketchy manner, is not described, and I have not been able to find the original. The figure, however, indicates a form with a slower rate of increase and much closer septa than *Orthoceras Clanense* has. It may possibly be referable to *O. Morrisianum*.

Remarks.—This fine species will recall some similar forms figured by Barrande ('Syst. Sil. de la Bohême'). The ornamentation makes it easily recognisable. It is not very rare in the Clane quarries, but I have not met with it anywhere else.

Locality.—Clane, county of Kildare.

[1] 'Faune Calc. Carb. Belgique' ('Ann. Mus. Roy. d'Hist. Nat. Belgique, sér. Paléont.,' vol. v), pt. ii, p. 69, pl. xlv, figs. 3, 3 *a*, 3 *b*.

[2] 'Figures Char. Brit. Foss.,' vol. i, Palæozoic, 1867–75, pl. xl, figs. 8 *a*, 8 *b*.

PLATE I.[1]

Orthoceras Leinsterense, *A. H. Foord.*

Fig. 1 *a*. Specimen showing the body-chamber and much of the septate part of the shell. 1 *b*. Longitudinal section of the same, showing the septa and the position of the siphuncle. 1 *c*. Convex surface of one of the septa showing the siphuncle. These figures are somewhat more than one half of the natural size. Clane. Dublin Museum of Science and Art. (Page 1.)

Orthoceras variabile, *A. H. Foord.*

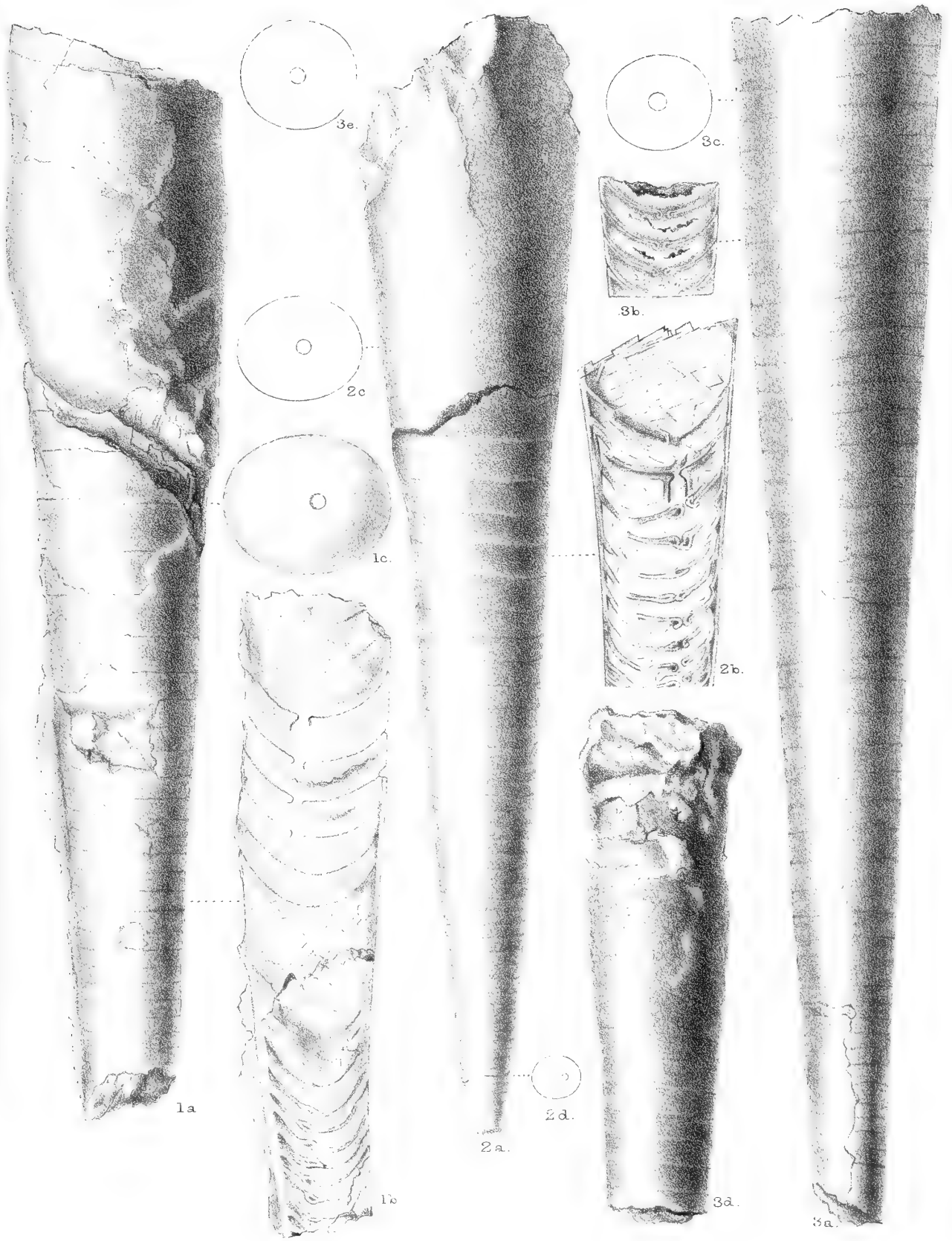
Fig. 2 *a*. Specimen with body-chamber and nearly all of the septate part; the latter has been polished to show the septa. 2 *b*. Longitudinal section showing the septa and a fragment of the siphuncle. 2 *c*. Transverse section with siphuncle. 2 *d*. The same, near the apex. These figures are somewhat more than one half of the natural size. Clane. Dublin Museum of Science and Art. (Page 2.)

Orthoceras Sancti-Doulaghi, *A. H. Foord.*

Fig. 3 *a*. Fragment of the septate part of a large specimen. 3 *b*. Longitudinal section, showing the septa and the position of the siphuncle. 3 *c*. Transverse section with siphuncle. 3 *d*. Fragment of a smaller specimen, showing the body-chamber. 3 *e*. Transverse section of the same, showing the siphuncle. St. Doulagh's. Dublin Museum of Science and Art. (Page 5.)

[1] All the figures in this and the following plates are of the natural size, except where otherwise stated.

PLATE I



W.H.Crowther del ,A.H.F dir

West, Newman imp

PLATE II.

Orthoceras Colei, *A. H. Foord.*

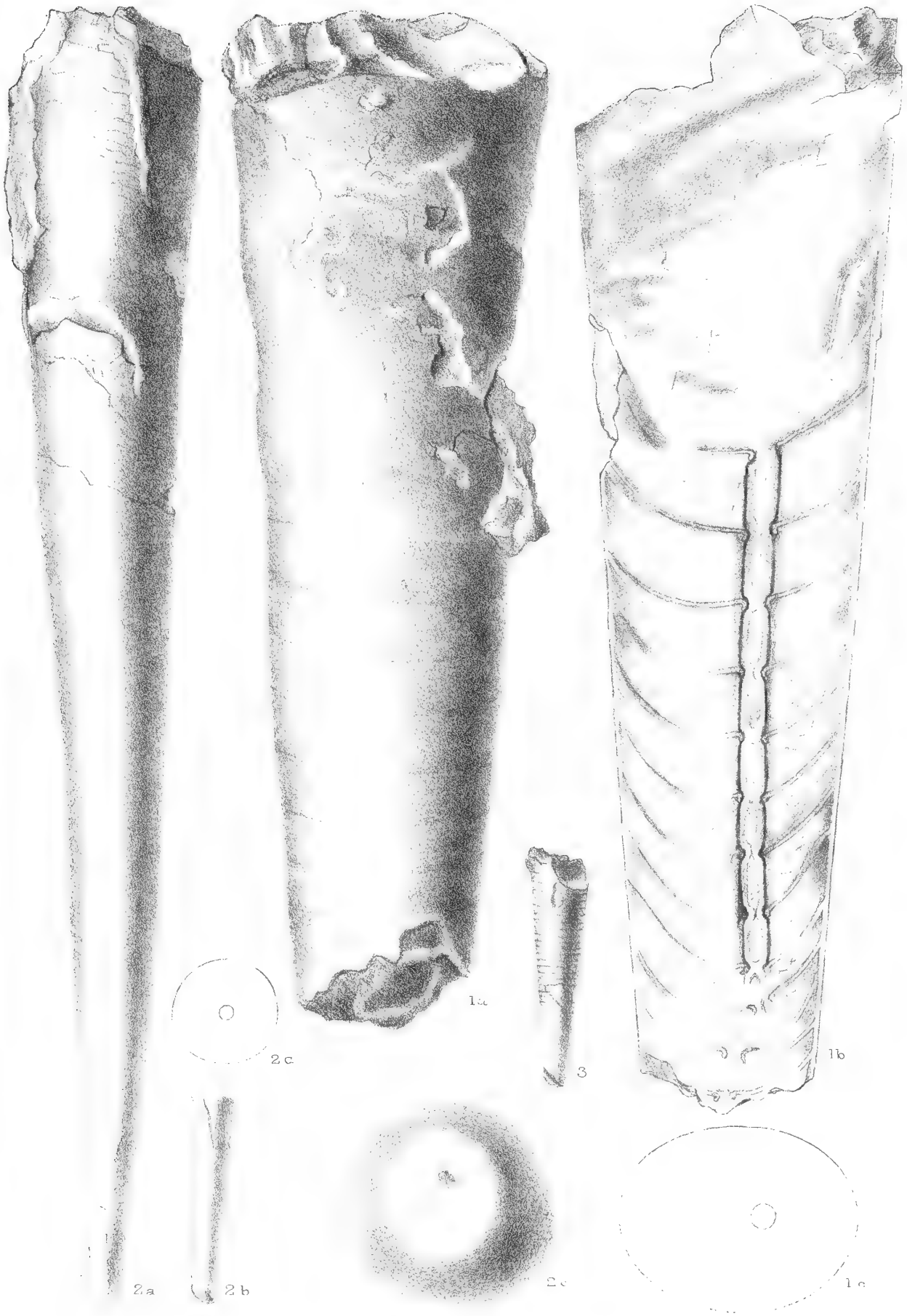
Fig. 1 *a*. Fragment showing part of the body-chamber and septate part of the shell. 1 *b*. Longitudinal section of the same, showing the septa and siphuncle. 1 *c*. Transverse section of the same. Clane. Dublin Museum of Science and Art. (Page 3.)

Orthoceras acre, *A. H. Foord.*

Fig. 2 *a*. Specimen wanting a portion of the body-chamber, but perfect at the apex. 2 *b*. The apical portion of 2 *a*, separated from it to avoid reduction of the figure. 2 *c*. Apical extremity greatly enlarged. 2 *d*. Transverse section, showing the siphuncle. Little Island. Dublin Museum of Science and Art. (Page 6.)

Orthoceras perapproximatum, *A. H. Foord.*

Fig. 3. Specimen showing the very numerous septa. Clane. Dublin Museum of Science and Art. (Page 11.)



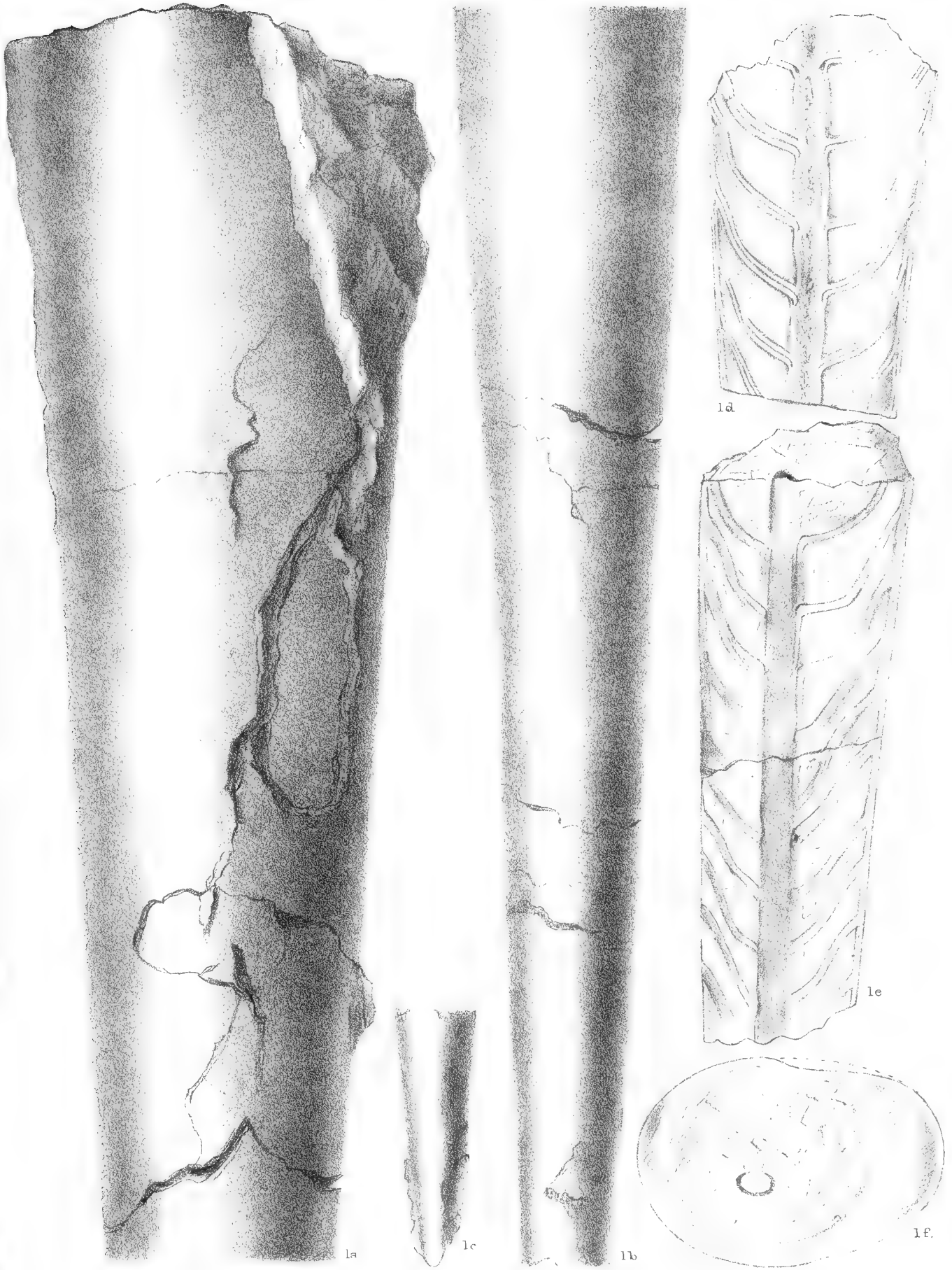
W.H.Crowther del. A.H.F. dir.

West, Newman imp.

PLATE III.

ORTHOCERAS NOLANI, *A. H. Foord.*

Figs. 1 *a*, 1 *b*, 1 *c*. A large specimen covered with the test, the figure divided into three portions to avoid the necessity of reducing it. 1 *d*. Longitudinal section of the same. 1 *e*. Longitudinal section of another individual. 1 *f*. Transverse section of the same along the longer diameter, and showing the excentric siphuncle. Clane. Dublin Museum of Science and Art. (Page 4.)



W.H.Crowther del., A.H.F.dir

West, Newman imp

PLATE IV.

Orthoceras Porteri, *A. H. Foord.*

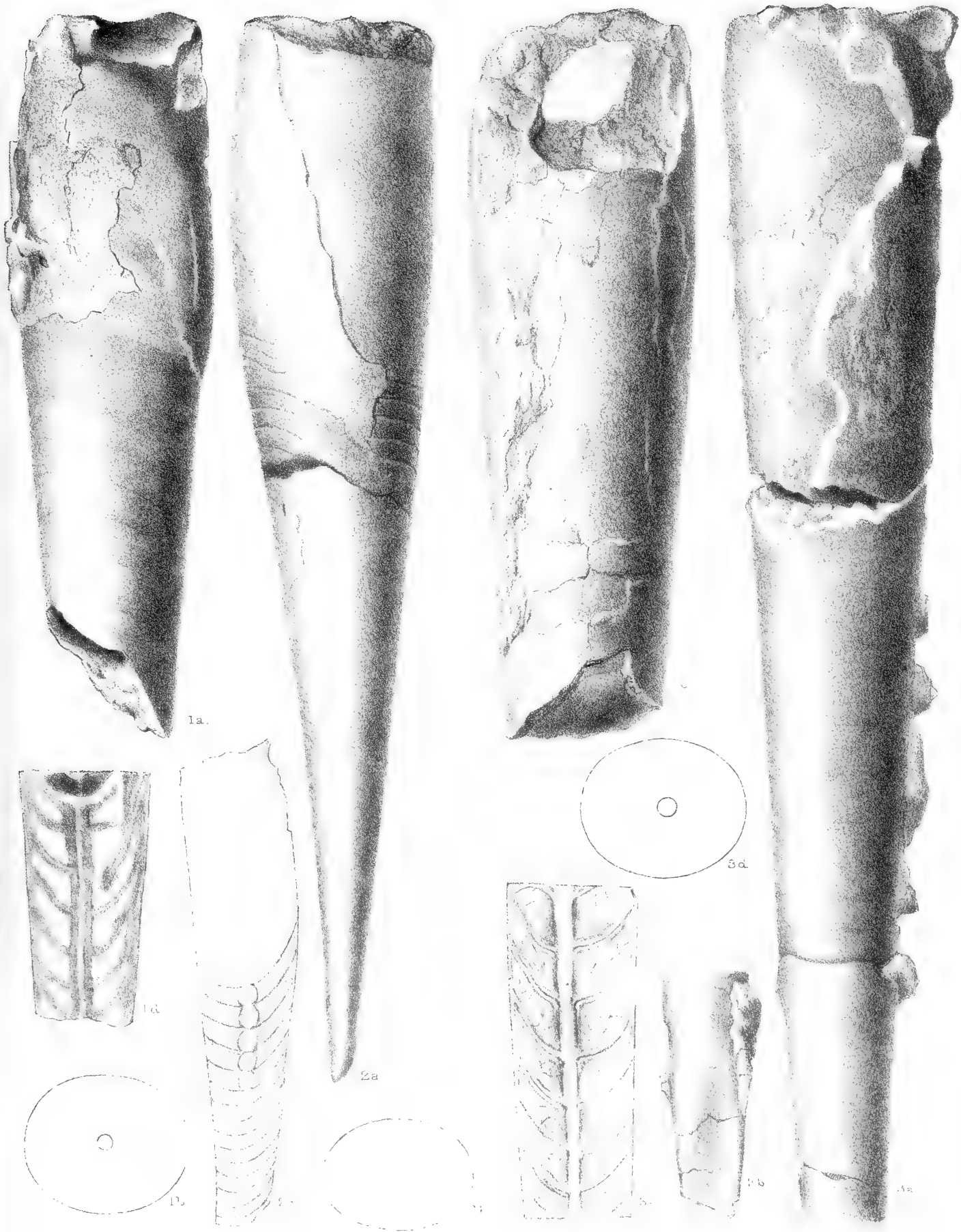
Fig. 1 *a*. Fragment with the greater part of the body-chamber. 1 *b*. Transverse section of the same. 1 *c*. Body-chamber of another individual. 1 *d*. Longitudinal section of another specimen. Little Island. Dublin Museum of Science and Art. (Page 9.)

Orthoceras subclavatum, *A. H. Foord.*

Fig. 2 *a*. A nearly complete specimen, showing the wavy and oblique septa. 2 *b*. Transverse section. 2 *c*. Longitudinal section of another individual, showing the beaded siphuncle. Little Island. Dublin Museum of Science and Art. (Page 13.)

Orthoceras venabulum, *A. H. Foord.*

Figs. 3 *a*, 3 *b*. Specimen with the surface slightly polished to show the septa. The extremity has been separated from the rest of the specimen in order to represent the latter of the natural size. 3 *c*. Longitudinal section from the same individual. 3 *d*. Transverse section, showing the siphuncle. Clane. Dublin Museum of Science and Art. (Page 10.)



H.Crowther del., A.H.F dir

West, Newman imp.

PLATE V.

Orthoceras lævigatum, *F. M'Coy.*

Fig. 1 *a*. Cast of an individual of which a portion has been lost. 1 *b*. A septum of the same, showing the siphuncle. 1 *c*. Fragment of another specimen. 1 *d*. Fragment with part of the test, showing transverse striæ. 1 *e*. A portion of the test of the same specimen enlarged. Ardlaman. Dublin Museum of Science and Art (Geological Survey of Ireland Collection). (Page 14.)

Orthoceras Wrightii, *S. Haughton.*

Fig. 2 *a*. The type specimen, showing the ornamentation. 2 *b*. Body-chamber of the same, showing at the base the obliquity of the septa. 2 *c*. Ornamentation of the surface, much enlarged. 2 *d*. Septum showing the siphuncle. Clonmel. In the Collection of Mr. Joseph Wright, F.G.S., of Belfast. 2 *e*. The specimen from Clane, drawn for comparison with 2 *a*. Dublin Museum of Science and Art. (Page 16.)

Orthoceras pilum, *A. H. Foord.*

Fig. 3 *a*. Specimen showing the septate part only, imperfect at both ends. 3 *b*. The last septum preserved, showing the siphuncle. Little Island. Dublin Museum of Science and Art. (Page 13.)

Orthoceras Hindei, *A. H. Foord.*

Fig. 4 *a*. Fragment consisting of nearly the whole of the body-chamber, with a few septa attached. 4 *b*. Longitudinal section of the same, showing the siphuncle. 4 *c*. Transverse section of the same. Little Island. Dublin Museum of Science and Art. (Page 12.)

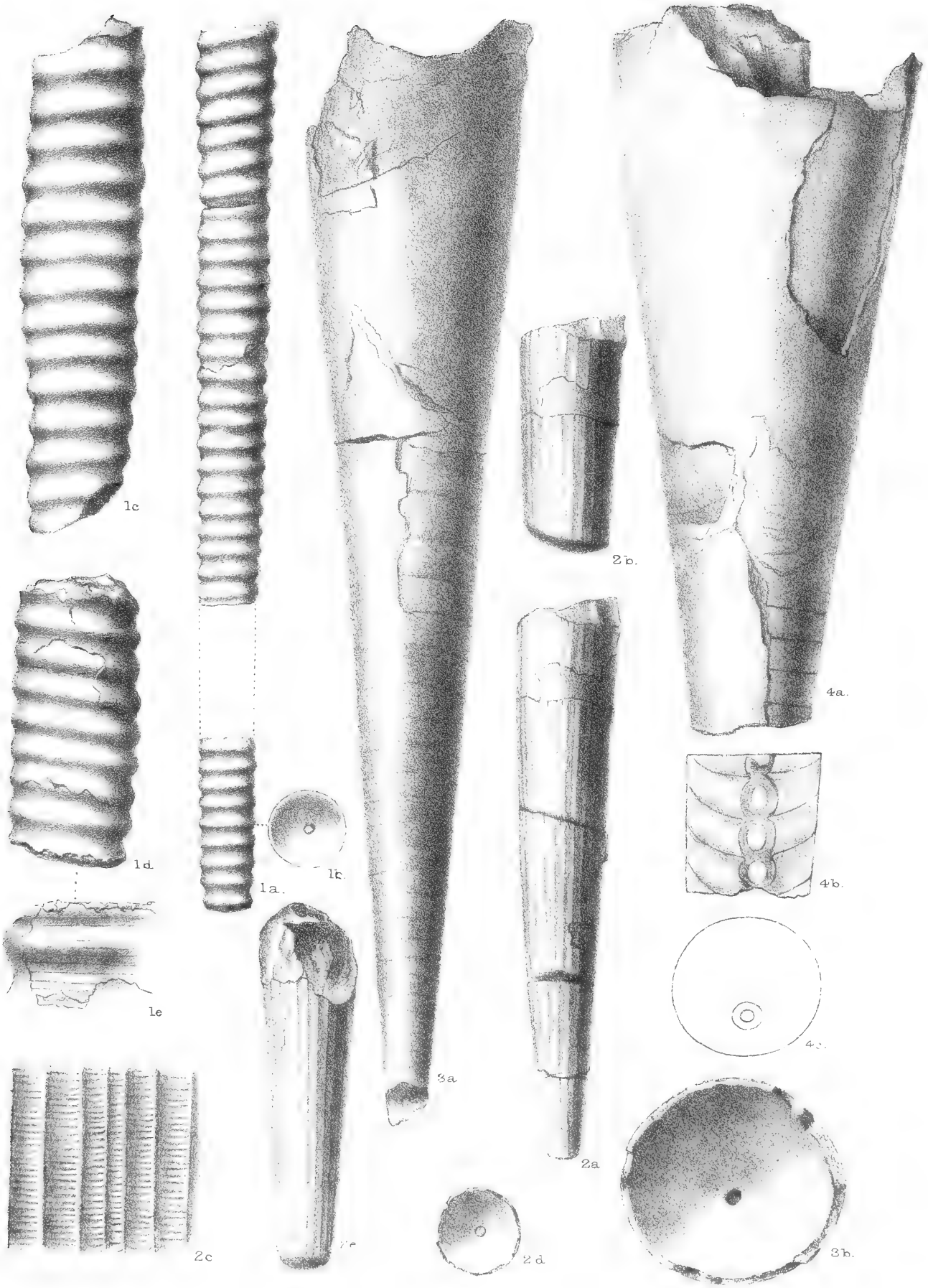


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PLATE VI.

Orthoceras hibernicum, *A. H. Foord.*

Fig. 1 *a*. Specimen almost entirely covered with the test. 1 *b*. Longitudinal section of the same, showing in the lower part the somewhat inflated siphuncle. 1 *c*. Septum showing the siphuncle. 1 *d*. The same nearer the apical end. 1 *e*. The ornamentation enlarged. Clane. Dublin Museum of Science and Art. (Page 19.)

Orthoceras pulcherrimum, *A. H. Foord.*

Fig. 2 *a*. Fragment consisting of nearly the whole of the body-chamber and some of the septa. 2 *b*. Longitudinal section of the same. 2 *c*. Portion of the test greatly magnified. Clane. Dublin Museum of Science and Art. (Page 19.)

Orthoceras Kildarense, *A. H. Foord.*

Fig. 3 *a*. Fragment composed of the body-chamber and five septal chambers. 3 *b*. Section of the same showing the siphuncle. 3 *c*. Fragment of another individual, with part of the test preserved. 3 *d*. Part of the test enlarged. Clane. Dublin Museum of Science and Art. (Page 17.)

Orthoceras salvum, *L. G. de Koninck.*

Fig. 4 *a*. Specimen completely covered with the test. 4 *b*. The test magnified. Doohyle. Dublin Museum of Science and Art. (Page 18.)

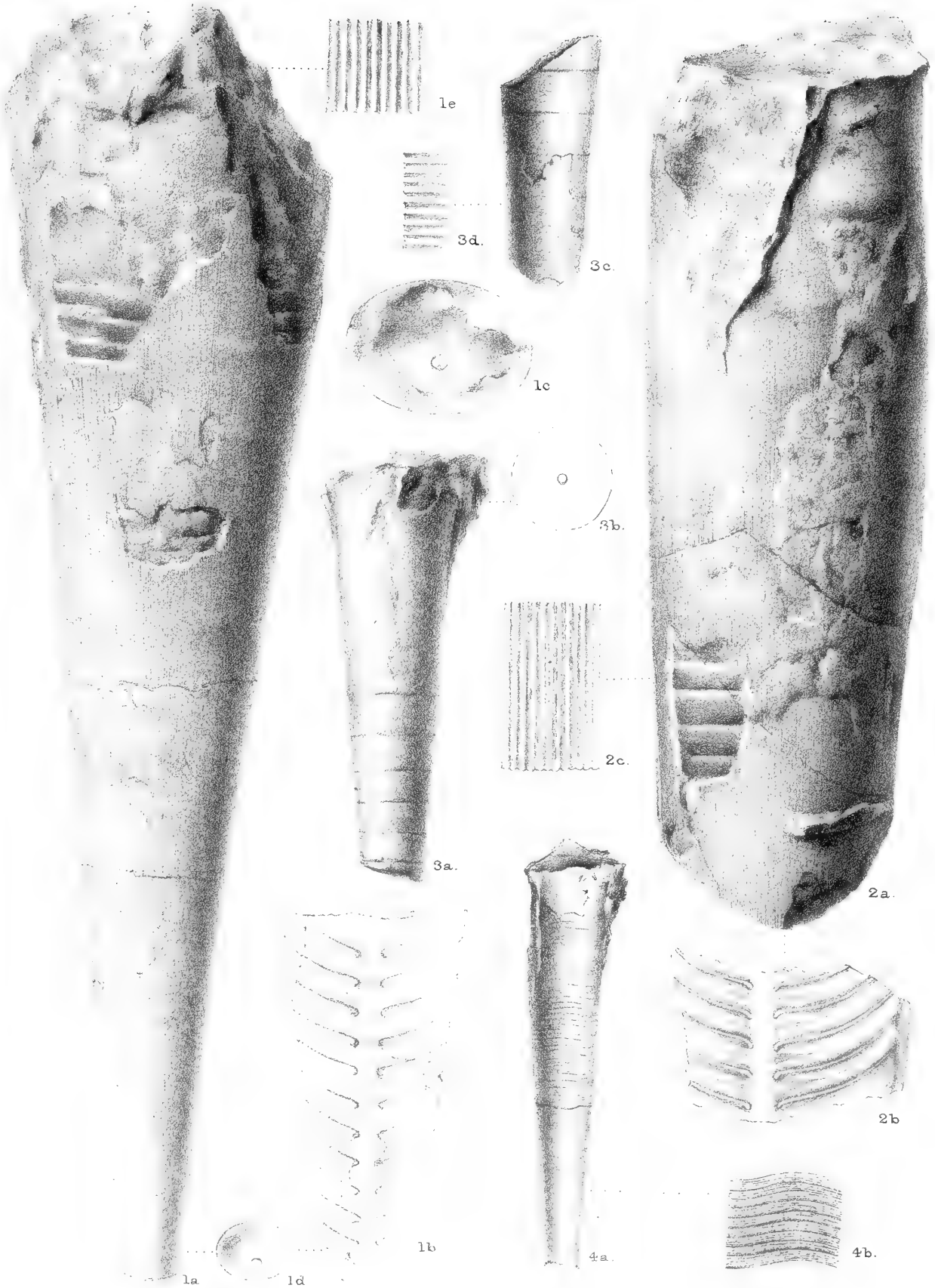

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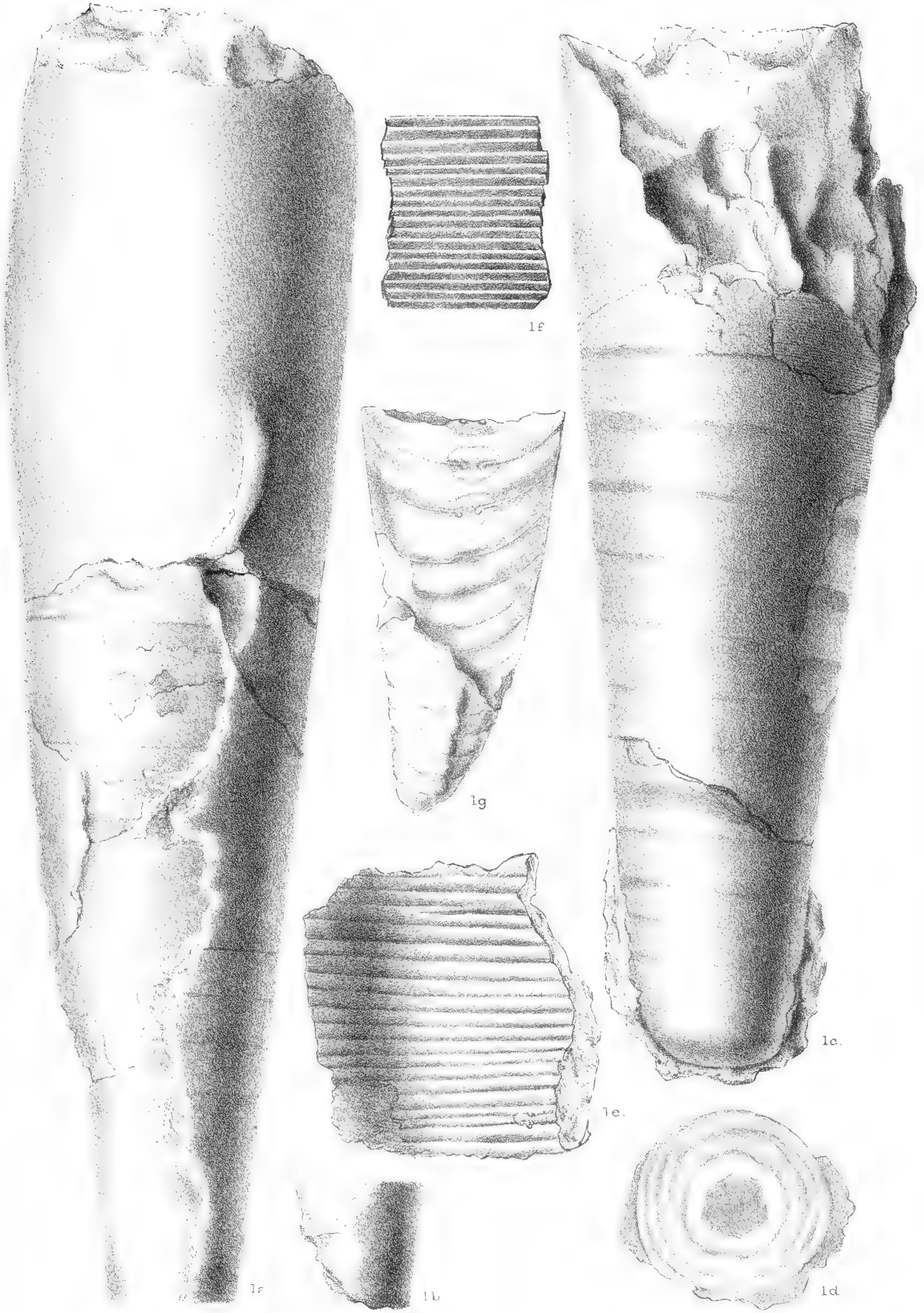
PLATE VII.

ORTHOCERAS CLANENSE, *A. H. Foord.*

Figs. 1 *a*, 1 *b*. Specimen showing body-chamber and a considerable portion of the septate part of the shell. 1 *b*. The lower part of 1 *a*. 1 *c*. Another specimen, showing the oblique septa and the fine striæ at the upper part. 1 *d*. Transverse section of the same. 1 *e*. Portion of the test of the same, greatly magnified, showing the imbricating character of the striæ. 1 *f*. The same, somewhat diagrammatic. 1 *g*. Apical portion of another individual, showing the beaded siphuncle of the young shell. Clane. Dublin Museum of Science and Art. (Page 21.)



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THE

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A MONOGRAPH

OF THE

DEVONIAN FAUNA

OF THE

SOUTH OF ENGLAND.

BY

G. F. WHIDBORNE, M.A., F.G.S.

VOL. III.—PART II.

THE FAUNA OF THE MARWOOD AND PILTON BEDS

OF

NORTH DEVON AND SOMERSET

(*continued*).

PAGES 113—178; PLATES XVII—XXI.

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1897.

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It closely resembles *P. pygmæus*, Whiteaves, which seems to be equally variable in shape, but it is still smaller, being only about 4 mm. instead of 10 mm. in length. Whiteaves compares his shell with *Macrodon parvus*, White and Whitfield.[1]

Affinities.—Our species approaches *Macrodon Hamiltoniæ*, Hall,[2] in shape, but is a minute instead of being a rather large shell.

Macrodus venustus, Stein.,[3] as given by Beushausen,[4] seems much the same shape, but is very much larger and apparently more trigonal.

2. Parallelodon priscus, *Goldfuss*, sp. ? Plate XII, fig. 6.

1834–40. Arca prisca, *Goldfuss*. Petref. Germ., vol. ii, p. 283, pl. clx, fig. 10.

Description.—Left valve rather small, slightly oblique, very convex, very transverse. Hinge-line as long as the shell, broad behind, where it has several long thin linear horizontal teeth. Umbo very prominent, incurved, tending forward and situated at or about the anterior fourth of the length. Anterior margin broad, slightly convex and oblique, meeting the hinge-line at a somewhat acute angle. Inferior margin very long, nearly straight and direct. Postero-inferior corner slightly produced, rounded. Posterior margin slightly convex and oblique, meeting the hinge at a slightly obtuse angle. Contour of back vertically very convex, horizontally flattened but becoming concave in the supero-lateral parts; with an obtuse ridge or angle running from the umbo to the postero-inferior corner, before which there seems to be a slight dorsal compression. Surface with strong concentric growth-ridges; finer ornament unknown.

Size.—Height 8 mm., length 17 mm., depth of one valve 3 mm.

Locality.—One specimen is in my Collection from Ironpost, near Dulverton.

Remarks.—The only specimen of this shell being a cast with very slight indications of the ornament, it is impossible fully to identify it. All that can be said is that it seems to be exactly like the equally imperfect specimen described by Goldfuss.

Affinities.—*Arca Michelini*, d'Archiac and de Verneuil,[5] appears to have a straighter, less oblique front margin, and a stronger dorsal constriction.

[1] 1862, White and Whitfield, 'Proc. Boston Soc. Nat. Hist.,' vol. viii, p. 299 (Lower Carb.).

[2] 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 349, pl. li, figs. 1—7, 10, 11.

[3] 1853, Steininger, 'Geol. Besch. Eifel,' p. 49, pl. ii, fig. 7.

[4] 1895, Beushausen, 'Abhandl. k. Preuss. Geol. Landes.,' n. f., pt. 17, p. 39, pl. iv, figs. 3, 4.

[5] 1842, de Archiac and de Verneuil, 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 373, pl. xxxvi, fig. 6.

3. Order—ANISOMYARIA, *Neumayr*, 1883.

I. *Family*—Modiolopsidæ, *Fischer*, 1887.

1. *Genus*—Modiolopsis, *Hall*, 1847.

1. Modiolopsis, sp. Plate XII, fig. 7.

Size.—Length 13 mm.

Locality.—One specimen from Baggy Point, South Cave, is in the Museum of Practical Geology.

Remarks.—The specimen here noted is too much obscured by matrix for description, but it appears to belong to this genus, and to be the only evidence of it at present forthcoming from these beds.

It is a long low shell with a very anterior umbo, from which a rather strong angle runs to the postero-inferior corner. The base seems long and straight, and the posterior end short and truncate.

II. *Family*—Mytilidæ, *Fleming*, 1828.

1. *Genus*—Modiola, *Lamarck*, 1801.

1. Modiola ? amygdalina, *Phillips*. Plate XIII, fig. 12.

1841. Modiola amygdalina, *Phillips*. Pal. Foss., p. 38, pl. xvii, figs. 62 *a—c*.

Description.—Shell small, narrow, oblique, very convex. Hinge-line probably rather short. Umbo large, rounded, prominent, incurved over the hinge-margin, and facing forwards. Anterior side produced, small, very convex. Antero-inferior side very long, straight. Postero-inferior corner large, produced, roundly convex. Posterior side oblique, convex. Contour convex confluently with umbo, becoming concave on the small, undefined rounded wings. Surface with strong growth-lines (not shown in the figure).

Size.—Height 14 mm., width 11 mm.

Locality.—One specimen in the Porter Collection is from Fremington.

Remarks.—This small shell, which is only a cast, is too indistinct for very certain identification. Its most characteristic feature seems the way in which the anterior end is produced just under the hinge, forming above a kind of lunule in front of the umbo, and bounded below by a slight constriction from the umbo,

which perhaps would render the margin a little concave if it were better displayed. In this point it reminds one of the genera *Modiola* and *Cypricardinia*.

Comparing it with the *M. amygdalina* of Phillips, it seems to me to agree remarkably with his description, and on placing it in the oblique positions in which his shell seems to be drawn, it assumes exactly the same form as his figure; in fact the shape of his drawings can only be explained by an anterior contour such as exists in our shell.

It is true that his figure shows much stronger growth-lines, but there is some evidence of this in our shell, considering that it is in the nature of a cast.

Affinities.—*Avicula pusilla*, Barrande,[1] a much smaller and extremely variable shell, occasionally approaches it in shape.

2. *Genus*—Spathella, *Hall*, 1885.

"Shell equivalve, very inequilateral, wider behind; anterior end short, narrowly rounded; beaks subanterior, small; umbonal slope rounded or subangular; surface with concentric striæ, sometimes lamellose; probably related to the *Lithophagi*."

The above are the characters given by Hall; and if, as seems from them and his figures, the following species belongs to it, it may be added that there seems to be an external ligament, a large oval muscle-scar situated in the centre of the anterior end, and a larger circular posterior muscle-scar situated on the upper part of the shell near the posterior end. Along the posterior hinge-line the surface seems concave, bearing two linear transverse ridges, but it does not appear whether they form part of the hinge.

1. Spathella munda, n. sp. Plate IX, figs. 1, 1 *a*; and Plate XI, figs. 1, 2.

Description.—Shell moderate in size, convex, very oblique and transverse. Hinge-margin very slightly curved, considerably less than the length of the shell, bearing one or two long, linear, horizontal ridges, which seem to bend beneath the umbo with hardly any break. Anterior margin very narrow and doubly convex, almost subangular in front. Inferior margin very long, oblique and nearly straight. Posterior margin very broad, semicircular below, becoming straight and oblique above as it merges into the hinge-margin. Umbo low, wide, flattened, proximate, slightly elevated above the hinge-line, tending forward and

[1] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. ccv, figs. 1—22, Ét. F, G.

situated at the anterior seventh of the length. Contour gently convex, becoming transversely flat or slightly concave on the back, and sometimes with a slight post-umbonal ridge which vanishes before reaching the postero-inferior corner. Surface with thirty or forty flat, step-like, regular ridges, possibly lamellar, narrow and divaricating in front, becoming gradually larger behind, and indistinct and confused in the postero-superior region, which seems bounded above by a rounded ridge or convexity close to the margin. Cast marked on and near the umbo with regular rows of numerous small rounded tubercles (indicating pits on the inner surface of shell). Anterior muscle-scar apparently shallow, oval, large, situated in the centre of the anterior end; posterior scar larger, situated near the upper part of the posterior end. Umbo in cast preceded by a shallow concave sulcus, running halfway down. Lunule biconcave, undefined. Shell-structure very thin.

Size.—Height 16 mm., length 35 mm., depth of one valve 5 mm.

Localities.—In the Porter Collection is one specimen (cast and mould) from Fremington; and in my Collection four specimens from Frankmarch.

Remarks.—The Fremington specimen is larger and longer than the others, and does not show the pittings, sulcus, and post-umbonal ridge seen in the latter. It seems, however, probable that they all belong to one species, and that the differences are due to their state of preservation. The character of the hinge seems peculiar and difficult to interpret in the different specimens.

Affinities.—It closely resembles the two species of *Spathella* described by Hall,[1] but differs in its more regular ornament, less cylindrical form, and narrower and longer anterior end. It seems to bear the resemblance to *Lithophagi* indicated by Hall.

Pullastra modiolaris, F. A. Römer,[2] is flatter, with a shorter anterior end, and smaller, less defined umbo.

3. *Genus*—Digoniomya (Provisional genus).

Shell very inequilateral, angular, transversely rhomboidal, acute behind. Hinge long, straight, thickened. Back depressed centrally, with rounded ridges running from the umbo to the anterior and posterior ends of the base, posteriorly oblique and flattened. Ligament external, situated in a long groove (?). Umbo acute, proximate.

This provisional genus is suggested with the greatest hesitation on account of the extreme poverty of the material; but it seems to be the only course open, as

[1] 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 1, No. 2, pp. 407, 408, pl. lxvi, figs. 36—42.

[2] 1850, F. A. Römer, 'Beitr. Harzgeb.,' pt. 1, p. 60, pl. ix, figs. 21 *a*, *b*.

I have been quite unable to find any genus in which there appears to be the slightest ground for placing the following species.

1. DIGONIOMYA ELEGANS. Plate XIII, fig. 13.

Description.—Left valve large, oblique, lozenge-shaped, very transverse, convex. Umbo small, very sharp, oblique, incurved, and prominent, situate very anteriorly, being only about one-tenth of the length of the shell from the anterior side, and excavated along its back by a concave depression which is continued to the middle of the hind margin. Hinge-line about two-thirds the length of shell, straight. Anterior margin very narrow, subangular. Inferior margin very long and slightly sigmoid, being a little concave towards the rear. Postero-inferior corner very much produced, narrow, and so sharply rounded as to be almost subangular. Posterior side very oblique, long, nearly straight. Contour of surface very convex vertically; the front and back of the umbo being continued in low rounded prominences to the antero-inferior and postero-inferior corners, between and behind which the shell is slightly concave. Surface apparently covered with a few irregular growth-lines.

Size.—Length 60 mm., height 20 mm., depth of one valve 10 mm.

Localities.—In the Musenm of Practical Geology is a specimen from Croyde.

Remarks.—I have been unable to refer this shell to any known genus. While remarkable in form, its state of preservation is not such as to give full information as to its nature.

III. *Family*—AVICULIDÆ, *d'Orbigny*, 1843.

I. *Sub-family*—AMBONYCHINÆ, *Miller.*

1. *Genus*—MYTILARCA, *Hall*, 1870.

The following species is provisionally placed under this genus solely on account of its general shape, and probably may have to be transferred elsewhere should clearer specimens be found.

1. MYTILARCA? MODIOLOIDES, n.sp. Plate XIII, fig. 8.

Description.—Left valve of moderate size, very oblique, subtriangular, convex. Anterior side very narrow and convex. Umbo apparently situated at or close to

the anterior point, rounded, proximate. Hinge-margin straight, about two-thirds the length of shell. Margin running from beneath the umbo in a long, oblique, straight or slightly flexuous line to the postero-inferior corner, which it rounds in a broad parabolic sweep, and is continued back obliquely in a gentle convex line to the rear of the hinge-margin. Greatest depth of shell near the umbo, and line of greatest depth running from the umbo close to the front margins. Contour of surface almost perpendicular on the antero-inferior slope, very convex on the back, and gradually becoming slightly concave near the postero-superior corner, so as to form a small undefined wing.

Size.—About 15 mm. long by 12 mm. high.

Locality.—One specimen from Braunton is in the Museum of Practical Geology.

Remarks.—The fossil above described is rendered rather obscure by the encroachment of the matrix over its margins, but it evidently is of a very typical mytiloid shape, and appears to be definitely unlike any other palæozoic species.

Affinities.—Cardiomorpha mytiloides, F. A. Römer,[1] seems to be a steeper and differently shaped shell.

Modiomorpha submissa, Barrande,[2] sp., as given by Barrois,[3] seems more transverse, and has a narrower umbo and more dilate front side.

Among other points the obliquity of the posterior side distinguishes it from *Leptodesma citimum.*

Mytilarca inflata, Whiteaves,[4] is somewhat like in shape and in the bluntness of the umbo, but is shorter and more convex.

Mytilus sabesianus, de Ryckholt,[5] appears to be shorter and more regularly ovate, with a sharper umbo, and a shorter and more concave antero-inferior margin. *Isocardia contorta*, Barrande,[6] may also be compared.

II. *Sub-family*—Aviculinæ, *Stoliczka*, 1871.

1. *Genus*—Cobracephalus (Provisional genus).

Shell inequivalve, inequilateral, oblique, with large front wing and dilate hind wing. Umbo extending above the long straight hinge-line, arching forward and, in the right valve, overhanging. Contour divided by five or six radiating angles, spreading from the umbo or its neighbourhood to the margins. Surface marked by crowded squared growth-lines.

[1] 1860, F. A. Römer, 'Beitr. Harzgeb.,' pt. 4, p. 163, pl. xxv, fig. 14.

[2] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. cclviii, figs. 4, 1–7, Ét. F.

[3] 1889, Barrois, 'Mém. Soc. Géol. Nord,' vol. iii, p. 170, pl. xii, figs. 2—2 *c*.

[4] 1891, Whiteaves, 'Cont. Canad. Pal.,' vol. i, pt. 4, p. 293, pl. xxxviii, figs. 5—6 *a*.

[5] 1851, de Ryckholt, 'Mélang. Paléont.,' pt. 2, p. 85, pl. xvi, figs. 22, 23.

[6] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. cclx, figs. 1, 1–14, Ét. E.

This suggested genus appears to approach *Cassianella* in shape, but is more oblique, and the right valve is deeply convex, while probably the other valve is much flatter. Many points must for the present remain undefined, and the genus must therefore be regarded as entirely provisional. It seems, however, to be essentially *aviculoid*. Its angularity of contour reminds us of *Conocardium*, but it has a definite wing in place of the tubular projection of that genus.

1. Cobracephalus angulosus, n. sp. Plate XIII, figs. 9, 9 *a*.

Description.—Shell small, convex, angulated, very transverse and oblique. Umbo prominent, elevated but flattened, much incurved, arching forward, acute, situated at or about the anterior third of the length, and apparently extending slightly above the hinge-line. Hinge-line equal to the greatest length of shell. Contour of surface vertically convex; horizontally angulated; being (1) flat on a narrow area bounded by rounded angles, which run from the umbo obliquely backward to inferior margin; (2) in front of this, deeply perpendicular, then oblique at the base of front wing, then flat on front wing, and lastly sigmoid at the antero-superior corner; (3) behind the central band, first perpendicular, then oblique, then angulated by a line from behind umbo to the postero-inferior corner, and then oblique and concave, forming a broad hind wing. Anterior wing large, trapezoidal, pointed in front, bounded by an angulated margin. Anterior margin apparently nearly perpendicular below the wing. Inferior margin very short and straight. Posterior margin oblique, convex, angulated. Surface covered by very numerous and crowded, parallel but unequal, sharp, elevated, concentric threads or striæ, separated by deep concavities, which are rather wider than the threads, and crossed by numerous indistinct radiations.

Size.—Height 10 mm., length 14 mm., depth 2·5 mm.

Localities.—There is a single specimen from Top Orchard in the Woodwardian Museum.

Remarks.—I have only seen a single valve of this strange shell.

2. *Genus*—Leptodesma, *Hall*, 1883.

The distinguishing mark of this genus, as compared with *Leiopteria*, is its nasute, angulated front wing. It also appears more oblique in general shape, the anterior margin being less protruded. Though some species seem difficult to assign, the two genera appear on the whole to be well characterised.

1. Leptodesma citimum,[1] n. sp. Plate XIII, figs. 7, 7 *a*.

Description.—Shell inequivalve. Left valve large, oblique, subtriangular, rather transverse, moderately convex. Umbo small, elevated, oblique, proximate, arching forward, overhanging the hinge-margin, apically acute, and situate at about one-fifth the length of the shell from its anterior end. Hinge-margin long, straight, equal to the greatest length of the shell. Anterior wing rather large, nasute in front, vertically convex, horizontally sloping, bounded by an oblique linear depression, which reaches the margin rather more than halfway down. Front cardinal angle between 60° and 90°. Anterior margin oblique, convex on the higher part of the wing, then slightly concave to the end of the wing, and then slightly convex as it passes into the short inferior margin. Postero-inferior corner broadly and deeply convex. Posterior margin slightly oblique, straight above, and gently convex below. Hind wing large, obliquely flat, with a postero-superior angle of about 100°, and defined by a straight oblique line from behind the umbo meeting the posterior margin not quite halfway down. Contour of surface transversely convex across the line of greatest elevation, which runs near the front side from the apex to the postero-inferior corner in a gently sigmoid sweep, the convexity increasing in front of it and gradually diminishing in rear of it. Shell marked by a few indistinct concentric growth-bulges.

Size of Left Valve.—Height 45 mm., length 57 mm., depth, 7 mm.

Locality.—Two specimens from Marwood and one from Barnstaple are in the Museum of Practical Geology, and one small specimen from Barnstaple in the Woodwardian Museum.

Remarks.—It has the appearance of being decidedly inequivalve. The specimens are almost in the condition of casts, lying in micaceous, ferruginous matrix, and having the surface destroyed. The margin does not lie in one plane, but is inversely sigmoid in front profile. The Woodwardian specimen is very much smaller than the others, but otherwise agrees with them, and shows the front wing to be nasute.

Affinities.—To *Leptodesma potens*, Hall,[2] it bears some resemblance in general shape, though differing in being more acute below and less concave posteriorly.

[1] Citerior, citimus.

[2] 1884, Hall, 'Pal. N. Y.,' vol. vi, pt. 1, p. 188, pl. xxi, figs. 21, 30; pl. xxii, figs. 11, 12, 19—21 and pl. lxxxix, fig. 7.

2. Leptodesma, sp. Plate XIV, fig. 1, and Plate XVII, fig. 1.

Description.—Left valve large, convex, extremely oblique and transverse. Hinge-line straight, probably very much shorter than the length. Umbo small, acute, very oblique, and situated at or close to the anterior end. Anterior wing apparently very small, oblique and narrow, undefined. Posterior wing narrow, flattish, triangular, with a thickened rounded upper margin over the hinge-line, and apparently with a small rib or bead separating it from the body. Anterior margin very long, oblique, and almost straight. Postero-inferior parts very much produced. Contour of surface convex across the line from umbo to postero-inferior corner, becoming steep near the anterior margin. Surface unknown, but evidently having some growth-ridges which become concave on the hind wing.

Size.—A specimen, defective behind, is 27 mm. high and 40 mm. long.

Localities.—In the Barnstaple Athenæum is a specimen from Pilton; and in Mr. Hamling's Collection another from the beach at Croyde.

Remarks.—Though these specimens are much too defective to enable us to give a full description, they seem to point to a remarkable and very distinct species, which (even allowing for possible distortion) was evidently characterised by its oblique mytiliform shape, though it doubtless belongs to the present genus.

Affinities.—From *Pterinea ventricosa*, as given by Goldfuss,[1] Phillips,[2] Follman,[3] and Frech[4] (though the versions of these authors do not seem always to agree with each other), it distinctly differs by its great obliquity and length, and by the shape of its wings.

From *A. sublamellosa*, F. A. Römer,[5] it is distinguished by its length, obliquity, and short front wing.

3. Leptodesma cultellatum, n. sp. Plate XIV, figs. 2, 2 *a*, 3.

Description.—Right valve small, very elongate and oblique, sabre-shaped, gently convex, with small defined wings. Umbo small, acute, prominent, hardly elevated above the hinge, and situated at the anterior one-eighth of the shell. Hinge-line short, straight, about half the length of the shell. Wings flat, sharply defined by impressed bounding lines. Front wing small, long,

[1] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 134, pl. cxix, fig. 2.

[2] 1841, Phillips, 'Pal. Foss.,' p. 49, pl. xxii, fig. 82.

[3] 1885, Follman, 'Verh. Nat. Vereins Rheinl.,' Jahr. 44, vol. xlii, p. 191, pl. v, fig. 7.

[4] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 97, pl. x, figs. 1—1 *c*.

[5] 1850, F. A. Römer, 'Beitr. Harzgeb.,' pt. 1, p. 13, pl. iii, figs. 4 *a*, *b*.

subtrapezoidal or tongue-shaped, bounded by a sigmoidal margin. Hind wing very narrow, triangular, bounded by a concave margin. Front margin very oblique, convex on the wing, concave at the base of the wing, and then gently convex below the wing, passing insensibly into the long, slightly convex, and oblique inferior margin. Postero-inferior corner very greatly produced, narrow and deeply convex. Posterior margin very oblique, slightly concave, with a curvature increasing upwards, meeting the hinge-margin at a right angle. Contour of shell gently convex, but steep posteriorly behind the line from umbo to the postero-inferior corner. Surface of back and wings covered by crowded minute, regular, parallel, distant, sharp concentric lines, and by a few irregular prominent growth-bulges.

Left valve differing from the right by having its sharp umbo rather elevated above the hinge-line, and its anterior wing convex and less defined.

Size.—Height 13 mm., length 30 mm., depth of both valves about 4 mm.

Localities.—In the Museum of Practical Geology is a slab (and its counterpart) containing the two valves in close proximity from Braunton; and in the Porter Collection is a specimen of the joined valves from Pilton, a left valve from Roborough, and another from Poleshill.

Remarks.—While not in actual contact, the two valves from Braunton doubtless belonged to the same animal; though, lying in different directions on a slab that has suffered contortion, their dimensions are rather different. The minute concentric ornament is remarkably regular; over the posterior slope its threads become rather stronger and more distant.

Affinities.—*Avicula innotata*, Barrande,[1] is a shorter shell with a longer hind wing and different ornament.

4. Leptodesma anatinum, n. sp. Plate XIV, figs. 4—6.

?1889. Avicula, sp., *Kayser*. Abhandl. Konig. Preuss. Geol. Landes., n. s., pt. 1, p. 19, pl. vii, fig. 9.

Description.—Left valve moderate in size, subquadrate, oblique, transverse, moderately convex. Umbo rather prominent, obliquely incurved, proximate, extending slightly above the hinge-line, and situated at the anterior third of its length. Anterior wing large, broad, subtriangular, and defined by a distinct, nearly vertical line from the front of the umbo. Posterior wing large, flattish, triangular, defined, not reaching quite so far back as the postero-inferior point. Anterior margin oblique, slightly incurved under the wing, and fuller below.

[1] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. ccxxix, figs. 11, 1–5, Et. E.

Inferior margin gently and evenly convex. Postero-inferior corner broadly rounded. Posterior margin gently concave. Hinge-line straight, and very nearly equal to the greatest length of the shell. Contour of surface convex in the centre, steeper in front, and slightly concave behind the umbo. Surface covered with numerous, very irregular, prominent growth-lines.

Right valve transverse, convex, subtriangular, oblique. Umbo smaller and narrower than that of the left valve, and not reaching above the hinge-line. Anterior wing convex, rather narrow, defined by an indistinct oblique line from the apex. Posterior wing long, narrow, concave, undefined. Anterior margin long, very oblique, slightly and broadly concave under the wing. Postero-inferior margin convex. Posterior margin apparently incurved. Contour of surface steeply convex across line from umbo to postero-inferior corner, being steeper behind than in front. Surface apparently similar to that of the other valve. Hinge-line long, bearing two very long, slight, horizontal lines, like teeth or ligamental grooves, behind the umbo. Anterior muscle-scar large, deep, circular, situated in the centre of the anterior wing, just in front of the umbo.

Size.—Left valve: height 19 mm., length 29 mm., depth about 4 mm. A right valve measures 13 mm. high, 25 mm. long, and about 3 mm. deep.

Locality.—There are two left valves and one right valve from Pilton in the Porter Collection.

Remarks.—Mr. Porter's fossils are in a fair state of preservation for these beds, and seem to be sufficient to define the species. Although the right and left valves are on different slabs, their agreement is such as to leave no doubt that they belong to the same species.

Affinities.—It presents much similarity to *Avicula crenato-lamellosa*, Sandberger,[1] as given by Frech,[2] but the present evidence points decidedly to its distinctness from it. In our specimens the front wing is much larger, and the posterior side less concave, and there are no signs of the existence of any radiations. *A. pseudo-lævis*, Follman[3], and Œhlert[4], is regarded by Frech as a synonym of Sandberger's shell. It appears to be distinguished from our specimens by its scalloped concentric striæ, by its greater height and more elongate hind wing, and by other points.

Pteronitella venusta, Billings,[5] of the Upper Silurian seems longer and narrower, with a smaller umbo and a smaller front wing.

The Ludlow shell which Sowerby identifies doubtfully with *Pterinea retroflexa*,

[1] 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 288, pl. xxix, fig. 16.

[2] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 49, pl. iv, figs. 5—5 *c*, and 13—13 *b*.

[3] 1885, Follman, 'Ver. n. Vereins Rheinl.,' vol. 42, p. 199, pl. v, figs. 2, 2 *a*.

[4] 1882, Œhlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 23, pl. iii, figs. 5, 5 *a*.

[5] 1874, Billings, 'Palæoz. Foss. Canada,' vol. ii, pt. 1, p. 142, pl. ix, figs. 5—5 *b*.

Hisinger, is congeneric, and is evidently closely allied. The specimens of it in the Museum of the Geological Society show great variability, but appear distinguished by their larger hind wing, which extends beyond the postero-inferior corner. As Sowerby points out,[1] it is most improbable that the Silurian species can be the same as Hisinger's form, if it be Jurassic.[2]

3. *Genus*—Leiopteria, *Hall*, 1883.

1. Leiopteria Conradi, *Hall?* Plate XIV, fig. 7.

?? 1881. Avicula (Pterinea?) serviens, *Barrande.* Syst. Sil. Bohême, vol. vi, pl. ccxxiii, figs. 2, 1–9, Ét. E.

? 1884. Leiopteria Conradi, *Hall.* Pal. N. Y., vol. v, pt. 1, p. 159, pl. xx, figs. 1, 2, 4; and pl. lxxxviii, figs. 1—4.

Description.—Shell small, oblique, rather transverse. Hinge-line equal to the length of the shell. Umbo small, acute, prominent, slightly elevated, and situated close to the anterior end. Front wing very small, rounded. Hind wing large, long, flat. Anterior and inferior margin long, oblique, gently curved. Posterior margin long, deeply sigmoid. Contour very convex across the line from the umbo to the postero-inferior region, in front of which it arches gently to the margin, and behind which it sinks with a sigmoid curve to the hind wing. Surface covered with rather numerous, concentric, irregular undulations, which appear to have probably been covered by finer striæ.

Size.—Height about 14 mm., length about 16 mm., depth of valve about 5 mm.

Localities.—One specimen is in the Woodwardian Museum from Barnstaple; and another in Mr. Hamling's Collection from near the Old Kiln at Croyde Bay.

Remarks.—These specimens are very imperfect, the first being a cast and defective in front, and the second being compressed in front, and affected by lines of pressure which have obscured the ornament. It appears, however, that they certainly belong to the genus *Leiopteria;* that, though differing considerably in some particulars, they probably belong to the same species; and that they are so very similar to *L. Conradi*, Hall, as probably to be identical with it. If so, the English shells probably belong to a dwarfed variety of that species.

Affinities.—*Leiopteria Dekayi*, Hall,[3] is less transverse, and has a much broader wing.

[1] 1839, Sowerby, in Murchison's 'Sil. Syst.,' p. 609, pl. v, fig. 9.

[2] 1826, Hisinger, 'Act. Holm.,' pl. vii, fig. 9; and 'Petr. Suec.,' p. 57, pl. xvii, fig. 12.

[3] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 164, pl. xx, figs. 16—18; and pl. lxxxviii, figs. 5—10.

Avicula Bodana, F. A. Römer,[1] appears to be more transverse, with a longer hinge-line, larger wings, and a straighter posterior margin.

Avicula Gervillei, Œhlert,[2] is a shorter, deeper, and less oblique shell, with a broader and less defined posterior region.

Avicula serviens, Barrande, seems very closely to resemble it; but its hind wing seems generally rather shorter, and its surface sometimes retains fine rays; and it is therefore probable that it is distinct.

2. Leiopteria? murata, n. sp. Plate XIV, fig. 8.

Description.—Right valve moderately small, flattish, transverse, oblique. Umbo apparently rather acute, elevated. Anterior side rather broad. Antero-inferior corner rather produced, broadly convex. Inferior margin wide, gently and evenly convex. Postero-inferior corner produced, convex. Front wing small, flat. Hind wing apparently large, broad, flat. Contour slightly convex vertically, almost flat on the back horizontally. Surface covered by regular, parallel, very distant, elevated ridges, which seem to incline backwards from the margins, to be truncated by a narrow groove on their summits, and to be separated by very wide and shallow smooth interspaces.

Size.—About 25 mm. high, 33 mm. long.

Locality.—A specimen of the right valve from Barnstaple is in the Woodwardian Museum; and one, which seems to be the mould of a corresponding left valve, is in my Collection from Upcott Arch Quarry.

Remarks.—These fossils evidently appear to belong to a distinct species, but they are unfortunately too imperfect to give a satisfactory conception of it. It bears a curiously strong superficial resemblance to *Ctenodonta lirata*, so strong that both specimens were at first mistaken for that shell. The likeness is, of course, entirely deceptive. It is evidently a *Leiopteria*, though both in shape and in ornament it differs distinctly from kindred forms.

4. *Genus*—Ptychopteria, *Hall*, 1883.

It "differs from *Actinopteria* in the nasute anterior extremity, and large, straight wing, marked by a strong longitudinal fold. Hinge-line narrow, linear; furnished with one or two linear, oblique, cardinal and lateral teeth. Surface with fine rays."

[1] 1860, F. A. Römer, 'Beitr. Harzgeb.,' pt. 4, p. 162, pl. xxv, fig. 9.

[2] 1881, Œhlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 22, pl. iii, figs. 5, 5 *a*.

Hall thus defines his genus, giving *P. Salamanca*, Hall, as an example. It accurately covers the English species.

1. Ptychopteria Damnoniensis, *Sowerby*, sp. Plate XIII, fig. 14; and Plate XIV, figs. 9—13.

1840. Avicula Damnoniensis, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. liii, fig. 22.
1841. — — *Phillips*. Pal. Foss., p. 51, pl. xxiii, figs. 90—92.
1841. — cancellata, *Phillips*. Ibid., p. 49, pl. xxii, fig. 84.
? 1884. Pterinea, cf. Damnoniensis, *Clarke*. Neues Jahrb. f. Min., Beil.-Band 3, p. 372.
? 1884. Ptychopteria Salamanca, *Hall*. Pal. N. Y., vol. v, pt. 1, p. 131, pl. xxiii, figs. 17—20.
? 1884. — Sao, *Hall*. Ibid., p. 132, pl. xxiii, figs. 16, 23.
1893. Avicula Damnoniensis, *Collins*. Trans. Roy. Geol. Soc. Cornwall, vol. xi, p. 35.

Description.—Shell rather large, convex, inequivalve, subtrigonal, generally very transverse. Hinge nearly as long as shell, straight. Umbo broad, proximate, situated very anteriorly, curving forward, low in the right valve, prominent and overhanging the hinge in the left valve. Anterior wing small, narrow, subtriangular, with an obliquely convex margin below, apparently meeting the hinge-margin at an acute angle. Inferior margin very long, oblique, and slightly convex. Postero-inferior corner much produced and very convex. Posterior margin oblique, straight. Hind wing long, triangular, rather broad, convex along its centre, and separated from the body by a strong linear concavity. Surface covered by very numerous, minute, equal, close, rounded ribs, crossed by a few strong growth-ridges, and by very numerous fine, close, rounded threads. Left valve more convex than the right.

Size.—Three specimens measure 23 mm. high by 40 mm. long, and 13 mm. deep; 14 mm. high by 18 mm. long, and 5 mm. deep; 32 mm. high by 40 mm. long, and 13 mm. deep. A specimen from West Angle is 47 mm. long.

Localities.—In the Barnstaple Athenæum are six specimens from Sloly, five from Marwood, one from Kingdon's, Shirwell, and two from Top Orchard. In the Museum of Practical Geology are eighteen from Marwood, one from Baggy, and eight from West Angle Bay, Pembrokeshire; in the Woodwardian Museum, Sowerby's type from Marwood, and six from Barnstaple; in my Collection one from Pouch Bridge. It crowds the surface of a bed just above the *Rh. laticosta* bed at Baggy.

Remarks.—*Avicula Damnoniensis*, Sow., as obtained from Marwood, varies so very much in shape, that it was divided by Phillips into three varieties ; it appears probable, however, that this is in a large degree due to the squeezing of the beds and the decayed state of the specimens, in which the ornament is more or less destroyed. Still it is probable that the species did really vary considerably.

The shells from the Pilton beds were separated as *A. cancellata* by Phillips, but there seems no good reason for this. They are perhaps smaller, more compact in shape, and very regularly ornamented, but these points are probably due to individual accident or to preservation. Sowerby's type seems to agree with a fine specimen from West Angle Bay, which shows from different parts of its surface that, though the hind wing may in some states of preservation seem without radiations, it really possessed them ; but the absence of radiations on the wing is the only character which Phillips mentions as definitely distinguishing Sowerby's species from his own ; while another character (the contour of the hind wing) which Phillips mentioned in *A. cancellata* is equally seen in many Marwood specimens of *A. Damnoniensis*. Probably if the latter specimens were in good preservation the supposed differences would disappear.

It appears probable that *Pt. Salamanca*, Hall, is also identical. In the defective state of our specimens it is difficult to be sure of exact details of shape, but any discrepancies that may be observable are such as might easily be accounted for by incidental causes. Moreover the differences between *Pt. Salamanca*, Hall, and *Pt. Sao*, Hall, seem so slight that they can hardly be more than varietal in a group of shells which we know from other species to be subject to much individual variation.

Affinities.—From the South Devon species of *Actinopteria*, as well as from *Actinopteria intermedia*, Œhlert,[1] sp., it is distinguished by the shape of its wing and the fineness of its ornament.

5. *Genus*—Aviculopecten, *M'Coy*, 1852.

1. Aviculopecten transversus, *Sowerby*, sp. Plate XVI, figs. 1—4.

1840.	Pecten transversus,	*Sowerby.*	Geol. Trans., ser. 2, vol. v, pt. 3, pl. liii, fig. 3.
1841.	—	*Phillips.*	Pal. Foss., p. 46, pl. xxi. fig. 77.
1844.	—	*M'Coy.*	Syn. Carb. Foss. Ireland, p. 101.
1855.	Aviculopecten transversus,	*M'Coy.*	Brit. Pal. Foss., p. 393.
1893.	—	*Collins.*	Trans. Roy. Geol. Soc. Cornwall. vol. xi, p. 36.

[1] 1881, Œhlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 21, pl. iii, figs. 1—1 *c*.

Description.—Right valve large, probably nearly circular, flattish, with small, nearly equal, and well-defined wings. Umbo nearly central, acute, depressed, proximate, not elevated above the hinge-line. Front wing flat, narrow, with an oblique convex margin, meeting the hinge-line at right angles, and defined below by a deep, oblique sinus. Posterior wing narrow, triangular, with a concave margin, meeting the hinge-line at right angles, and defined below by a less definite sinus. Anterior margin deeply notched under the wing, produced centrally, and broadly and evenly convex. Inferior and posterior margins convex. Surface of back ornamented by numerous sharp, triangular rays (divided by deep linear furrows) which are simple near the umbo, but, as they recede from it, develop a smaller similar ray on each side, so that near the margins they form groups of three triangular ridges, of which the central is the highest; the whole surface being crossed by numerous regular, fine, sharp, distant threads or striæ. Surface of front wing with four or five strong, rounded ridges, divided by similar furrows, crossed by numerous fine, rounded striæ. Surface of hind wing with more numerous and indistinct rays, crossed by rather more irregular striæ.

Left valve very similar, but probably rather deeper, and with a larger, broader, and less defined hind wing.

Size.—Phillips's figured specimen is 51 mm. long, but is vertically compressed. Other specimens are still larger, but I have been unable to find any that give the true dimensions, all the specimens having suffered distortion.

Localities.—In the Museum of Practical Geology is Phillips's figured specimen from Brushford, and a second from Braunton. In the Barnstaple Athenæum are two fine specimens from Goodleigh and Pilland, and a poor one from Top Orchard; in the Porter Collection are two specimens from Pilton; and in the Woodwardian Museum are five specimens from Barnstaple and one from South Petherwyn.

Remarks.—Though always distorted, several of the specimens are very fine, and enable us to learn a good deal of the character of the shell.

Phillips, though adopting Sowerby's name, remarks that he has very little doubt that it is the same shell as *Pterinea radiata*, Goldfuss.[1] M'Coy, however, points out that it is distinct from that species. It is distinguished by its radiated wings, and its more numerous and finer ribs of nearly equal size, grouped with remarkable regularity in a different way from those of the German form, which, moreover, has wider interspaces.

[1] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 135, pl. cxix, figs. 7 *a*, *b*; and ? 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 19, pl. i, fig. 2.

2. Aviculopecten nexilis, *Sowerby*, sp. Plate XVI, figs. 5, 6, and Plate XVII, figs. 2, 3.

1840. Pecten nexilis, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. liii, figs. 1, 2.

1891. Aviculopecten aquisgranensis, *Frech*. Abhandl. Geol. Specialk. Preuss., Band ix, pt. 3, p. 19, pl. i, figs. 1—1 *b*.

Description.—Shell small, rather flat (the right valve being apparently almost flat and the left gently convex), subcircular, probably very slightly oblique, nearly equilateral. Wings small, flat, triangular, broad, nearly equal, bounded by sigmoid margins, defined (especially the anterior wing) by strong straight sulci, which reach the margins. Lateral margins, deeply concave under the wings, and then becoming deeply convex in the lower parts, the posterior corner being slightly more produced. Inferior margin nearly semicircular. Hinge-line straight, rather more than half the length of the shell. Umbo of the right valve small, sharp, central, proximate to the hinge-margin; umbo of the left valve rather larger, deeper and more rounded. Contour of back slightly convex, deepest near the umbo, spreading out flatly to the margins. Surface covered with about fifty fine, sharp, minute, elevated, distant, alternating ribs, about half of which have divaricated from the centre; the whole crossed by equally numerous but still finer and smaller parallel concentric threads, which extend also over the wings. Wings with about seven radiating rays similar to those on the body of the valves.

Size.—16 mm. long, 17 mm. high, and 4 mm. deep (left valve).

Localities.—In the Museum of the Geological Society is Sowerby's type from Barnstaple; in the Barnstaple Athenæum, two specimens from Top Orchard and one from Braunton; in Miss Partridge's Collection, one from Upcott Arch Quarry; and in my Collection, several specimens from the Ostracod-bed close to the Laticosta bed at Baggy.

Remarks.—For a long time I was only acquainted with very imperfect specimens of this shell; but recently I have found it occurring in abundance in the lower beds of Croyde Bay. There is no doubt of the identity of these fossils with the species as described by Sowerby.

Aviculopecten aquisgranensis, Frech, appears exactly identical in every respect.

Affinities.—It is distinguished from *A. Hallii* by its very much finer and more numerous ribs.

Pecten subradiatus, F. A. Römer,[1] from the Culm, which is very similar in shape, is described as having numerous finer lines between the major rays.

Avicula Posidonis, F. A. Römer,[2] is more transverse and squarish, with comparatively larger wings and finer rays, but in other respects is similar. If his specimen had been subject to considerable transverse contortion it might perhaps have approximated our species; but Römer seems to imply that its figure represents its true shape, while specimens show that Sowerby's figure is not much contorted.

Pecten polytrichus, Phillips,[3] as given by Römer[4] and by Frech,[5] differs in having smaller wings and umbo, broader sides, and a decidedly more rounded form, as well as a few of the rays somewhat greater than the rest. Phillips's own species is still farther removed; it differs from the shell which these German authors have identified with it by the very much greater inequality of its major and minor ribs, and is akin to, if not identical with, the species named *Avicula Ibergensis* by F. A. Römer.[6]

P. Helmerseni, Semenow et Möller,[7] is similar, but has only transverse striations on its wings.

Crenipecten Winchelli, Meek,[8] may be compared with it, though probably not congeneric.

Pecten oceani, Goldfuss,[9] has much coarser ribs.

3. Aviculopecten granulosus, *Phillips*, sp. Plate XIII, fig. 15.

1841. Pecten granulosus, *Phillips*. Pal. Foss., p. 46, pl. xxi, figs. 75 *a*, *b*.

Description.—Shell small, obliquely ovate, as broad as long. Umbo small, oblique, acute, situated nearly at the anterior third of the length. Hinge-margin straight, about half the length of the shell. Wings small, triangular, broad, flat, very sharply defined, and with gently sigmoid margins; the hind wing being rather larger and longer than the front. Other margins oval, the greatest convexity being in the postero-inferior region. Surface microscopically

[1] 1852, F. A. Römer, 'Beitr. Harzgeb.,' pt. 2, p. 91, pl. xiii, fig. 19.
[2] 1855, F. A. Römer, ibid., pt. 3, p. 11, pl. iii, fig. 4.
[3] 1841, Phillips, 'Pal. Foss.,' p. 46, pl. xxi, fig. 76.
[4] 1860, F. A. Römer, 'Beitr. Harzgeb.,' pt. 4, p. 161, pl. xxv, fig. 5.
[5] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 16, pl. i, figs. 9—9 *b*.
[6] 1855, F. A. Römer, 'Beitr. Harzgeb.,' pt. 3, p. 35, pl. vii, fig. 3.
[7] 1863, Semenow and Möller, 'Mélange Phys. et Chim.,' vol. v, p. 679, pl. iv, figs. 14 *a*, *b*.
[8] 1875, Meek, 'Pal. Ohio,' vol. ii, p. 296, pl. xv, figs. 50, 56; and 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 89, pl. ix, fig. 1, 2, 4, 25—30.
[9] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 42, pl. lxxxviii, fig. 10.

crenulated by very numerous sharp radiating and concentric lines, which together cover it with a multitude of minute squares; surface of front wing similar but slightly coarser; that of hind wing much coarser, and with the transverse lines dominant. Contour of left valve gently convex.

Size of Right Valve.—Length 14 mm., height 14 mm.

Localities.—There are two specimens from Pilton in the Porter Collection, and one from Landlake in the Museum of Practical Geology.

Remarks.—The two specimens from Pilton closely agree with Phillips's figure of the opposite (?) valve, and are evidently identical though they do not preserve any signs of the ornament except on the hind wing. The ornament on the Landlake specimen is exactly like that in Phillips's figure, except that it is still more minute. That specimen is rather more oblique and transverse, but it is quite possible that (as it is a mould) it might have been the original of his figure in spite of its appearing to represent the opposite valve. It is flatter than the Pilton specimens.

Affinities.—*Pecten linteatus*, Goldfuss,[1] is very similarly ornamented, but appears to be longer and more direct, and to have more rounded rays and considerably larger wings.

Aviculopecten pelmensis, Frech,[2] more nearly approaches it in shape, but bears much fewer and coarser radiations.

6. *Genus*—Actinopteria, *Hall*, 1883.

1. Actinopteria rudis, *Phillips*, sp. Plate XV, fig. 14.

1841. Avicula rudis, *Phillips*. Pal. Foss., p. 50, pl. xxii, figs. 85 *a*, *b*.
?1892. Actinopteria rudis, *Whidborne*. Dev. Faun., vol. ii, p. 73, pl. viii, figs. 4, 6, 6 *a*.

Description.—Left valve very high, slightly oblique, ovoid. Umbo prominent, extending above the hinge-line, situate anteriorly. Hinge-line short. Hind wing short, triangular, very broad, and clearly defined. Posterior margin forming a slightly obtuse angle with the hinge-margin, straight on the wing, and convex below it. Contour of back convex. Surface with numerous fine, sharp, distant rays, and a few indistinct undulations of growth. "Lower valve: general figure elongate, with a square, short hinge-line and prominent beak near the anterior end; surface covered with flexuous and irregular lines of growth" (Phillips).

Size.—A left valve measures about 15 mm. high.

[1] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 78, pl. cxiv, fig. 9; and 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 17, pl. ii, figs. 3—5.

[2] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 15, pl. i, figs. 7—7 *b*.

Localities.—A specimen from Barnstaple and two from south-west of Sloly in the Woodwardian Museum, and two very indistinct shells from Sloly in the Barnstaple Athenæum, appear to belong to this species.

Remarks.—Under this heading Phillips has figured two very indistinct valves from Pilton and Bradiford, viz. a left valve which closely resembles our specimens, and a right valve showing the concentric lines described by him.

Our fossils are all too indistinct to throw further light upon the species, or to enable us to be certain whether the Lummaton form is identical. While most of the specimens seem to have a rather large and rayed hind wing, in the specimen here figured it seems short and smooth. Though this certainly throws a little doubt on its identity, I am inclined to regard it as immaterial. The smoothness, at all events, seems simply due to accidental obliteration of ornament.

Affinities.—*A. Jugleri,* F. A. Römer,[1] approaches it most nearly, but is more oblique, and, judging from the figures of it given by various authors, differs in other particulars.

7. *Genus or Sub-genus*—Pterinopecten, *Hall*, 1883.

1. Pterinopecten polytrichus, *Phillips*, sp. Plate XV, fig. 1.

1841. Pecten polytrichus, *Phillips.* Pal. Foss., p. 46, pl. xxi, fig. 76.
1855. Avicula Ibergensis, *F. A. Römer.* Beitr. Harzgeb., pt. 3, p. 35, pl. vii, fig. 3.
1884. Pterinea Ibergensis, *Clarke.* Neues Jahrb. f. Min., Beil.-Band iii, p. 370.
1891. Avicula Ibergensis, *Frech.* Abhandl. Geol. Specialk. Preuss., Band ix, pt. 3, p. 44, pl. iii, fig. 3.

Description.—Left valve very large, nearly flat, rather oblique, higher than long. Umbo probably very small, low, and situate at or about the anterior fourth of the length of the value. Hinge-line straight, nearly equal to the length. Margins unknown, but probably the inferior short, slightly oblique, and convex, the postero-inferior slightly produced and broadly convex, and the posterior nearly direct and gently sigmoid. Hind wing large, flat, broad, triangular, undefined, and with a nearly perpendicular margin. Contour of back gently convex near umbo, sloping out flatly to margins. Surface with about eight large, rounded, distant, radiating ribs, rapidly decreasing in size laterally, between each of which is an alternating series of seven very much smaller ribs, of which the fourth is the

[1] 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 21, pl. vi, fig. 4.

largest and the second and sixth next in size; the whole crossed by seven or eight very low and indistinct undulations, and by very numerous fine concentric striæ. Surface of hind wing with about twenty small, equal, alternating ribs only.

Size of an imperfect valve.—Length 60 mm., height 80 mm., depth 8 mm.

Locality.—One imperfect mould from Croyde Bay is in the Museum of Practical Geology.

Remarks.—The figure of this fossil is given from a wax cast taken from the mould. It is very different in size, shape, and ornament from any of the accompanying fossils, but owing to its own imperfection, and to the unsatisfactory description of the forms with which it may be compared, there is considerable difficulty in deciding its species.

Phillips's figure of *Pecten polytrichus* is similarly ornamented. It appears smaller and more transverse, and its major ribs seem stronger behind than in front, but it has every sign of being taken from a very much compressed and fragmentary specimen, and it is the right or opposite valve to ours. It may be observed that Phillips defines two varieties, one with alternating minor ribs from Brushford, and the other with equal minor ribs from Mudstone Bay. The latter may prove to be a distinct species, but my belief is that the former at all events is identical with ours, and that the differences visible are to be accounted for either by distortion or by his specimen being only the umbonal parts of a larger shell.

Again, *Avicula Ibergensis*, F. A. Römer, appears from its figure to agree with our fossil in shape and character, chiefly differing in being much smaller and in having two major ribs on the hind wing. Frech, who refigures Römer's type, makes it even more like Phillips's specimen than ours. It seems probable that it is only a variety of the English fossil, the differences seen being simply due to age.

Affinities.—The shell identified by Römer[1] and by Frech[2] with *P. polytrichus* is totally different from Phillips's species, and may be easily distinguished both by its ornamentation and by its very much smaller wings.

Avicula dillensis, Frech,[3] has a different and much simpler style of ornament on the left valve; though the right valve is more similar, differing, however, in having more numerous rays and much fewer concentric threads.

A. pectinoides, Sowerby,[4] approaches it in size and shape, but has many more major ribs, and its ornament is, as is shown by M'Coy,[5] of an entirely different nature.

[1] 1860, F. A. Römer, 'Beitr. Harzgeb.,' pt. 4, p. 161, pl. xxv, fig. 5.

[2] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 16, pl. i, figs. 9—9 *b*.

[3] Ibid, p. 39, fig. 2, pl. iii, fig. 9, and pl. xiv, fig. 17.

[4] 1840, Sowerby, 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. liv, fig. 2.

[5] 1855, M'Coy, 'Brit. Pal. Foss.,' p. 393.

Myalinodonta Normaniana, d'Orbigny, sp.,[1] as given by Œhlert,[2] differs specifically in the absence of major ribs, as well as generically in the absence of an anterior wing.

Aviculopecten transversus is easily distinguished by its obliquity being less, and by its ribs being piled up in groups.

2. Pterinopecten? Hallii, n. sp. Plate XV, figs. 2—6.

?1887. Aviculopecten, cf. exacutus, *Tschernyschew*. Mém. Com. Géol., vol. iii, pt. 3, p. 45, pl. vii, fig. 7.

Description.—Left valve small, convex, subcircular, not oblique. Umbo large, rounded, rather prominent, subcentral, subacute, proximate, and slightly elevated above the hinge-line. Anterior wing rather large, broad, triangular, slightly convex, sharply defined, with a convex margin meeting the hinge-line at about 100°. Posterior wing large, broad, triangular, undefined, with a concave margin meeting the hinge-line at an acute angle of about 60°. Hinge-line straight, nearly or fully equal to the length of the shell. Contour of back highly and evenly convex, perpendicular by the anterior, and rather steep by the posterior wing. Anterior margin long, convex round the wing, sharply concave at its base, and then broadly convex round the lower part. Inferior margin roundly and evenly convex. Posterior margin broad, sigmoid, nearly vertical. Surface of back covered (1) except on the extreme posterior part, with twenty-five to forty prominent, elevated, rounded, alternating, radiating ribs, becoming smaller rearward, and diminishing in number as they approach the umbo, and (2) on the extreme posterior part by a number of microscopic rays; the whole crossed by twenty or thirty minute, sharp, regular, parallel, very distant threads. Surface of wings with five or six fine, distant radiations, and with rather coarser and closer transverse striæ.

Size of left valve.—Length 15 mm., height 15 mm., depth 5 mm.

Localities.—In the Barnstaple Athenæum are four specimens from Top Orchard, one from Meer Top, and one from Roborough. In the Porter Collection is one from Pilton.

Remarks.—These specimens, though fairly preserved, are all more or less defective, especially about the wings, and all appear to be left valves. There is not, therefore, material fully to describe the shell, and it is of course possible that right valves described under another head really belong to it, though I do not at present know of any which there is any reason to match with it.

[1] 1849, d'Orbigny, 'Prodrome,' vol. i, p. 87.

[2] 1882, Œhlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 30, pl. v, figs. 1—1*e*.

It appears referable to the genus *Pterinopecten*. The front wing is very definite, and the adjacent front boundary of the back is long, straight, and deep; the hind wing is more diffuse and broad. The transverse threads are so delicate that they are only occasionally visible or preserved. The ribs are rather irregular, a few being larger than the rest; toward the rear they become smaller and more even, and then, as a rule, suddenly cease, the last rib reaching the margin above the postero-inferior corner. The space behind this seems smooth, but is really covered with microscopic rays, and upon it the transverse threads become very prominent.

Affinities.—From *Pecten alternatus*, Phillips,[1] it differs by its smaller and more numerous ribs, and by its sharp transverse threads. The latter character may, however, perhaps only be due to a better state of preservation; and the former is weakened by the fact that while our specimens have usually about thirty rays, in one case they are reduced to twenty. Phillips gives the number as about twelve and represents them as very much larger, closer, and rounder; so that there seems sufficient reason to regard his species as distinct.

Aviculopecten (*Pterinopecten*) *dauniensis*, Frech,[2] approximates it, but is more oblique, with a smaller umbo, larger wings, and decidedly fewer and coarser rays and concentric ridges.

3. Pterinopecten scabriradians, n. sp. Plate XV, figs. 8, 9; and Plate XVII, fig. 4.

Description.—Right valve small, flat. Umbo small, apparently central, not elevated above the hinge-line. Hinge-line probably as long as the shell. Front wing very long, deeply notched, and extremely narrow, with a long, very oblique, slightly sigmoid margin, and separated from the body by a straight, deep, oblique groove. Lower margins apparently convex. Hind wing undefined. Surface bearing rather numerous, close, strong, rounded, highly nodulated rays, which frequently divaricate, and are separated by linear furrows, sometimes perhaps crossed by undulations. Surface of front wing with two very strong nodulated rays near the hinge, and smooth below.

? Left valve very convex, subcircular. Umbo acute, elevated above the hinge. Hind wing large, very broad, triangular, flat, bounded by a straight margin, and rather well defined by a line from the umbo to the margin. Lower margin apparently almost evenly convex. Surface covered by about twenty very distant, narrow, elevated, sharpish rays, crossed by and nodulated by still more distant, regular, parallel, concentric lines, enclosing with the rays flat oblong interspaces.

[1] 1841, Phillips, 'Pal. Foss.,' p. 47, pl. xxi, fig. 78.

[2] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 22, pl. i, figs. 8—8 *b*.

Size.—Height 11 mm., length 12 mm.

Localities.—A small distorted right valve, from the lane between Wrafton and Heanton, is in my Collection. A slab containing a similar right valve, together with a left valve which may belong to the same species, is in the Porter Collection from the neighbourhood of Pilton.

Remarks.—Whether these two valves, which are differently ornamented, belong to the same species remains to be proved. It appears safest so to regard them, as they occur together on one block of stone, and each seems quite different from any other Pilton species.

The first figured specimen of the right valve is worn and defective; a specimen found since shows that the rays bear strong transverse tubercles on their summits. What indications there are of transverse lines tend to confirm the identity of the two valves.

Affinities.—The left valve closely approximates *Pterinopecten exfoliatus*, Hall,[1] but appears to have a sharper and less oblique umbo; while the radiations on our right valve are not obsolescent. It is possible that better specimens might prove it identical with one, if not both of our valves.

Pt. undosus, Hall,[2] though different in ornament, has the front wing as deeply defined and notched as that of the present species.

Some species of *Aviculopecten* given by Hall do not differ very greatly; in fact, *Pterinopecten* and *Aviculopecten* so run into each other that it seems difficult to find a line of demarcation.

Pecten æqualis, M'Coy,[3] has fewer rays and a smaller and more definite hind wing than is seen in our left valve.

Aviculopecten Neptuni, Goldfuss,[4] sp., as given by Frech,[5] approaches our left valve in shape and general appearance, though not in size, ornament, or convexity; but it differs much from our right valves.

4. Pterinopecten Austeni, *F. A. Römer*, sp. Plate XV, figs. 10, 10 *a*, 11.

1855. Avicula Austeni, *F. A. Römer*. Beitr. Harzgeb., pt. 3, p. 37, pl. vii, fig. 16.

Description.—Left valve rather small, wider than long, flattish, slightly oblique, subcircular. Umbo rounded, prominent, proximate, situated somewhat

[1] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 61, pl. i, figs. 16, 17; and pl. lxxxiii, figs. 6, 7.

[2] Ibid., p. 72, pl. ii, figs. 10—19; and pl. lxxxii, fig. 7.

[3] 1844, M'Coy, 'Syn. Carb. Foss. Ireland,' p. 89, pl. xv, fig. 13.

[4] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 125, pl. cxvi, figs. 4 *a*, *b*.

[5] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' vol. ix, pt. 3, p. 18, pl. ii, figs. 1, 2.

anteriorly, direct and extending slightly above the hinge-margin. Hinge-margin giving the greatest length of the shell, straight behind the umbo, and at rather a lower level and slightly oblique in front of it. Anterior wing rather small, broad, triangular, flat, defined by a depression running obliquely forward from the apex, and marked by two or three linear rays, and by eight or nine sharp, distant, regular, transverse ridges. Hind wing large, flat, broad, undefined. Anterior margin nearly straight and perpendicular above, and becoming obliquely rounded in the lower part, the curve continuing along the inferior margin, and the postero-inferior corner being roundly convex. Posterior margin perpendicular and slightly concave. Surface covered with about eighteen strong, steep, acute, triangular, elevated, very distant ribs, becoming stronger and more distant gradually from the rear forwards, and separated by broad, gently convex intervals; the whole crossed by thirteen or fourteen sharp, regular and regularly distant threads or subfoliaceous ridges, which are slightly concave between the rays. Rays produced into long marginal spines, so that the margin is, in the central parts at least, deeply scalloped. Lateral angles sharp and slightly acute.

Size of Valve.—Height 22 mm., length 23 mm., depth about 4 mm.

Localities.—There are four specimens of the left valve from Pilton in Mr. Porter's Collection, and one from Barnstaple in the Woodwardian Museum. Römer found a specimen in the "first quarry north of Pilton on the way to Marwood."

Remarks.—This species was long ago founded by F. A. Römer on a Devonshire fossil, but it appears to have escaped the notice of English geologists, as I can find no reference to it in either Morris's or Etheridge's Catalogue, or elsewhere. Not having seen Römer's type specimen, I had intended to quote it simply on his authority; but in Mr. Porter's Collection I at once recognised four examples of it, one of which is almost perfect, and agrees in every respect with Römer's figure and description. He remarks that the concentric ribs are strongest on the swollen intervals, while they become small and form no clear knots upon the rays. The species is far removed from any other English Devonian species, and from any foreign species described by Frech, Hall, &c.

5. Pterinopecten mundus, n. sp. Plate XV, figs. 12, 12 *a*, 13, 13 *a*.

Description.—Shell large, oblique, convex. Left valve more or less convex, very oblique. Anterior wing small, narrow. Umbo minute, not elevated above the umbo. Hinge-line straight (in front of umbo), lined with three or four minute, parallel, transverse cartilage-furrows. Anterior margin short, convex,

oblique. Inferior margin rather wide, convex, oblique. Postero-inferior margin widely rounded or semicircular. Posterior margin oblique, nearly straight. Surface covered with about twenty-three large, elevated, very rounded ribs, between which is a single similar series of much smaller ribs, separated by concave interspaces equal to the smaller ribs in width; the whole crossed by minute and indistinct close concentric striæ. Contour (in old forms) probably very steep, becoming almost perpendicular in front. Right valve apparently very similar to the other valve, very convex, with a large expanded wing in front.

Size.—A small left valve is 24 mm. high by 20 mm. long. A larger valve is about 38 mm. high by 32 mm. long, and 8 mm. deep.

Locality.—There are two specimens in the Woodwardian Museum from Barnstaple, and another in the Museum of Practical Geology from Croyde.

Remarks.—All these three specimens are defective, and, though they clearly show the general character of this handsome species, are difficult to interpret in detail, and therefore the above description must be regarded as in a measure tentative.

The best specimen is a small, flattish left valve in the Woodwardian. This shows the small anterior wing, above which is seen the straight hinge (about ·5 mm. wide), bearing three or four parallel ligamental furrows. With this fossil appears to agree the Croyde specimen, except that it is much more convex, and that the anterior side seems much more rounded, as though the anterior wing, which is gone, were much smaller. The other Woodwardian specimen is so distorted by pressure that it is impossible to make out its original contour; but its general shape and the large size of the ribs on the remaining wing (which is, however, evidently very much distorted) may possibly point to its being the opposite or right valve.

Affinities.—It may be near *Pecten alternatus*, Phillips,[1] from South Petherwyn, but that shell is said to be *not* oblique, and is smaller, and has fewer, more elevated, closer, and more definitely alternating major ribs, while there are no signs of the minor series. Whatever, therefore, may be the shell which Phillips's figure represents, there is at present no sufficient reason to identify it with the present species.

Avicula rudis, Phillips,[2] widely differs in having a very much more finely radiated left valve and a concentrically marked right valve.

[1] 1841, Phillips, 'Pal. Foss.,' p. 47, pl. xxi, fig. 78.

[2] 1841, ibid., p. 50, pl. xxii, figs. 85 *a*, *b*.

IV. *Family*—Pectinidæ, *Fleming*, 1828.

1. *Genus*—Crenipecten, *Hall*, 1883.

I have placed the following shell under the present genus because I think I can see faint indications of a crenulated hinge-line, which, however, the roughness of the matrix renders very doubtful.

1. Crenipecten? auritus, n. sp. Plate XV, fig. 7? and Plate XVI, figs. 15, 16.

Description.—Right valve small, flat, short, direct. Umbo small, central, direct, acute, flattened, proximate, and not extending above hinge-line. Hinge-line very nearly equal to the greatest length, apparently pitted or dentated. Anterior wing very large, broad, an almost right-angled isosceles triangle in shape, bearing indications of rays, and separated from the body by a deep hollow groove or sinus. Anterior and posterior margins almost straight and direct superiorly, convex inferiorly. Inferior margin short and convex. Contour very flat. Surface of back bearing ten or twenty very low, rounded rays.

Left valve rather more convex. Umbo small, extending slightly above the hinge-line. Anterior wing short, triangular, very broad, bearing a few rays, having a convex margin, and separated from the body by a deep straight groove. Surface (except the wing) covered by low, rounded, distant, irregular ribs, which do not all reach the umbo, and are separated by wider, shallow, concave interspaces.

Size.—Length 8 mm., height 10 mm.

Localities.—In the Barnstaple Athenæum are two specimens of the right valve from Top Orchard, and one of the left valve from Bradiford, and in the Porter Collection one left valve from Pilton, and another, which is doubtful, from Smoking House Lane.

Remarks.—This shell appears to be distinct, and probably rather far removed from the other species occurring in these beds. Owing, however, to the very poor state of preservation of the specimens its description is very difficult; and it has proved impossible to figure it in a satisfactory manner, the critical points being much obscured by the matrix, or by fracture of the shell.

The specimen from Bradiford, though indistinct, appears undoubtedly to be a left valve; and therefore it appears that we can identify the full shell, and may regard it as distinct from any other species which is known by only one of the valves.

2. *Genus*—Pleuronectites, *Schlotheim*, 1820.

(Streblopteria, *M'Coy*, 1851.)

Shell subequivalve, oval or subcircular; anterior side obliquely produced in front; hind wing large, confluent, with a right or obtuse terminal angle; front wings short, in the left valve defined by an oblique groove, and in the right indented by a byssal notch; surface smooth or finely radiated; muscular scar faint and above the centre; hinge with a narrow oblique tooth in front of the umbo; ligamental groove simple and narrow.

The above description is condensed from De Koninck's definition of *Streblopteria*,[1] which is a genus with the Carboniferous *Meleagrina lævigata*, M'Coy,[2] for its type. Frech[3] points out that it is synonymous with *Pleuronectites;* and *Pl. lævigata*, Schlotheim,[4] of the Trias, which is the type of that genus, though differing specifically, is evidently congeneric with M'Coy's species.

1. Pleuronectites Piltonensis, n. sp. Plate XVI, figs. 7—9, 10 ?, 11 ?

Description.—Right valve small, subovoid, broad, gently convex, more or less oblique. Umbo small, acute, direct, rather flattened, hardly extending above the hinge, and situated rather behind the middle. Hinge-line more than half the length of shell. Anterior wing long, narrow, convex, ovate, marked by four or five coarse low rays and some cross striæ; defined by a deep narrow groove, and bounded by a semicircular margin. Posterior wing short, flat, obtusely triangular, defined by a linear oblique groove. Anterior margin semicircular at the wing, then with a deep, narrow, angular notch, and then spreading out in a broad, bluntly subangular curve, which becomes subcircular below. Inferior margin narrow, convex. Posterior margin neatly convex. Contour of back gently convex, spreading out flatly to the margins. Surface apparently smooth (or only microscopically marked). Muscle-scar very large, central, situated in the upper half of the shell.

? Left valve ovoid, more or less broad and oblique, rather convex. Umbo oblique, acute, reaching slightly above hinge. Anterior wing small, flat, short, equilaterally triangular, and marked with a few radiating and transverse lineations. Posterior wing apparently small, short, flat, and very broad, more or less distinctly defined,

[1] 1885, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. xi, p. 202.

[2] 1844, M'Coy, 'Syn. Carb. Foss. Ireland,' p. 80, pl. xii, fig. 5.

[3] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 12.

[4] 1820, Schlotheim, 'Petref.,' vol. i, p. 217; and 1850–56, Bronn, 'Lethæa,' ed. 3, p. 161, pl. xi, fig. 11.

and with its margin confluent with the margin of the body. Margins generally convex, gently concave below the anterior wing. Contour of back gently convex.

Size.—A right valve is 15 mm. long, 16 mm. high, and 3 mm. deep.

Localities.—In the Barnstaple Athenæum are one left and one right valve from Top Orchard, and left valves from Bradiford, Raleigh, and Kingdon's, Shirwell. In the Porter Collection are three or perhaps four right valves and two left valves from Pilton, and two left valves from Roborough. In my Collection is one doubtful right valve from Wrafton Lane.

Remarks.—These specimens are for the most part in a poor state of preservation, and their surface is decayed or gone. They are extremely puzzling from the variety of shapes which they assume, owing probably to the tenuity of the shell. The right valves are, however, easily recognisable by their peculiar convex, radiated, pear-shaped anterior wing. Hence we can identify shells which are inversely oblique with others which are, apparently through squeezing, almost direct. The left valves are sometimes direct, but generally oblique in the opposite direction. It has seemed to me, however, after a careful examination, that this change of shape may be not improbably due to contortion, and therefore I have ventured to place them with these right valves, which otherwise correspond, though I fully realise that the discovery of better preserved specimens may prove them distinct. The figured right valves from Mr. Porter's Collection (Pl. XVI, figs. 7 and 8) should be regarded as the types of the species; that in the Barnstaple Museum would have to be separated if further discoveries were to prove that it is not distorted; while the only left valve that can be certainly referred to it is a very poor specimen of Mr. Porter's, the other left valves being only placed here provisionally until better specimens prove whether they are identical or not.

Affinities.—*Pecten consimilis*, M'Coy,[1] seems closely related, and has a similarly ornamented ear, but it differs in having its umbo larger and more central, and in being less oblique and very much smaller in size

Pecten perobliquus, F. A. Römer,[2] seems more oblique and more produced in the postero-inferior part than our right valves, bears no rays on the ear, and has transverse striæ on the other parts.

Crenipecten obsoletus, Hall,[3] and *C. glaber*, Hall,[4] approach in shape, but neither of them appears to have a radiated ear, and they are probably more equilateral.

Streblopteria lateralis, de Koninck,[5] comes very close, but does not appear to have a radiated ear, and appears more regularly ovoid in outline.

Meleagrina lævigata, M'Coy,[6] seems decidedly more oblique and transverse.

[1] 1844, M'Coy, 'Syn. Carb. Foss. Ireland,' p. 91, pl. xv, fig. 16.

[2] 1850, F. A. Römer, 'Beitr. Harzgeb.,' pt. i, p. 48, pl. viii, fig. 4.

[3] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 84, pl. ix, figs. 19, 21. [4] Ibid., p. 85, pl. ix, figs. 20, 22?.

[5] 1885, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. xi, p. 206, pl. xxxii, fig. 16.

[6] 1844, M'Coy, 'Syn. Carb. Foss. Ireland,' p. 80, pl. xii, fig. 5.

2. Pleuronectites lepis, n. sp. Plate XVI, figs. 12, 13.

Description.—Left valve small, flat, circular, slightly transverse. Umbo low, flat, direct, central, acute, small. Hinge-line apparently about half the length. Anterior wing small, flat, triangular, rather narrow, defined by a strong, long, rather concave wall from the umbo. Posterior wing very small, short, undefined. Anterior margin rather concave at the wing, then sloping obliquely forward, and becoming broadly convex round the body of the shell. Inferior margin wide, gently convex. Posterior margin deeply convex below, becoming nearly straight and oblique round the posterior wing. Contour of back nearly flat, perpendicular and steep over the front wing. Surface marked by one or two strong growth-lines, and apparently with very fine and regular concentric striæ. Right valve very similar to the left valve.

Size.—Height 15 mm., length 18 mm., depth of one valve 2 mm.

Localities.—Two, or perhaps three, specimens from Top Orchard are in the Barnstaple Athenæum; and one from Pilton in the Porter Collection.

Remarks.—It is not very certain whether this is a good species. The flattish circular shape and general character appear to give a distinctive appearance; but in a deposit which has suffered so much from distortion it is exceedingly difficult to decide whether an apparent peculiarity of shape may not possibly be due to accident. It appears, however, that there is sufficient reason to assume that it is distinct.

Affinities.—It seems rather similar to *Aviculopecten Schulzi*, Frech,[1] in shape and in the smoothness of the valves, but it differs by having a less defined and angulated posterior wing. The wings in the German species, moreover, of which a right valve only is figured, are strongly radiated.

Streblopteria pullus, de Koninck,[2] appears more equilateral, and has a more defined hind wing.

3. Pleuronectites Hicksii, n. sp. Plate XVI, figs. 14, 14 *a*.

Description.—Left valve very small, convex, subcircular, higher than long. Umbo low, sharp, direct, incurved, and extending somewhat above the hinge-line. Hinge-line more than half the length of the shell. Anterior wing (probably short) broad, triangular, defined by a straight, steep, oblique line from the umbo.

[1] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 21, pl. i, fig. 10.

[2] 1885, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. xi, p. 208, pl. xxxii, fig. 13.

Posterior wing apparently obtusely triangular, small. Lower margins probably strongly convex. Contour very gently convex, becoming perpendicular or even rather excavate above the lines which bound the wings. Surface microscopically marked by crowded, regular, elevated, distant concentric threads, and similar but less regular and distinct radiating lines, and with a few transverse striæ on the front wing.

Size.—The specimens are too defective for measurement.

Localities.—A specimen from Bradford is in the Barnstaple Athenæum; and a very doubtful one from Pilton in the Porter Collection. One from the lane between Wrafton and Heanton, and another from Upcott Arch Quarry, are in my Collection.

Remarks.—This is another little species, of the nature of which we have at present very imperfect information. There seems no doubt that it is quite distinguishable from *Pl. Piltonensis*, but I am not so certain whether *Pl. lepis* may not prove to be a synonym of it. The fine concentric ornament is very characteristic, and appears to be different from that on the adjacent species.

Affinities.—The right valve of *Pecten perobliquus*, F. A. Römer,[1] comes very near, but seems to differ in being shorter and much more oblique.

Pleuronectites devonicus, Frech,[2] is closely approximate, with an exactly similar ornament, but having a smaller and radiated front wing and a rounder umbo. Its front wing seems nearer an equilateral triangle in shape, and the front margin is consequently more indented. It also appears to be a more globose shell.

3. *Genus*—Pernopecten, *Winchell*, 1865.

This genus is regarded by Zittel as a section of *Crenipecten*. Hall[3] refers to it the Palæozoic (if not also the Jurassic) species of *Entolium*, Meek; and shows that, if identical, it has a priority of a few months over the latter.

Its hinge-line is described as straight, but in the type specimen as figured by Hall the wings protrude upward at least as much as in the shell described below.

1. Pernopecten insperatus, n. sp. Plate XVII, fig. 5.

Description.—Shell small, flat, nearly equilateral, subcircular; umbo flat, low, slightly anterior, small, rounded. Wings subequal, protruding to a moderate height

[1] 1850, F. A. Römer, 'Beitr. Harzgeb.,' pt. i, p. 48, pl. viii, fig. 4.

[2] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 13, pl. xvii, figs. 8, 8 a.

[3] 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 1, sect. ii, p. lvii, woodcuts 1—3.

above each side of umbo, subtriangular. Hinge-margin less than half the length of the shell, with two deep internal ridges extending obliquely downwards three quarters of its length. Margins subcircular. Contour flat, the umbonal area being defined in front by a slightly curved line, and behind by a strong straight depression, extending to the centre of the posterior margin. Surface (?).

Size.—Height 16 mm., length 16 mm.

Locality.—One specimen from Top Orchard is in the Barnstaple Athenæum.

Remarks.—The only specimen of this shell with which I am at present acquainted is so indistinct that I at first omitted it from the plates, but further examination convinced me that it has protruding wings in the style of *Amussium*, and is therefore generically distinct from the other specimens with which I supposed it associated. These wings are lower and rounder than is usual in the species that have been referred to the genus *Entolium*, and its slightly inequilateral shape seems to distinguish it from most of the Belgian Carboniferous forms.

I am not aware that any other species of the genus has hitherto been described from Devonian rocks.

4. Prothyris,[1] sp. Plate XVII, fig. 6.

Description.—Shell moderate in size, ensiform, very elongate, its length being about three times its height. Anterior margin apparently rounded and notched. Inferior margin very long and straight, and nearly parallel to the upper margin, the shell being slightly higher in front than behind. Posterior margin apparently gaping. Umbo low, rounded, situated at or about the anterior fifth of the shell. Surface marked with rather few close, low, rounded growth-lines, most visible in the marginal half, and with eight or ten rather strong, unequally distant, linear, oblique, impressed rays running from behind the umbo to the posterior fourth of the inferior margin. Post-cardinal slope apparently narrow, flat, oblique, and marked by a few much stronger radiating ridges.

Size.—Height 10 mm., length 30 mm.

Locality.—Two specimens are in my Collection from Sloly Quarry.

Remarks.—These specimens are interesting from the clearness of their peculiar ornament. They are too imperfect for identification, but one of them appears to show the characteristic notch of the genus, though in a much-injured condition. Both in size, shape, and ornament they seem so different from either of the species described above that I think they will prove distinct from any of them.

[1] See page 86.

MOLLUSCOIDEA.

1. Class—BRACHIOPODA, *Duméril*, 1806.

1. Order—ARTICULATA, *Deshayes*, 1836.

I. *Family*—Terebratulidæ, *King*, 1846.

1. *Genus*—Rensselläria, *Hall*, 1859.

1. Rensselläria ? formosa, n. sp. Plate XVII, figs. 7—9.

Description.—Dorsal (?) valve elongate, convex, suboval, without a fold. Surface covered by about twenty low, close-set, flatly rounded ribs, which do not divaricate, but gradually increase in size from the umbo to the margins. Two lofty median septa, continued a short distance forward from the umbo, subparallel and not united, possibly supporting the hinge-plate, and surrounded by a low ovoid ridge, which starts near the umbo, and, passing just in front of them, may perhaps define a muscular area. Dental sockets lateral, triangular. Shell-structure very minutely and regularly punctate.

Size.—A slightly crushed valve is 26 mm. long, by 16 mm. wide, and 7 mm. deep.

Localities.—Four specimens from Ashford Strand are in my Collection, and two from Pilton and Poleshill in the Porter Collection.

Remarks.—These specimens are all more or less imperfect. The first one discovered (fig. 7) had assumed almost the exact shape and appearance of *Tropidoleptus carinatus* (Conrad), and consequently I catalogued it as that shell. Further examination, and comparisons on the one hand with our Ashford specimens, and on the other with Davidson's figured specimens of *T. carinatus*, and with German specimens kindly lent me by Mr. Upfield Green, have proved that its umbonal arrangements agree with the former and not with the latter, and that the specimen owes its peculiar shape to excessive distortion. It therefore is proved not to be *T. carinatus*, and that species does *not* occur in the Pilton Beds.

The best of my specimens from Ashford appears to afford considerable information about this species, which is evidently beautiful and interesting, but perplexing withal. Externally it might well be referred to *Rensselläria*, but I cannot satisfactorily correlate what is seen of the internal details with those given by Hall for his

genus. The pores of the surface suggest its affinity to the *Terebratulidæ* or to *Retzia*. The cast (fig. 8 *a*) shows two short, deep, close, but unconnected subparallel fissures; on each side of these are shallow, slightly curved grooves, starting close to the apex, and meeting each other just in front of the fissures, so as to form a small ovoid fossula, which perhaps defines the muscle region; again on each side of this lie rather deep oblique fissures, which seem to be the moulds of the walls of the triangular dental sockets. These features do not tally with those of German specimens of *R. stringiceps* shown me by Mr. Upfield Green, nor do they seem as if they would be consistent with the structures described by Hall, even in an immature state. On the other hand, I am inclined to think that the shell is most likely to be allied to *Renssellæria* or *Trigeria*, which it appears strongly to resemble in outward form and some other points. Consequently, as enough is not yet known about it to give a generic definition, it seems best to leave it provisionally under *Renssellæria*; observing, however, that it appears to me most probable that it will be found to require a new generic name when better specimens have been discovered.

Affinities.—*R. stringiceps*, F. Römer,[1] differs in having much finer and more numerous ribs, *i. e.* forty instead of twenty. The Ilfracombe shell which Davidson[2] refers to that species is further distinguished by its constant divarication of ribs. Again, the ribs of all the American forms given by Hall and Clarke are much finer and more numerous.

R. crassicosta, Kock,[3] appears to have the same number of ribs, but, judging from the figures, the ribs are loftier, and the shell much more globose. There is, perhaps, still greater external resemblance in *Centronella* (*Trigeria*) *Guerangeri*, Verneuil, sp.,[4] but that is a much smaller shell.

II. *Family*—Spiriferidæ, *King*, 1846.

1. *Genus*—Athyris, *M'Coy*, 1841.

1. Athyris ? sp. Plate XVII, fig. 10.

Remarks.—A few minute, smooth, flattish, elongate, oval shells were obtained by Mr. Porter from Pilton. In shape they appear to be peculiar, but they do not

[1] 1844, F. Römer, 'Rhein. Uebergangsgeb.,' p. 68, pl. i, figs. 6 *a*, *b*.

[2] 1864, Davidson, 'Brit. Foss. Brach.,' vol. iii, p. 10, pl. iv, figs. 5—7.

[3] 1880, Gosselet, 'Esquisse Géol.,' vol. i, pl. i, fig. 20; 1881, Kock, 'Jahrb. f. Min.,' vol. ii, p. 387; and 1883, Kayser, 'Jahrb. Preuss. L. A.,' p. 123, pl. v, figs. 2—5.

[4] 1883, Œhlert, 'Bull. Soc. Étud. Sci. Angers' (1883), p. 59, pl. i, figs. 1—11; and pl. ii, figs. 1—6.

show sufficient character to enable us to judge whether they are the young of some larger species, or one of those small Brachiopods which cannot be satisfactorily identified without some knowledge of their internal structure.

Sub-genus—SEMINULA, *M'Coy*, 1844; emend., *Hall and Clarke*, 1894.

2. ATHYRIS (SEMINULA) OBLONGA, *Sowerby*, sp. Plate XVII, figs. 11, 11 *a*, 12 ? 12 *a*.

1840. ATRYPA OBLONGA, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. liii, fig. 6.
? 1840. — INDENTATA, *Sowerby*. Ibid., pl. liv, fig. 6.
1864. ATHYRIS ?, *Davidson*. Brit. Foss. Brach., vol. iii, p. 17, pl. iii, figs. 1, 16.
1896. ATHYRIS ? OBLONGA, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 375.

Description.—Shell slightly pentahedral (or suborbicular), subglobose. Ventral valve the larger; beak prominent, with short dental lamellæ; muscle-scars apparently very short and wide. Dorsal valve with very small dental sockets; muscle-scars short, cylindrical, and very narrow; hinge-plate broad, anteriorly straight. Cast of both valves covered with vascular impressions. Fold and sinus apparently only marginal, low, and not very broad. Surface quite smooth, but with four or five growth-ridges. Margins meeting in an arching line, the ventral valve being thrown back at the shoulders and then advancing to the front.

Size.—Length 19 mm., width 19 mm., depth 10 mm.

Localities.—Ashford Strand, Laticosta Cave Baggy, Saunton, Poleshill, Roborough, &c.

Remarks.—An internal cast with a portion of the mould of the same shell is in my Collection, and from this specimen the above description has been almost entirely taken. Judging from Hall and Clarke's revision of the *Athyridæ* this shell clearly falls within the limits of the sub-genus *Seminula* of M'Coy,[1] of which they[2] say that its smooth exterior, its subpentahedral form, its sinuate valves, and the peculiar character of its muscle-scars are distinctive features, and that branching vascular sinuses are sometimes retained over the whole pallial area of both valves. In our specimen all these points are observable, though its fold and sinus are very indistinct. Similar specimens seem not uncommon at Ashford, and a bed close to the Laticosta bed at Baggy is paved with valves, which from their shape and smoothness (excepting their few growth-lines) are undoubtedly identical. I have

[1] 1844, M'Coy, 'Synopsis Carb. Foss. Ireland,' p. 158.
[2] 1894, Hall and Clarke, 'Pal. N. Y.,' vol. viii, pt. 2, p. 93.

also met with about twenty very similar casts in various collections, which appear to be indistinguishable, and which generally show more or less distinctly such points as the vascular sinuses, the subpentahedral shape, and the marginal fold, which rarely seems to be at all strong. With such unsatisfactory material it is of course difficult in many cases to be sure of specific identity; for instance, the type of *Atrypa oblonga*, Sowerby, in the museum of the Geological Society is extremely obscure, and I long hesitated between identifying it with the above specimens, or with those referred below to *Cleiothyris Royssii*. Its oblong shape is, I think, evidently only due to distortion, but the character of the fold and the size of the dental sockets agree best with the present shell. Moreover Sowerby describes it as "smooth," as are also our specimens. But while, therefore, we may conclude that it belongs, and consequently gives its name, to the species now under consideration, we may note that it is not in itself an exponent of its specific value.

For some time it seemed to me possible that our shell might belong to *Athyris concentrica*, von Buch, but having examined some casts from the Lower Devonian of Germany which Mr. Upfield Green informs me belong to that species, I find them to be entirely different and distinct.

The shape of our shell seems different from any of the various English Carboniferous forms of *Seminula*.

Sub-genus—CLEIOTHYRIS, *King*, 1850; emend., *Hall and Clarke*, 1894.

3. ATHYRIS (CLEIOTHYRIS) ROYSSII, *Léveillé*. Plate XVII, figs. 13—15*a*; Plate XVIII, figs. 1—5; and Plate XX, figs. 1, 2.

1835. SPIRIFER DE-ROYSSII, *Léveillé*. Mém. Soc. Géol. Fr., vol. ii, figs. 18—20.
1840. ATRYPA HISPIDA, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. liv, fig. 4.
1840. — DECUSSATA, *Sowerby*. Ibid., pl. liv, fig. 5.
? 1841. SPIRIFERA DECUSSATA, *Phillips*. Pal. Foss., p. 70, pl. xxviii, figs. 120 *b*—*e*.
1844. ATHYRIS DECUSSATA, *M'Coy*. Syn. Carb. Foss. Irel., p. 147.
1844. — DEPRESSA, *M'Coy*. Ibid., p. 147, pl. xviii, fig. 7.
1844. — HISPIDA, *M'Coy*. Ibid., p. 148.
1855. — CONCENTRICA, *M'Coy* (pars). Brit. Pal. Foss., p. 378.
1861. — ROYSSII, *Davidson*. Brit. Foss. Brach., vol. ii, pt. 5, p. 84, pl. xviii, figs. 1—11.
1864. TEREBRATULA ELONGATA ?, *Davidson*. Ibid., vol. iii, p. 8, pl. i, fig. 9.
1864. ATHYRIS CONCENTRICA, *Davidson* (pars). Ibid., vol. iii, p. 14, pl. iii, figs. 15 (?), 17 (?), 24 (?) (only).
1864. — sp., *Davidson*. Ibid., pl. iv, figs. 1—3.

1877. Spirigera Roissyi, *Gosselet*. Ann. Soc. Géol. Nord, vol. iv, p. 313.
1896. Athyris? concentrica and rugulosa, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 375.

Description.—Shell, *in the young state*, transverse, flattish, with the ventral valve flattest, without fold or sinus. Ventral valve with small, deep adductor scars, and diffuse diductors. Dorsal valve with a central septum, thickened posteriorly, supporting a broad recurved hinge-plate, which seems to intrude into the beak, and the anterior corners of which support the short crura. Muscle-scars paired, each pair being elongate and narrow, while a small internal visceral foramen is seen just in front of the adductors. Spires consisting of about nine whorls, and filling the whole cavity of the shell. Surface covered with very numerous concentric ridges, which are often paired, and appear generally smooth, but sometimes show signs of spiniferous elongations.

Shell, *in the older state*, becoming large, and sometimes very transverse, with a narrow median septum and strong dental plates. Fold broad, flatly oval, protruding in front. Surface covered by extremely numerous lamellar striæ, which become more crowded and definitely spiniferous near the margins.

Size.—Large distorted fragments measure 30 mm.

Localities.—Very common in most localities, *e. g.* Upcott Arch, Croyde Bay, Ashhill Quarry, Braunton Down, Incheldon, Pouch Bridge, Roborough, Poleshill, South Petherwyn.

Specimens figured by Davidson as *Terebratula elongata*, Schlotheim? and as *Athyris concentrica*, von Buch?, are in the Museum of Practical Geology; and others by Sowerby, as *Atrypa hispida* and *A. decussata*, are in the Woodwardian Museum.

Remarks.—Two forms, both of which are not uncommon in the Pilton Beds, appear to be the young and old states of the same species, and are united by some intermediate but less distinct examples.

(1) We have, first, small, flat, transverse casts, which are wide-spread and common (Pl. XVIII, figs. 1—3), and have been figured by Davidson as "*Athyris*, sp.? supposed to belong to *A. concentrica*." In these many internal details may be seen. In one specimen (Pl. XVII, fig. 15) the beginnings of the crura are preserved. The muscular scars and the spires are occasionally shown, and as the casts often occur in their moulds we can learn also the surface-ornament. This ornament generally seems to consist of smooth concentric ridges, but in some of the specimens these ridges are seen to be spiniferous, exactly corresponding with *A. hispida*, Sowerby, from South Petherwyn, so that there is no doubt that that species is identical with the present. *A. decussata*, Sowerby, is another South Petherwyn shell, which Sowerby also quotes from Barnstaple, and as his figure shows a similar ornament, it is doubtless only another example of the same

species in a rather more advanced stage of growth. It may be compared with Pl. XVII, fig. 15.

With regard to these shells, however, it must be noted that it seems difficult to correlate their internal arrangements with those of *Athyris*. They agree in the small opening of the visceral canal in front of the muscle-scars; but there appear differences in the absence of defined ovoid dental sockets, in the strength of the median septum, and in the hinge-plate being apparently produced and curving forward into the beak. Possibly these structures may be due to the immaturity of the shell. They perhaps agree best with those of the sub-genus *Seminula*, as limited by Hall and Clarke,[1] but according to them that group has a smooth exterior, while judging from the surface the present shell would fall within the sub-genus *Cleiothyris* as defined by them.[2]

(2) There are also frequently found, though almost always in an extremely crushed and distorted condition, much larger shells, which I formerly believed to belong to a distinct species. These show a broad flattened fold, and a surface of imbricated concentric lines, which appear very similar to those of the smaller form in the central parts, but which become closer and very definitely fringed and spinous marginally (Pl. XX, figs. 1 and 2). In one slab of these moulds in the Barnstaple Athenæum is a cast (the mould of which definitely shows the same surface-ornament) which is identically similar to the cast figured by Davidson as "*Terebratula elongata*, Schlotheim?," and therefore that name must be removed from our Devonian lists, as in them it is evidently only synonymous with that of the present shell. This cast bears much resemblance to the cast of *Athyris lamellosa* figured by Hall and Clarke.[3]

The question now arises whether this Devonshire species is identical with any previously described form. M'Coy unites it with *A. concentrica*, von Buch, and in this he is in part followed by Davidson. The character of the surface, however, seems clearly to negative this. Very indistinct radiations on the ridges of *A. concentrica* are certainly mentioned by von Buch[4] and M'Coy, but do not seem to break their continuity; and M'Coy, when identifying Sowerby's shell with it, asserts that "the decussation, to which Sowerby alluded, is only produced by the decomposition of certain of the concentric laminæ, according with their original fibrous texture, and is not visible in sound specimens." But the evidence of our larger specimens distinctly disproves this assertion. In several of them the rows of puncta on the ridges (as seen in the mould) are much too definite to be explained in any such way; while in one or two (Pl. XX, fig. 1), where the surface is

[1] 1894, Hall and Clarke, 'Pal. N. Y.,' vol. viii, pt. 2, p. 93.

[2] Ibid., p. 90.

[3] Ibid., pl. xlvi, fig. 20.

[4] 1834, von Buch, 'Über Terebrat.,' p. 103.

broken off aslant, rows of fine comb-like spines like those of *Athyris Royssii* are distinctly visible. Now Gosselet and Hall (for instance) distinguish *A. concentrica* by its want of such spines, and that seems to be the general character of the shells that are recognised as belonging to that species. Hence we may certainly conclude that our shell is not *A. concentrica*, but some species of the sub-genus *Cleiothyris* to which *A. Royssii* belongs.

From the great distortion of the specimens, and their preservation only as moulds, it is not easy to compare it with Carboniferous examples of *A. Royssii*. It seems, perhaps, to differ in the spines being generally smaller, and the striæ being more numerous and becoming more crowded marginally; but it evidently itself varies in these points, and *A. Royssii* must have been equally variable, as Davidson says that he has counted eighty striæ on a moderately sized specimen, whereas those he figured must have had fewer. The figure of the Irish *A. depressa*, M'Coy, which Davidson identifies with *A. Royssii*, appears almost exactly like our shells; and Gosselet records *A. Royssii* from the Famennian of Belgium, with which Dr. Barrois, in his visit to Devonshire last summer (1896), classed the Pilton Beds. Therefore, though I formerly thought that the larger specimens of our shells might be distinguished, I feel now no difficulty in regarding them as *A. Royssii*, though possibly they may prove to be a local variety of it.

Affinities.—*Athyris reticulata*, Gosselet,[1] is said to be distinguished from *A. Royssii* by its smaller size, and by its width being greater than its length. In these respects it may not differ from our shell, but it may perhaps have had a stronger and more angular fold.

2. *Genus*—Spirifera, *Sowerby*, 1815.

1. Spirifera microgemma, *Phillips*. Plate XVIII, figs. 7, 7 *a*, 8.

1841.	Spirifera microgemma, *Phillips*.			Pal. Foss., p. 68, pl. xxvii, figs. 116 *a*, *b*.
1864.	—	lineata ?, *Davidson* (pars).		Brit. Foss. Brach., vol. iii, p. 43, pl. iv, fig. 16 (only).
1882.	—	—	—	Ibid., vol. v, p. 32, pl. ii, figs. 5, 5 *a*.
1896.	—	—	*Whidborne*.	Proc. Geol. Assoc., vol. xiv, p. 375.

Localities.—In the Porter Collection are six specimens from Pilton and one from Roborough; in the Barnstaple Athenæum two from Upcott, one from Top Orchard, and one from Vicarage Well; in the Woodwardian Museum one from Barnstaple.

Remarks.—Davidson seemed inclined to regard *Sp. microgemma*, Phillips, as

[1] 1877, Gosselet, 'Ann. Soc. Géol. Nord,' vol. iv, p. 312, pl. iii, fig. 3.

identical with *Sp. lineata*, Martin, sp., but left the question undecided. Under *Sp. lineata* he included as varieties *Sp. elliptica*, Phillips,[1] and *Sp. imbricata*, Sowerby,[2] sp., but afterwards separated the latter on account of the different shape of its spirals. An examination of a large series of Carboniferous specimens of the above shells shows that in them the fold and sinus are generally absent, are very rarely clearly marked, and never deflect the transverse ridges. Waagen concludes from Davidson's description that dental plates are absent, though they are certainly mentioned by M'Coy.[3]

Our Pilton specimens are with two exceptions much distorted, and none show the ornament except under the aspect of a mould. They all have definite signs of a fold and sinus, which frequently deflect the transverse striæ; their transverse ridges are few and coarse, being not more than fifteen or twenty; their spines are just visible to the naked eye. One cast shows short but evident arching dental plates. In another the spines are seen to be bicanaliculate (as described by Davidson in a Carboniferous shell). Those specimens which seem to be least distorted are slightly transverse, and the curvature of the front margins somewhat approaches a semicircle. Hence it appears that they constitute a form which does not seem to vary much, and which differs considerably from the general run of Carboniferous forms, but most nearly approaches *Sp. imbricata*. Whether the difference should be regarded as of specific or only varietal value remains yet to be decided; but if *Sp. imbricata* be distinct from *Sp. lineata*, the presumption is that the present form is equally distinguishable from each of them, and therefore it seems preferable to resume, at least provisionally, Phillips's specific name.

2. Spirifera Verneuilii, *Murchison*. Plate XVIII, figs. 9—13 *a*.

1840. Spirifer Verneuili, *Murchison*. Bull. Soc. Géol. Fr., vol. xi, p. 252, pl. ii, figs. 3 *a—e*.
1840. — Lonsdalii, *Murchison*. Ibid., p. 251, pl. ii, figs. 2 *a—c*.
1840. — Archiaci, *Murchison*. Ibid., p. 252, pl. ii, figs. 4 *a—c*.
1858. — — *Pacht*. Baer and Helmeren's Beitr. Russ. Reiches, Band xxi, p. 95.
1864. Spirifera disjuncta, *Davidson*. Brit. Foss. Brach., vol. iii, p. 23, pl. v, figs. 1—12; and pl. vi, figs. 1—5.
1868. Spirifer disjunctus, *Dames*. Zeitsch. Deutsch. Geol. Gesell., vol. xx, p. 494.

[1] 1836, Phillips, 'Geol. Yorks.,' pt. 2, p. 219, pl. x, fig. 16.
[2] 1822, Sowerby, 'Min. Conch.,' vol. iv, pl. cccxxxiv, fig. 3.
[3] 1855, M'Coy, 'Brit. Pal. Foss.,' p. 429.

1871. Spirifer Verneuili, *Kayser*. Ibid., vol. xxiii, p. 587.
1881. Spirifera Verneuilii, *Davidson*. Brit. Foss. Brach., vol. iv, p. 339, pl. xxxviii, figs. 9—14.
1882. — — — Ibid., vol. v, p. 35, pl. ii, fig. 1.
1882. Spirifer Verneuili, *Barrois*. Mém. Soc. Géol. Nord, vol. ii, p. 257, pl. x, figs. 7 *a—d*.
1886. — disjunctus,[1] *Wenjukoff*. Fauna Dev. Syst. N.-W. und Cent. Russl., p. 64, pl. iii, figs. 1—7; and pl. iv, figs. 1—4.
1894. — Verneuili, *Gosselet*. Mém. Soc. Géol. Nord, vol. iv, p. 1, pls. i—v; pl. vi, figs. 58, 59.
1894. — disjunctus, *Hall and Clarke*. Pal. N. Y., vol. viii, pt. 2, p. 24.

Localities.—Pilton, Ashford Strand, Orchard House Pilton, Goodleigh, Top Orchard, Croyde Bay, Tutshill, Roborough, Shirwell, Saunton, Braunton, Bradiford, Hagley Bridge, one mile south of Wiveliscombe, Luscott Barton, Poleshill, Kingdon's Shirwell, Laticosta Cave Croyde, Upcott Arch, Pouch Bridge, Rock Inn Quarry (near Wiveliscombe), Camelford, Tintagel, South Petherwyn. It is one of the most frequent Brachiopods of the Pilton Beds. In the Woodwardian Museum is a specimen from the Lingula-zone of Sloly.

Size.—The largest specimen I have seen is more than eight inches in width.

Remarks.—Davidson regarded all the Spirifers from the Pilton Beds, which have numerous plaits on the fold, as belonging to *Sp. Verneuilii*, with which he united *Sp. Archiaci*, *Lonsdalii*, *Murchisoniana*,[2] and *Barumensis*, as well as the various forms described by Phillips and by Sowerby from these beds. More lately, however, he appears to have expressed an opinion that *Sp. Barumensis* was distinct. It would appear that he was at one time inclined not only to separate *Sp. Murchisoniana* specifically, but to refer it to *Cyrtia*, a genus which afterwards he declined to recognise.

Sp. Verneuilii is defined by Gosselet as covered with numerous fine ribs from margin to beak, those of the fold and sinus bifurcating, but those of the wings being always simple (and thereby differing from *Sp. striata*). On the latter character he lays much stress, stating that among Belgian species it is only shared by *Sp. Orbeliana*, which he distinguishes by the slightly convex centre of its sinus and the trapezoidal form of its "languette." *Sp. aperturata*, Schlotheim, he defines as having the lateral ribs narrower than the intervening furrows, and occasionally though rarely bifurcating.

Whether our Pilton fossils all belong to the present species is a question by no means easy to decide. Being almost always distorted and imperfectly preserved, it is most difficult to say whether any lines of distinction can be drawn between

[1] Grouped with *Sp. Verneuili*, *Sp. Archiaci*, *Sp. tenticulum*, and *Sp. Brodi*.

[2] 1845, Murchison, von Keyserling, and de Verneuil, 'Geol. Russia,' vol. ii, p. 160, pl. 4, figs. 1 *a—d*.

the multitudinous examples preserved in different collections, though they evidently vary very greatly. Three lines of variation are apparent in them. (1) The area is sometimes narrow and concave, as in the type; and sometimes extremely broad and flat, as in the form *Sp. Barumensis*, Salter, MS., of which examples are found in which the area is much higher than wide, and the umbo hardly if at all incurved. (2) The dental plates are sometimes short and sometimes extremely large and massive, extending almost to the front of the ventral valve. (3) The minute ornament of the shell (which is rarely preserved) is seen sometimes (in specimens from Ashford Strand) to be fine transverse lines, sometimes (in specimens from Ashford Strand) fine longitudinal lines, and sometimes (in specimens from Snapper Quarry) coarse, concentric, irregularly arching rows of pores. It appeared to me at one time that these variations might indicate specific differences, but the examination of foreign specimens does not seem to support this idea.

With regard to the first point, the very numerous figures given by Gosselet show very great variation in the size of the area, though perhaps hardly as great as is seen in the North Devon shells. Moreover in the latter I observe that there does not seem any distinct demarcation to be drawn between shells with narrow areas and those with broad, and that both varieties occur of all sizes. In none of our specimens have I seen any indication of a foramen.

With regard to the second point, the dental plates appear to be most developed in large shells with broad areas, but in smaller specimens with broad areas they are sometimes very short; while Davidson has figured a small specimen with a narrow area from Budleigh Salterton in which these plates are exceedingly developed. It is to be noted that Hall describes them as being inconsiderable in his *Aperturati*-group (which includes *Sp. Verneuilii*) except in a few shells, which he separates from the "*disjunctus*-type" under the name of the "*Hungerfordi*-type." He, however, states them to be very differently developed in shells of adjacent external form.

With regard to the third point, at first sight it appears to be impossible to reconcile the three variations of minute ornament given above. Davidson states that the surface is covered by numerous fine contiguous concentric lines. Gosselet figures one specimen with similar concentric lines, while he figures *Cyrtia Murchisoniana* with fine longitudinal lines. In our specimens I find that these two classes of ornament certainly occur together, though where one is prominent the other is almost obliterated. Few of the Continental specimens I have examined show the minute characters. In specimens of *Sp. Lonsdalii* three coarse longitudinal lines are seen on each rib, as originally described; and in Murchison, von Keyserling, and de Verneuil's 'Russia,' a specimen of *Sp. Archiaci* is figured with an irregular spinous ornament. But in the British Museum is a very large series of Spirifers from China, some of which are referred to *Sp. Verneuilii* (one being so labelled in the Davidson Collection, along with a specimen exactly

similar in ornament from Chimay, in Belgium), while others are referred to *Cyrtia Murchisoniana* (one of these being the figured Chinese specimen[1] of it). While the extreme forms of these shells seem perfectly distinct, I have failed to find any definite line of specific division between them. Though they vary much in shape, some being longer, more ovoid shells, and having a shorter hinge-line than any European forms, they may be traced without break into the ordinary forms of the shell, and even on to those alate forms with produced wings. Their styles of minute ornament, which is often perfectly preserved, are not constant to particular shapes, though in the elongate form, in which a foramen is sometimes seen, this minor ornament generally consists of fine longitudinal threads, and in the broad form generally of transverse lines or of coarser longitudinal threads irregularly broken into spines,—similar, in fact, to the Russian figure,—and thus approaches the texture seen in our specimens from Snapper Quarry. In the Museum of Practical Geology is a specimen from South Petherwyn with the same structure as these Snapper specimens, which have narrow areas. That shell has a large flattish receding area, and a slightly incurved umbo, and evidently falls within the variety *Sp. Barumensis*. Lastly, in the Woodwardian Museum is a slab from South Petherwyn, with three specimens, which show transverse rows of punctations with a tendency to run into longitudinal lines, thus connecting our two figured examples from Ashford and Snapper; and, moreover, the ornament in these three specimens is of three different degrees of coarseness, intermediate between those of the two last-mentioned shells.

It would thus appear—

(1) That the various styles of ornament here described are not inconsistent with each other, and may all belong to *Sp. Verneuilii*, and consequently that *Sp. Verneuilii* is as variable in ornament as in shape.

(2) That though it is still possible that more than one species may be included under this name, there is no evidence of this from our Devonshire specimens; even the form *Sp. Barumensis*, distinctive as it sometimes seems, does not appear to have any definite characters for its separation.

(3) That the variations of *Sp. Verneuilii* are remarkably great. It might possibly be described as "a species in process of solution." While I venture to think that the difficulties to certain developments of evolutionary theories which are in vogue at present may ultimately be found to be insurmountable, we may say that if species have changed at all it is probable that there were times when the forces of variation were especially active. Every now and then we meet with a species which is so variable that it seems impossible to say whether it is one or a collection of forms. This may be a permanent state, or it may be the crisis in its life-history where it is breaking up into a number of new species. The variations in

[1] Davidson, 'Quart. Journ. Geol. Soc.,' vol. ix, 1853, p. 355, pl. xv, figs. 6—9.

Sp. Verneuilii are so great and intermingled that it may be in that transition stage.

(4) That some of the shapes of *Sp. Verneuilii* might from external ornament be placed under the genus *Cyrtia*. What is known of the internal arrangements of these shells does not separate them from *Spirifera*, and the size and flatness of their area are certainly not a sufficient reason for doing so. What, therefore, the genus *Cyrtia* may be worth must depend on structures not seen in our English specimens. These shells also resemble some species of *Syringothyris*—*e. g. S. cuspidata*—externally, but distinctly differ from them internally.

3. Spirifera obliterata, *Phillips*. Plate XIX, figs. 1—4 *a*.

?1840.	Spirifer Bouchardi,	*Murchison*.	Bull. Soc. Géol. Fr., vol. xi, p. 253, pl. ii, figs. 5 *a*—*c*.
1841.	Spirifera obliterata,	*Phillips*.	Pal. Foss., p. 78, pl. xxxi, fig. 135.
1896.	— —	*Whidborne*.	Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Shell very transverse, fusiform, alate. Hinge-line very long, marked in the cast with crenulations. Cardinal angles very acute. Beak small, incurved. Ventral valve with a narrow sinus, bisected by an elevated line, and dorsal valve with a low narrow fold bisected by a median groove. Dental plates short. Lateral ribs low, rounded, five or more in number (sometimes numerous), gradually decreasing in size, and becoming faint or evanescent on the wings. Ovarian area strongly pitted.

Size.—Height of dorsal valve 9 mm.; width 26 mm.

Localities.—In the Museum of Practical Geology is Phillips's type specimen of *Sp. obliterata* from Brushford; in the Barnstaple Athenæum is a specimen from Top Orchard; in Mr. Hamling's Collection one from Top Orchard; in my Collection four from Ashhill Quarry near Brushford, and two from near the Kiln, Croyde Bay.

Remarks.—Phillips's specimen, being on a slab with other fossils, was unobserved at the time that Davidson described the Devonian Brachiopoda. It has since been recognised, and proves to belong to a definite species of which several other examples have occurred in the Pilton Beds. This specimen is in poor condition, and may perhaps have been slightly shortened by pressure. The usual shape of the species appears to be still more transverse. It seems to be distinguished by its small, narrow, undefined fold and sinus, and by its low rounded ribs, which seem to vary considerably in number, to be broad and prominent near the centre, and to diminish rapidly and regularly toward the sides, so that the wings sometimes appear almost smooth. The fold is very undefined;

it is difficult to say from our specimens how many of the central ribs should be counted as belonging to it.

I am inclined to think it possible that this form may be only a variety of *Sp. Bouchardi*, Murchison. In Murchison's figure the ribs seem stronger and more numerous (those on each side of the sinus being very strong), and the transverse lineation stronger and more regular. These slight differences may, however, partly be explained by the better state of preservation of Murchison's specimen. Moreover our Devonshire shells, none of which are sufficiently well preserved to show the transverse ornament clearly, display much variation in the number of the ribs and other points. On the other hand, specimens of *Sp. Bouchardi* from Ferques in the Davidson Collection are less like them, and all appear to differ in their more angular shape, their definite folds, and their very strong lineations.

Phillips regarded *Sp. obliterata* as allied to *Sp. speciosa*, Schlotheim;[1] but Dr. Barrois, to whom I have shown a photograph of it, sees no reason for supposing it identical. It seems to be distinguished from that species, and from its ally or variety *Sp. paradoxa*, Schlotheim,[2] by the bifurcation of its fold and sinus, and the more definite grading of its ribs.

Sp. mucronata, Conrad, as given by Sandberger,[3] and *Sp. phalæna*, Sandberger,[4] seem to be less transverse, and to have stronger and more equal ribs.

4. Spirifera (Martinia?) Urii, *Fleming*. Plate XIX, figs. 5—7.

1828. Spirifera Urii, *Fleming*. Brit. Anim., p. 376.
1840. Atrypa unguiculus, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. liv, fig. 8.
1841. Spirifera unguiculus, *Phillips*. Pal. Foss., p. 69, pl. xxviii, figs. 119 *a—f*.
1864. — Urii, *Davidson*. Brit. Foss. Brach., vol. iii, p. 41, pl. iv, figs. 25—28.
1884. — (Martinia?) Urii, *Davidson*. Brit. Foss. Brach., vol. v, p. 418.

Localities.—Croyde, Braunton, Petherwyn, Top Orchard, Bradiford, Vicarage Well Pilton, Frankmarsh, Upcott Arch Quarry, Ashhill Quarry, Wrafton Lane, &c.

Size.—Height about 9 mm.; width about 13 mm.

Remarks.—This is a very common and characteristic species. From Devon-

[1] 1813, Schlotheim, 'Taschenbuch f. Mineral.,' vol. vii, p. 52, pl. ii, fig. 9.
[2] Ibid., p. 28, pl. ii, fig. 6.
[3] 1889, F. Sandberger, 'Entw. Unter-Abtheil. Dev. Systems Nassau,' p. 104, pl. iii, fig. 2.
[4] Ibid., p. 105, pl. iii, figs. 3, 3 *a*.

shire it was first described under the name *Atrypa unguiculus*, Sowerby, but was united to the Carboniferous *Sp. Urii* by Davidson, and no doubt correctly so.

The muscle-scars seen in some of our specimens are long and very narrow, and there are no dental plates or median septum. Thus they appear to fall within the group *Martinia*, to which Davidson doubtfully referred them, though they certainly bear in some aspects a resemblance to *Ambocœlia*, the value of which cannot be measured until the spires are discovered. None of our specimens show the surface, but Davidson has figured a Carboniferous example with numerous coarse spines.

In size the Devonian fossils somewhat exceed the dimensions of the Carboniferous shell as given by Davidson.

Affinities.—This species seems widely different from the Lummaton *Sp. infima*, mihi,[1] which I suspect belongs to *Ambocœlia*.

I think also that Holzapfel[2] is right in separating it from *Sp. inflata*, Schnur,[3] which was joined with it by Kayser;[4] though my strong impression is that both the shells he figures under that name should be referred to other species.

5. Spirifera mesomala, *Phillips*. Plate XIX, figs, 8, 9 ? 9 *a* ? 9 *b* ?

1841. Spirifera mesomala, *Phillips*. Pal. Foss., p. 78, pl. xxxi, fig. 137.

Description.—Shell small, moderately transverse, with apparently rounded wings. Beak moderately elevated and incurved. Ventral sinus wide, concave, with two or three indistinct lineations, not breaking its smoothness. Lateral ribs simple, prominent, rounded, distant, about ten on each side; without signs of transverse markings.

Size.—A specimen measures about 6 mm. wide.

Locality.—One specimen is in my Collection from Saunton Hotel, and one or two in Mr. Hamling's Collection from Snapper Quarry. A very imperfect specimen in Mr. Upfield Green's Collection from Sloly may belong to this species, but is perhaps more likely to be a small worn example of *Sp. Verneuilii*, var. *Barumensis*.

Remarks.—Phillips's description of his species is so incomplete that Davidson,

[1] 1893, Whidborne, 'Dev. Fauna,' vol. ii, p. 108, pl. xiii, figs. 1—3.

[2] 1895, Holzapfel, 'Abh. k. Preuss. Geol. Landes.,' n. s., pt. 16, p. 253, pl. xi, fig. 20 (?); and pl. xvii, fig. 6.

[3] 1854, Schnur, 'Palæontographica,' vol. iii, p. 211, pl. xxxvii, fig. 2.

[4] 1871, Kayser, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. xxiii, p. 584.

not having seen an example of it, simply quoted it on Phillips's authority without expressing an opinion upon its specific value. It may prove to be only the young form of *Sp. Verneuilii*.

I have found two or three small shells which seem likely to be the same species as Phillips's, but they are insufficient to give decided evidence on the question.

The small specimen (fig. 8) from Saunton has certainly a distinctive appearance. It is a ventral valve, and looks as though it would accurately correspond with Phillips's figure of the dorsal valve.

3. *Genus*—Spiriferina, *d'Orbigny*, 1847.

1. Spiriferina cristata (*Schlotheim*), var. octoplicata, *Sowerby*. Plate XIX, figs. 10, 11, 11 *a*.

1858.	Spiriferina cristata, var. octoplicata,			*Davidson*. Brit. Foss. Brach., vol. ii, pt. 4, p. 38, pl. vii, figs. 37—47.
1864.	—	—	—	*Davidson*.[1] Ibid., vol. iii, p. 46, pl. vi, figs. 11—15.
1895.	—	—	—	*Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Localities.—In the Barnstaple Athenæum are specimens from Ashford Strand; in the Porter Collection from Poleshill and Pilton; in Mr. Hamling's Collection from near the Kiln, Croyde; and in my Collection from East Anstey Station, Ashford Strand, and Pouch Bridge.

Size.—A specimen measures about 21 mm. wide.

Remarks.—This is certainly the species which Davidson figured from Looe and recorded from Pilton, and it has therefore an extensive vertical range in the Devonian rocks. It is a well-characterised form. It is very transverse, with a narrow area, a much incurved beak, numerous (eleven to twenty-one) strong deep ribs, strong, regular, distant transverse lines or flounces, and a very coarsely punctated shell-structure. These puncta seem sometimes to lie in lines corresponding with the transverse lineations. Its fold and sinus are narrow and flattened, and have respectively a very slight median furrow and rib. In the

[1] In the heading of the species Davidson omits the name *octoplicata*, but supplies it at p. 123 and in the plates. Though the same divergence occurs in the lists in his last volume, it seems clear that the omission was purely accidental.

ventral valve there appears to be a median septum, which, taken together with the punctated surface, indicates that it belongs to *Spiriferina*.

The present shell is the Devonian representative of the race which includes the Silurian *Sp. elevata*, Dalman,[1] sp., and the Carboniferous and Permian *Sp. cristata* (and its variety *octoplicata*).

As given by Davidson, *Sp. elevata* has a much wider area and a less incurved beak, *Sp. sulcata*[2] fewer ribs and sometimes sharper wings, and *Sp. crispa*[3] closer transverse lines and fewer ribs. These forms Davidson does not refer to *Spiriferina*, but retains in *Spirifera*.

On the other hand, I can see no differences whatsoever between it and his Carboniferous figures of *Sp. cristata*, var. *octoplicata*, except that the ribs seem slightly less numerous, and a minute median depression is seen on the fold. The small rib on the sinus is equally visible both in the Carboniferous and the Devonian shells. The Permian *Sp. cristata*[4] itself has fewer ribs and a more lofty umbo. Thus it seems that the present shell is inseparable from the Carboniferous form, whatever may be its relation to the Silurian and the Permian species.

Affinities.—*Sp. Zeilleri*, Barrois,[5] closely resembles it, and may possibly even prove identical; but its lamellæ seem fewer, and its fold not biplicated.

In *Sp. aculeata*, Schnur,[6] the transverse lines seem broken into long fringes instead of simply showing puncta. With regard to that shell it may be noted that Holzapfel[7] places *Spiriferina insculpta*, Phillips, sp., as a synonym of it, so far as regards the Devonian form described by Davidson[8] from Lummaton. Whether this Lummaton shell is separable from the Carboniferous type of *Sp. insculpta*, and whether it possesses the distinctive longitudinal lineation which exists on the lamellæ of *Sp. aculeata*, are questions I venture to think are not yet proved in the affirmative; but in any case two points have been overlooked by Herr Holzapfel, viz. (1) that the Lummaton species is a *Spiriferina*, not a *Spirifera*; and (2) that if it is not *Sp. insculpta*, Phillips, it *certainly* is *Sp. pulchella*, Sowerby.[9] The latter point appears clearly on the examination of Sowerby's type in the museum of the Geological Society. If, therefore, Herr Holzapfel is right in

[1] 1867, Davidson, 'Brit. Foss. Brach.,' vol. iii, pt. 7, p. 95, pl. x, figs. 7—11.

[2] Ibid., vol. iii, pt. 7, p. 91, pl. x, figs. 4—6.

[3] Ibid., vol. iii, pt. 7, p. 97, pl. x, figs. 13—15.

[4] 1858, ibid., vol. ii, p. 17, pl. i, figs. 37—40, 45, 46; and pl. ii, figs. 43—45.

[5] 1882, Barrois, 'Mém. Soc. Géol. Nord,' vol. ii, p. 256, figs. 13, 13 *a*, 13 *b*.

[6] 1854, Schnur, 'Palæontographica,' vol. iii, p. 203, pl. xxxiv, figs. 2 *a*, *b*.

[7] 1895, Holzapfel, 'Abhandl. k. Preuss. Geol. Landes.,' n. s., pt. 16, p. 250.

[8] Holzapfel quotes Davidson thus:—"1864, *Spirifer insculptus*, 'Brit. Dev. Brach.,' Supplement, pl. i, fig. 32." This reference requires to be thus corrected:—"1882, *Spiriferina insculpta*, 'Brit. Dev. Brach.,' Supplement, pl. i, fig. 32."

[9] 1840, Sowerby, 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. lvii, fig. 8.

this matter, he has unconsciously proved that *Sp. aculeata*, Schnur, is a synonym of *Spiriferina pulchella*, Sowerby, sp.

III. *Family*—Rhynchonellidæ, *d'Orbigny*, 1847.

1. *Genus*—Rhynchonella, *Fischer de Waldheim*, 1809.

Sub-genus—Camarotœchia, *Hall and Clarke*, 1894.

1. Rhynchonella (Camarotœchia) Partridgiæ, *Whidborne*. Plate XIX, figs. 12—14.

1841. Terebratula pleurodon ?, *Phillips* (pars). Pal. Foss. (not Geol. Yorks.), p. 86, pl. xxxv, figs. 155 *a*, *b*.
1865. Rhynchonella pleurodon, *Davidson* (pars). Mon. Brit. Foss. Brach., vol. iii, p. 62, pl. xiii, figs. 12, 13.
1896. — Partridgii, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Shell generally rather small, transversely oval or sub-pentagonal, apparently becoming more transverse with age. Ribs strong, elevated, acutely triangular, reaching to the umbones, and deeply interlocking at the margins, separated by furrows. Ventral valve with a rather elevated and erect sharp beak, and a sinus which becomes deep in front, so that the "languette" forms a low sub-tetrahedron. Ribs, three on the sinus and about seven on the sides. Lateral ribs with a slightly concave sweep, and terminating marginally with a sharp angle. Dental plates oblique, reaching about one-third down from the beak, their front ends being joined by a low curved ridge which defines the muscular impressions. Dorsal valve with a flat and straight median fold, becoming prominent in front and sharply angulated at the margin, containing almost invariably four ribs. Sides dilate and drooping. Median septum reaching nearly half-way to the front, and having at its posterior end diverging branches which support the dental sockets (?), which are crenulated exteriorly.

Size.—Some specimens are more than 24 mm. wide.

Localities.—Pilton Vicarage Well, Poleshill, Top Orchard, Roborough, Goodleigh, Raleigh, Bradiford, Frankmarsh, Collar Bridge, Kingdon's Shirwell, Saunton, Croyde Bay, Laticosta Cave, Ashford Strand, Upcott Arch Quarry, Ashhill Quarry, Pouch Bridge, Fremington, &c.

Remarks.—This species is abundant and wide-spread in the Pilton Beds, but being usually crushed, contorted, or fragmentary, its exact characters are not easy to define. In writing of it Phillips specially remarks on the difficulty of deciding,

in so complicated a genus, the species of shells which are in such a poor state of preservation, and doubtfully refers them to his Carboniferous *Rh. pleurodon*.[1] In this he has been followed by Davidson and others; but it seems probable that there are sufficient grounds for distinguishing them from the Carboniferous shell, even in their defective state. *Rh. pleurodon* generally has five ribs on the fold, though they may vary from three to nine. From the study of a large number of specimens of our Pilton shell I find that they have almost invariably four ribs on the fold with three on the sinus. Gosselet lays great stress on the number of ribs on the fold, using it as a distinguishing character for his various Upper Devonian species; and, if his view of its importance is correct, we have here a sufficiently definite specific distinction; for, even granting that in many species of *Rhynchonella* the number of ribs on the fold is very various, there seems no reason why in other cases their definite number should not be a point of specific importance. Moreover, the profile of the present shell seems much less rounded than that of *Rh. pleurodon;* the front of the median ribs of the dorsal valve and of the lateral ribs of the ventral valve sweeping definitely outwards till they are abruptly turned in at the margin at a sharp angle, more in the manner of *Rh. anisodonta* than of *Rh. pleurodon*.

Our shells occur as casts, and as I have only seen specimens of the true *Rh. pleurodon* retaining the shell, I have been unable to compare the interior, the arrangements of which are well indicated in our fossils. These arrangements appear exactly the same as those by which Hall and Clarke[2] define their genus *Camarotœchia*, to which they refer Gosselet's Upper Devonian species, though they do not indicate whether they also include in it *Rh. pleurodon*.

While, however, there seem to be sufficient grounds for distinguishing *Rh. Partridgiæ* from *Rh. pleurodon*, their relationship is probably very close, the former being apparently somewhat more specialised than the latter. One point of agreement which may be noted is the slight median channeling of the lateral ribs, which is often seen in the Pilton shells, and is mentioned by Davidson as a character of *Rh. pleurodon*.

Affinities.—None of the Upper Devonian *Rhynchonellæ* described by Gosselet[3] in 1887 appear to correspond with our species. While several have the same number of median ribs, they all (as well as *Rh. Daleidensis*, F. Römer,[4] or *Rh. inaurita*, Sandberger[5]) differ in their more rounded profile and the less acutely produced sweep of their medio-dorsal and latero-ventral ribs.

[1] 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 222, pl. xii, figs. 25—30.
[2] 1894, Hall and Clarke, 'Pal. N. Y.,' vol. viii, pt. 2, p. 189.
[3] 1887, Gosselet, 'Ann. Soc. Géol. Nord.,' vol. xiv, p. 188.
[4] 1844, F. Römer, 'Rhein. Uebergangsgeb.,' p. 65, pl. i, figs. 7 *a—c*.
[5] 1856, Sandberger, 'Verst. Rhein. Nassau,' p. 337, pl. xxxiii, figs. 5—5 *c*.

2. Rhynchonella (Camarotœchia) togata, n. sp. Plate XIX, figs. 15—18.

? ? 1841. Spirifer rudis, *Phillips*. Pal. Foss., p. 78, pl. xxxi, figs. 136 *a—c*.
1896. Camarotœchia[1] togata, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Shell very large, subtrigonal, hardly (if at all) wider than long. Beak apparently elevated, acute, and only moderately incurved. Ventral valve with a broad subtrigonal sinus, becoming deep in front and bearing two strong median ribs; and with four ribs on each side, of which the first is very strong and the others are successively less distinct. Dental plates (which may be sometimes absorbed ?) short, diverging. Muscular area strongly impressed. Dorsal valve with three ribs on the fold, with a short median septum (less than a quarter of the total length) divided into branches posteriorly, supporting an incipient spondylium, and with strongly crenulated outer socket-walls.

Size.—Length and width about 33 mm.

Localities.—In the Porter Collection are two specimens from Pilton and one from Roborough; in the Barnstaple Athenæum one from Pilton; in the Museum of Practical Geology four, labelled North Devon, Marwood, Braunton, and Barnstaple. I have recognised it at Ashhill Quarry.

Remarks.—Though this species appears well characterised, our specimens are all too fragmentary and crushed to permit its full definition. Of them five are ventral and three dorsal valves; and in the latter the indications of lateral ribs are obscure, probably in part on account of the crushing of the shell, whereas in the former they are very strong and definite.

With regard to its generic position, a careful comparison of our specimens with the figures given by Hall[2] of his group *Camarotœchia* shows that in all points of structure it falls well within its limits.

It is not impossible that this may be the same shell as *Spirifera rudis*, Phillips. His types appear to be lost, and he gives practically no description. His three figures are so "rude" that they may be regarded as unidentifiable, but one of them is very like a dorsal valve of this species. Probably, if our shells were trimmed down, fragmentary specimens could be produced which would agree with all three of his drawings, though possibly the same effect might be produced by trimming other shells in a similar manner. At all events Phillips's species is too ambiguous for any identification with it to be safe.

I have examined the type of *Rh. subdentata*, Sowerby,[3] in the Woodwardian

[1] By a clerical error this word was printed *Camarella* in my list.

[2] 1894, Hall and Clarke, 'Pal. N. Y.,' vol. viii, pt. 2, pl. lvii, figs. 15—32, 49.

[3] 1840, Sowerby, 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. liv, fig. 7.

Museum. It evidently belongs to the same species as the specimen which Phillips[1] refers to it, but which Davidson[2] unites with *Rh. reniformis*, Sowerby, only differing from it by the possession of a low arching fold. On the other hand, the second Devonian specimen figured as *Rh. reniformis* by Davidson[3] appears more likely to belong to *Rh. Phillipsii*, Davidson.[4] From the present form all these specimens differ by their wide and nearly straight hinge-lines, and by the character of their folds. Whether, therefore, *Rh. subdentata* be a synonym of *Rh. reniformis* or not, it is certain that the present species is distinct from both.

3. Rhynchonella laticosta, *Phillips*, sp. Plate XX, figs. 3, 3 *a*, 4.

1841. Terebratula laticosta, *Phillips*. Pal. Foss., p. 85, pl. xxxiv, fig. 153.
1865. Rhynchonella laticosta, *Davidson*. Brit. Foss. Brach., vol. iii, p. 61, pl. xiv, figs. 1—3.

Locality.—It occurs abundantly in a bed about 1 foot thick, which is exposed in a small cave under the cliff near the wall that bounds the south side of Baggy promontory. It is represented in the various collections by specimens which are always defective and contorted.

Size.—A specimen measures 40 mm. wide.

Remarks.—Of this handsome and distinct species I have unfortunately been unable to obtain any specimens that will yield a satisfactory figure. Its beak appears to be prominent and only moderately incurved, and to have long dental plates. The fold and sinus seem low, rounded, and not strongly defined, with five or six ribs on the former, and four or five in the latter. The ribs are strong, and reach quite to the umbo, but appear rounded and not much elevated. In the dorsal valve is a median septum reaching about halfway forwards. The margins of the valves are rounded in.

Affinities.—It appears widely different from our other Devonian species.

Rh. Pengelliana, Davidson,[5] from Looe, is still larger, and has more ribs on the fold. The Carboniferous *Rh.? Carringtoniana*, Davidson,[6] has feebler and more numerous ribs.

[1] 1841, Phillips, 'Pal. Foss.,' p. 90, pl. xxxv, fig. 164.
[2] 1865, Davidson, 'Brit. Foss. Brach.,' vol. iii, p. 62, pl. xiii, fig. 7.
[3] Ibid., fig. 6.
[4] 1882, Davidson, ibid., vol. v, p. 43, pl. ii, fig. 14.
[5] 1865, Davidson, ibid., vol. iii, p. 61, pl. xii, figs. 8, 9.
[6] 1863, ibid., vol. ii, pt. 5, p. 227, pl. xxiii, fig. 22; and pl. liii, figs. 1, 2.

IV. *Family*—Strophomenidæ, *King*, 1846.

1. *Genus*—Orthis, *Dalman*, 1828.

1. Orthis interlineata, *Sowerby*. Plate XX, figs. 6, 7.

1840. Orthis interlineata, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. liii, fig. 11; and pl. liv, fig. 14.
1840. — plicata, *Sowerby*. Ibid., pl. liii, fig. 10.
1841. — interlineata, *Phillips* (pars). Pal. Foss., p. 63, pl. xxvi, figs. 106 *a*, *b* (only).
1841. — parallela, *Phillips*. Ibid., p. 64, pl. xxvi, fig. 109 *a*—*d*.
1865. — interlineata, *Davidson*. Brit. Foss. Brach., vol. iii, p. 91, pl. xvii, figs. 18—23.

Localities.—This shell is common and wide-spread. It occurs at Top Orchard, Bradiford, Kingdon's Shirwell, Upcott, Braunton, Pilton, Wrafton Lane, Saunton Point, Frankmarsh, Ashhill Quarry, Croyde, Petherwyn, and Landlake.

Size.—Height 12 mm., width 16 mm.

Remarks.—The types of *O. interlineata* and *O. plicata*, Sowerby, which are in the museum of the Geological Society, evidently belong to the same species. Davidson also reunites with it *Orthis parallela*, Phillips, which Phillips had separated from it. *Orthis orbicularis*, var., Murchison [1] (which Davidson seems to refer to in his description of this species), does not seem distinguishable from it. Murchison, himself, regarded his shell as distinct from the *Orthis orbicularis* [2] of the Silurian System, which is united to *O. lunata*, Sowerby,[3] by Davidson.

2. Orthis, sp. Plate XX, figs. 8, 8 *a*, 9.

1841. Orthis interlineata, *Phillips* (pars). Pal. Foss., p. 63, pl. xxvi, figs. 106 *c*, *d* (only).
? 1841. — plicata, *Phillips* (not *Sowerby*) (pars). Ibid., p. 64, pl. xxvi, fig. 108 *e* (only).

Description.—Shell minute, flat. Umbo elevated, prominent, rounded. Hinge-line much shorter than the width of the shell. Lateral margins semicircular.

[1] 1840, Murchison, 'Bull. Soc. Géol. Fr.,' vol. xi, p. 255, pl. ii, figs. 8 *a*—*c*.
[2] 1839, Sowerby, in Murchison, 'Sil. Syst.,' p. 611, pl. v, fig. 16.
[3] Ibid., p. 611, pl. v, fig. 15.

Front margin gently convex. Valve with a median depression. Surface covered with about twenty strong, distant, alternating ribs, which have the appearance of being microscopically lineated and granulated.

Size.—Height 4 mm., width 5 mm.

Localities.—Two or three specimens are on a slab from Saunton in Miss Partridge's Collection, and its reverse in the Porter Collection. I have, I believe, observed two or three better specimens of this tiny shell, but, failing to take note of them at the time, am now unable to find them.

Remarks.—Phillips figured a specimen which is almost identical with ours, both in size, shape, and ornament. This he referred to *O. interlineata*, but it seems to me questionable if our shell be the young of that species, as it seems distinguished not only by the fewness of its ribs, but by the size of its umbo and by several other points. We have not, however, sufficient evidence to enable us to arrive at its true character.

2. *Genus*—Orthotetes,[1] *Fischer de Waldheim*, 1830.

1. Orthotetes crenistria (*Phillips*), var. arachnoidea, *Phillips*. Plate XX, figs. 10, 11.

1836. Spirifer arachnoideus, *Phillips*. Geol. Yorks., vol. ii, p. 220, pl. xi, fig. 4.
? 1841. Orthis semicircularis, *Phillips*. Pal. Foss., p. 65, pl. lviii, fig. 112*.
1865. Streptorhynchus crenistria et var. arachnoideus, *Davidson*. Brit. Foss. Brach., vol. iii, pt. 5, p. 81, pl. xviii, figs. 4, 7.
1896. Orthotetes crenistria, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

[1] I have to thank Professor Rupert Jones for the trouble he has taken in deciding the orthography of this name. It was originated in 1829 by Fischer de Waldheim (not by Evans) ('Bull. Imp. Soc. Nat. Moscou,' p. 375) for a shell found by Mr. Evans at Pakhrino, which he (*i. e.* Fischer) believed to be of a new genus, and named *Orthotetes*, deriving it from ὀρθωτής (*i. e.* ὀρθότης), "straightness," because "at the hinge is a transverse impression straight and linear." In 1837 ('Oryct. Gouv. Moscou,' p. 133) he repeats the same spelling and derivation, and figures the shell. In 1850 ('Bull. Imp. Soc. Nat. Moscou,' p. 491) he describes and figures it under the same name, and distinguishes it from *Orthis*.

Professor Rupert Jones writes, "Orthotetes was made wilfully from ὀρθωτής, and, though irregular, must be accepted as an intended name." Bronn and Davidson wrote it thus; but later authors, *e. g.* Zittel, Œhlert (deriving it from ὀρθός), and Hall, changed it to *Orthothetes*. *Orthothetes* might be derived from ὀρθός and θέτης, but that would mean "the adoptive father of straight things" (or ? of an *Orthis*), and would be (even on evolutionary principles) hardly an improvement on Fischer's original malformed word. If altered at all it should have been changed to *Orthotes*.

Localities.—Croyde Bay, Saunton Point, Saunton Hotel, Ashford Strand, Upcott Arch Quarry, Bradiford, Poleshill, Kingdon's Shirwell, Paper Mills Ilfracombe Road, Goodleigh, Top Orchard, Pouch Bridge, Rock Inn Quarry near Wiveliscombe, Petherwyn. Only moderately common.

Size.—One specimen is more than 50 mm. long and wide.

Remarks.—Davidson considers that our Pilton fossils show no difference from the Carboniferous species, *O. crenistria*. It is to be observed, however, that in the typical form of this species three or four smaller ribs often occur between two of the larger, whereas in our specimens the larger and smaller ribs always alternate regularly. Our ventral valves, moreover, appear to be usually flat rather than concave. Hence they appear to fall within the variety *arachnoidea* as given by Davidson, who indeed seems to refer them to that form.

A comparison of our shells with Lummaton specimens of *O. umbraculum* seems to show that the distinction made between them by Davidson can most probably be sustained. While both species are very variable, their ornament seems to differ in character, the ribs of *O. umbraculum* being relatively closer and sometimes differently grouped, while the transverse threads in *O. crenistria* are stronger. I have not, however, seen any Lummaton specimens with the surface sufficiently well preserved to show the minute ornament which Davidson describes as characterising Eifel specimens of that species.

Davidson[1] regards *Orthotetes pecten*, Linné, sp., as closely resembling in size and striation some shapes of *O. umbraculum*. These two certainly seem more like each other that they are to *O. crenistria*.

Œhlert,[2] in a lucid and elaborate dissertation on *O. hipponyx*, Schnur, sp.,[3] refers that shell to the Lower Devonian, *O. umbraculum* to the Middle Devonian, *O. crenistria*, var. *devonica*, Keyserling, sp.,[4] to the Upper Devonian, and *O. crenistria* to the Carboniferous, as cognate forms. From his description, however, Keyserling's shell does not seem to agree with the Pilton form. Davidson states that it has been sometimes referred to *O. crenistria*, var. *senilis*.[5]

The Pilton shell is in itself very variable in the number and strength of its ribs. A very large variety occasionally occurs (Pl. XX, fig. 10) in which they are very much finer and more numerous than usual (being sometimes more than 200), and in which the ventral valve is definitely concave. This multiplication of ribs may be partly but not entirely due to age. It is interesting to

[1] 1865, Davidson, 'Brit. Foss. Brach.,' vol. iii, p. 78; and 1871, ibid., pt. 7, p. 306.

[2] 1897, Œhlert, 'Bull. Soc. Géol. Fr.,' ser. 3, vol. xxiv, p. 856, pl. xxvii, figs. 12—16.

[3] 1851, Schnur, 'Progr. d. h. Bugersch.,' p. 4.

[4] 1846, Keyserling, "Reise Petschora-Land, Geol. Beobacht.," p. 221, pl. vii, figs. 7—7 *c*.

[5] 1865, Davidson, 'Brit. Foss. Brach.,' vol. iii, p. 80.

compare this form with Œhlert's figures of *O. hipponyx*, which lies between it and *O. umbraculum*.

3. *Genus*—Strophomena, *de Blainville*, 1825.

1. Strophomena rhomboidalis, *Wilckens*, sp. Plate XX, fig. 5.

1865. Strophomena rhomboidalis, var. analoga, *Davidson*. Brit. Foss. Brach., vol. iii, p. 76, pl. xv, figs. 15—17.
1884. — — *Davidson*. Ibid., vol. v, p. 467.
1893. — — var. analoga, *Whidborne*. Dev. Fauna, vol. ii, p. 149.

Localities.—This is a moderately common shell in the Pilton Beds, and is represented in most museums. Among the localities are Top Orchard, Pilton, Braunton, Goodleigh Road, Croyde, Poleshill, Pottington, Fremington, Upcott Arch Quarry, Wrafton Lane. It is also found in the Ilfracombe Beds.

Remarks.—Our specimens are often excellently preserved, and include the interiors of both valves as well as the exterior. I can see nothing to distinguish them as a variety; if anything, they are more like the Silurian than the Carboniferous shells. Davidson, in fact, adopted for the typical Silurian form the description he had before given for his Carboniferous variety, and he ultimately dropped the varietal name *analoga* from the Devonian and Carboniferous shells. Our North Devon specimens certainly support this view.

V. *Family*—Productidæ, *King*, 1846.

1. *Genus*—Productus, *Sowerby*, 1812.

1. Productus prælongus, *Sowerby*, sp. Plate XX, figs. 12, 12 *a*, 13, 13 *a*.

1840. Leptæna prælonga, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. liii, fig. 29.
1855. Producta prælonga, *M'Coy*. Brit. Pal. Foss., p. 390.
1865. Productus prælongus, *Davidson*. Brit. Foss. Brach., vol. iii, p. 102, pl. xix, figs. 22—25.

Description.—Ventral valve very elongate, suboval, evenly convex. Hinge-line nearly, if not quite, as long as the width of the shell. Umbo extremely large, extending very greatly beyond the hinge, and recurved upon it so that its apex is in its close proximity. Surface with a very narrow, shallow, irregular,

sinus from the level of the hinge-line to the margin, bearing a longitudinal row of four or five very large spines. Cast ornamented with very numerous, reticulating, longitudinal threads, which show a tendency to group themselves into more or less incipient ribs. Wings with a few coarse tubercles (spines) near the corners.

Dorsal valve transverse, geniculated, with a minute umbo; having (as seen from within) a large elevated triangular ridge down the centre, and seven or eight smaller broken ridges on each side, which increase in size as they cross the flat part of the shell, and extend to the margins; the whole nodulated by rugose transverse undulations, which are minute near the umbo, but soon become very coarse. Ears convex, prominent, marked only with transverse ridges.

Size.—About 35 mm. long and wide.

Localities.—Croyde, Braunton, Saunton, Top Orchard, Kingdon's Shirwell, Ashford Strand, Upcott Arch Quarry, Wrafton Lane, Rock Inn Quarry, Pouch Bridge. It is very abundant, generally gregarious; but it seems local, probably being confined to limited beds, which in the disturbed condition of the Pilton Series it is not easy definitely to trace.

Remarks.—The external surface of this shell does not appear to be known. The ventral valve occurs in a state that shows a coarse ramifying fibrous texture, which has the appearance of having originally been covered by an additional layer of shell. This valve is remarkable for the incipient central keel in the midst of a rather definite shallow groove or sinus, which bears a row of very large and probably long, cylindrical, or slightly clavate spines. There are also a few coarse spines on the ears. The ribs are rounded and more or less indistinct, and there seem no signs of spines upon them.

The dorsal valve is so dissimilar from the ventral valve in shape and markings that it was regarded by my friend Mr. Townshend Hall as a distinct species; but Sowerby's type, which is in the Woodwardian Museum, preserves both valves in contact, as pointed out by M'Coy, and thus proves their true relationship. On account of its geniculate form it is always its inner face which is exposed, and I have therefore described it from that point of view. If it were seen from the outside its characters would probably be almost exactly reversed.

2. Productus prælongus, *Sowerby?* var. simplicior, n. var. Plate XX, figs. 14, 14 *a*, 15, 15 *a*.

1865. Productus longispinus?, *Davidson.* Brit. Foss. Brach., vol. iii, p. 103, pl. xx, fig. 7.

1896. — — *Whidborne.* Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Ventral valve usually rather small, elongate, gibbose, but flattened on the marginal half of the centre of the valve. Umbo more or less elevated, recurved upon the hinge. Hinge-line shorter than the width of the shell. Surface having (1) from fifteen to twenty-five rather irregular, rounded rays, rising some distance in front of the umbo, and bearing some large, long spines, which tend to arrange themselves in transverse rows; (2) exceedingly minute fibrous markings; and (3) a few irregular transverse undulations on the wings and umbonal parts.

Size.—An unusually large specimen measures 33 mm. long, 20 mm. wide, and 10 mm. deep; its umbo extends about 8 mm. behind the hinge-line.

Localities.—In the Woodwardian Museum are eight specimens from Croyde and three from Top Orchard; in the Museum of Practical Geology one from Braunton; in the Porter Collection five from Pilton and one from Poleshill; and in the Barnstaple Athenæum a slab containing specimens mentioned and figured by Davidson as "*P. longispinus*, Sowerby?"

Remarks.—The specimens in the Barnstaple Athenæum, which Davidson referred somewhat doubtfully to *P. longispinus*, are very imperfect and indistinct; but they are evidently identical with the other specimens mentioned above, which are most of them in a better state of preservation, and afford clear proof that they do not belong to the same species as Sowerby's Carboniferous *P. longispinus*. They have much stronger and fewer ribs, and none of them show any signs whatever of an angular median sinus.

From the typical form of *P. prælongus* they usually differ by (1) their smaller size; (2) the absence of a sinus bearing a vertical row of very long spines; (3) the presence of spines on other parts of the body, which are often arranged in concentric rows; and (4) their very much more definite and regular ribs.

On the other hand, these points of difference are not constant. One or two of the specimens show a distinct tendency to a slight median groove or concavity, and have median spines arranged longitudinally. It appears to me that it will therefore be best to regard them as a variety of *P. prælongus*, as it may prove to be only an immature or stunted form of that shell.

3. Productus scabriculus, *Martin*, sp. Plate XX, figs. 16—18, and Plate XXI, fig. 12.

1809. Anomites scabriculus, *Martin*. Petrif. Derb., p. 8, pl. xxxvi, fig. 5.

1841. Leptæna scabricula, *Phillips*. Pal. Foss., p. 58, pl. xxiv, figs. 97 *a*, *b*.

1861.	Productus scabriculus,	*Davidson.*		Brit. Foss. Brach., vol. ii, pt. 5, p. 169, pl. xliii, figs. 5—8.
1865.	—	—	—	Ibid., vol. iii, p. 103, pl. xx, figs. 3 (?), 4—6.

Description.—Ventral valve convex, gibbose, transverse or occasionally slightly elongate. Umbo flattened, moderately elevated, recurved over the hinge-line. Sinus low, broad, undefined. Surface marked on the umbo and wings with coarse concentric ridges, which vanish in front; and also covered by about fifty coarse, close, rounded, irregularly alternating and occasionally discontinuous ribs, occasionally carrying spines (which in some specimens appear to be set forward and in others backwards). Wings with a few large spines in their corners.

Dorsal valve strongly geniculated, marked on the flat portion with coarse, rounded, divaricating ribs, which are crossed and nodulated by closer concentric ridges; these ribs alone being continued over the elbow, in front of which they are very irregular.

Size.—About 28 mm. long by 34 mm. wide.

Localities.—In the Woodwardian Museum is a ventral valve from Croyde and two dorsal valves. In the Porter Collection is a ventral valve from Smoking House Lane, and two from Pilton, and eight dorsal valves from Pilton, Roborough, and Poleshill.

Remarks.—I have been unable to recognise the Devonshire examples which Phillips and Davidson figured. Their figures of the dorsal valves with their corded ornament and internal markings are clear. Phillips's figure of the ventral valve is certainly very vague in itself, but in conjunction with his description it may be taken to represent a small specimen of this species. Davidson's figure is covered with spines, and it appears very difficult indeed to distinguish it from some of the figures which he gives of *Strophalosia productoides*, while in a slab in the Davidson Collection labelled by him "*St. productoides* and *P. scabriculus*" I have been able to discover only specimens of the former species.

At the same time some ventral valves have been found, which, though generally distorted, appear to present all the characters of this species. Having compared them with numerous Carboniferous specimens, and especially with those in the Bristol Museum, to which Phillips himself likened his Pilton specimens, I see no reason for hesitating to refer them to this Carboniferous form. These specimens correspond, moreover, with a number of dorsal valves from the Pilton beds, of some of which there can be no doubt that they belong to *P. scabriculus*, though it is difficult to be certain whether others can be distinguished from *Str. productoides*.

4. Productus interruptus, *Sowerby*, sp. ? Plate XXII, figs. 1—3.

? 1840. Leptæna interrupta, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. lvi, fig. 7.
? 1841. — n. sp. ? *Phillips*. Pal. Foss., p. 229, pl. lviii, fig. 98.
? 1844. Producta interrupta, *M'Coy*. Synops. Carb. Foss. Irel., p. 110.
? 1865. Productus, sp., *Davidson*. Brit. Foss. Brach., vol. iii, p. 103, pl. xx, fig. 8.

Description.—Ventral valve small, very gibbose, approximately hemispherical. Umbo small, flattened, not prominent, incurving to the hinge-line. Ears apparently small. Ribs numerous, low, rounded, more or less distinct, occasionally divaricating, much interrupted in the umbonal region by a number of deep irregular concentric grooves (which are bounded by ridges) and crossed, especially in the marginal parts, by very numerous, regular, minute, impressed threads. Dorsal valve apparently concave, following the contour of the ventral valve, indistinctly ribbed, and transversely ridged or wrinkled throughout.

Size.—Length 13 mm., width 11 mm.

Localities.—Six slabs (three of which are from Fremington) containing several specimens are in the Porter Collection. Two specimens from Ashford Strand, one from Fremington and one from Newport near Barnstaple, are in Mr. E. F. G. Bryan's Collection.

Remarks.—This small species has the appearance of being very distinct, but our specimens are all more or less imperfect and in poor condition. The shell seems to be papyraceous. The strong irregular grooves, followed by blunt ridges, which are chiefly seen in the central portions of the shell, break up the ribs into short series in a manner which presents great likeness to *P. fimbriatus*, Martin,[1] so that it is not impossible that it may prove to be an extreme variety of that species. At the same time in our shells these grooves seem much narrower, so as to cause less extensive interruption to the ribs, and at least in the ventral valve they are only seen in the posterior part of the shell, the ribs being continuous for the marginal half of their length. The umbo, moreover, seems much smaller and depressed, and no spines are now visible upon the ribs. It is probable, therefore, that they are distinct.

Leptæna interrupta, Sowerby, is a shell from the Limestone of Plymouth. Its type is in the Museum of the Geological Society. It was said by Davidson to "appear exceedingly like a small example of the Carboniferous *P. fimbriatus*, Sowerby, or *P. laxispinus* (*i. e. P. laciniatus ?*), M'Coy, which may have got accidentally mixed up among Rev. W. Y. Hennah's Plymouth specimens." Its only

[1] 1861, Davidson, 'Brit. Foss. Brach.,' vol. ii, pt. 5, p. 171, pl. xxxiii, figs. 12—15; and pl. xliv, fig. 15.

difference, however, from our specimens is that the ribs may be rather more numerous, and that the interruptions extend to the marginal parts; and it appears to me most probable that they both belong to the same species, and therefore that Mr. Hennah's specimen is a Devonian fossil.

The figure of *Producta laciniata*, M'Coy,[1] from the Middle Carboniferous of Ireland, which is very like the figure given by Sowerby of his species, but has much finer and more spinous ribs, is regarded by Davidson as possibly a variety of *P. fimbriatus*, though separated from it by M'Coy.

5. Productus corrugatus, *M'Coy*. Plate XXI, figs. 4, 5.

1844. Producta corrugata, *M'Coy*. Synops. Carb. Foss. Ireland, p. 107, pl. xx, fig. 13.
1845. Productus tenuistriatus, *Verneuil*. Pal. Russia, vol. ii, p. 266, pl. xvi, fig. 6.
1855. Producta corrugata, *M'Coy*. Brit. Pal. Foss., p. 459.
1861. Productus cora, *Davidson* (? not *d'Orbigny*). Brit. Foss. Brach., vol. ii, pt. 5, p. 148, pl. xxxvi, fig. 4; and pl. xlii, fig. 9.
1896. — tenuistriatus, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Ventral valve large, subglobose, rounded or perhaps sometimes slightly depressed along the centre of the back. Ears small and undefined. Beak wide, convex, incurved, overhanging the hinge-line, and having a few strong foldings or rounded wrinklings on its sides and on the ears. Ribs extremely numerous, minute, rounded, irregularly flexuous, sometimes alternating, divided by similar furrows, and very occasionally bearing minute spines; remaining of a uniform size over the whole valve, and sometimes splitting into two or three and again reuniting. Surface crossed by close, regular, microscopic transverse striæ.

Localities.—In the Porter Collection are nine or ten specimens from Fremington and one from Kingdon's Shirwell; in Miss Partridge's Collection is one from Fremington.

Size.—The specimens are all crushed or imperfect; one is 38 mm. long by 25 mm. wide; others were evidently larger.

Remarks.—Our shells are rounded or perhaps sometimes flattened on the back, but I have not seen anything in them that amounts to a sinus. The ribs, though always minute, seem to vary in size and number in different specimens, as also do their flexuosity and their habit of division and reunion, which are some-

[1] 1844, M'Coy, 'Synops. Carb. Foss. Irel.,' p. 110, pl. xx, fig. 12.

times excessive. Davidson's figures show still finer and more numerous ribs than do our shells.

Our shells are so exceedingly like M'Coy's *P. corrugatus* from the Yellow Sandstone and Carboniferous Limestone of Ireland as to be certainly identical with it; for, though M'Coy says it had no spines, his figure seems to show indications of minute rare spines such as are evident in our specimens. Davidson, following de Koninck, who had examined d'Orbigny's types, united M'Coy's species with the South American *P. Cora*, d'Orbigny. On the other hand, d'Orbigny's original figure of *P. Cora*[1] looks totally different. Its spines are much coarser and more frequent, and it has a row of large hinge-spines. Waagen, who figures an Indian example which bears out at least the first two of these distinctions, sides with M'Coy in denying its identity with the English, Irish, and Belgian shell. He divides his section *Lineata* into two groups: (1) those with a sinus, as *P. Neffidievi*, Verneuil[2] (which Davidson united to *P. Cora*), and *P. lineatus*, Waagen;[3] and (2) those without a sinus, as *P. Cora*, d'Orbigny, and ? *P. semireticulatus*, Martin. Again, Tschernyschew distinguishes the Permio-Carboniferous *P. tenuistriatus*, Verneuil, from *P. corrugatus*, M'Coy (which M'Coy had united with it), by the irregularity of the fission and reunion of the ribs, and both these forms from *P. Cora*, d'Orbigny, by the absence of spines on the middle parts of the shell, and by the fineness of the ribs. But our Devonshire specimens are accurately identical with *P. tenuistriatus* in every respect, and in some of them the irregularity and flexuosity of the ribs and the paucity of the spines are fully as great as in the Russian shell which Tschernyschew figures, while in others the ribs seem as straight and the spines as imperceptible as described by M'Coy.

It seems, therefore, best to place our shells with *P. corrugatus* and *P. tenuistriatus*, which they prove to be mutually identical, and to leave the disputed question of the identity of *P. Cora*, d'Orbigny, in abeyance.

6. Productus, cf. P. subaculeatus, *Murchison*. Plate XXI, figs. 1—3.

Localities.—Two fragmentary specimens from Fremington and one from Pilton are in the Porter Collection. One from Saunton is in the Barnstaple Athenæum.

Size.—Width about 30 mm. Length of a spine more than 44 mm.

[1] 1842, d'Orbigny, 'Paléont. Voyage Amér. Mérid.,' p. 55, pl. v, figs. 8—10.

[2] 1845, Murchison, Verneuil, and Keyserling, 'Russia,' vol. ii, p. 259, pl. xviii, fig. 2.

[3] 1884, Waagen, 'Salt Range Brach.,' p. 673, pl. lxvi, figs. 1, 2; and pl. lxvii, fig. 3.

Remarks.—The above-named specimens, which are too imperfect to admit of specific determination, belong to some species of *Productus* which was covered by numerous, but not crowded, coarse and very long spines, arranged more or less regularly in transverse rows, and apparently most developed in the marginal parts; its umbo appears to be rather small and not very prominent; its ears are small, and bear a few very strong spines; its shape is gibbose and rather transverse; its ventral valve has a small sinus down the back; its dorsal valve is geniculated, and crossed in the flat portion by rather numerous corrugations.

To whatever species these shells belong, they appear to be distinct from the species described above. Their surface may perhaps have been something like *P. spinulosus*, Sowerby,[1] but they are distinguished from that shell by their sinus, their larger size, and the much greater length of their spines. Not one of the specimens is sufficiently good to enable us to ascertain its true shape or the details of its surface-ornament. It is probably related to or even a variety of *Productus* (or *Productella*) *subaculeatus*, Murchison,[2] but its spines seem more numerous than is usual in that species.

2. *Genus*—Strophalosia, *King*, 1844.

1. Strophalosia productoides, *Murchison*, sp. Plate XXI, figs. 6—11.

1840. Orthis productoides, *Murchison*. Bull. Soc. Géol. Fr., vol. xi, p. 254, pl. ii, figs. 7 *a*—*c*.
1840. Leptæna caperata, *Sowerby*. Geol. Trans., ser. 2, vol. v, p. 3, pl. liii, fig. 4.
1865. Strophalosia productoides, *Davidson* (pars). Brit. Foss. Brach., vol. iii, p. 97, pl. xix, figs. 13, 14 (only ?).
1871. — — *Kayser*. Zeitsch. Deutsch. Geol. Gesell., vol. xxiii, p. 638.

Localities.—Baggy Point, Laticosta Cave, Croyde, Saunton, Braunton, Poleshill, Ashford Strand, Frankmarsh, Top Orchard, Roborough, Ashhill Quarry, Pouch Bridge, South Petherwyn. It is abundant and often gregarious, but rather local, being probably confined to particular zones in the Pilton series.

Size.—A specimen measures about 50 mm. long by 55 mm. wide.

[1] 1861, Davidson, 'Brit. Foss. Brach.,' vol. ii, pt. 5, p. 175, pl. xxxiv, figs. 18—21; and 1880, ibid., vol. iv, p. 299, pl. xxxvi, fig. 11.

[2] 1865, Davidson, 'Brit. Foss. Brach.,' vol. iii, p. 99, pl. xx, figs. 1, 2; and 1882, ibid., vol. v, p. 54, pl. iii, fig. 22; and 1893, Whidborne, 'Dev. Fauna,' vol. ii, p. 154; see also p. 156, pl. xvii, fig. 12.

Remarks.—There is some difficulty in defining the specific limits of this abundant shell on account of its variability, and the likeness of some of its shapes to species of *Productus*.

Its typical form has nearly circular margins and fairly numerous small spinous markings; it is well represented by Murchison's original figure, and by those of Sowerby's *Leptæna caperata*. Specimens which are rather more transverse than this, and have rather more numerous spinous markings, occur commonly at Pilton (Pl. XXI, fig. 10). In another variety the thorn-like spinous markings are replaced by strong and more or less continuous ribs, and the transverse wrinkles are confined to the posterior half (Pl. XXI, fig. 8); these shells seem in their usual imperfect condition sometimes so similar to *P. scabriculus* that it is not easy to draw the line between them, but they appear distinguishable by their smaller umbones, their broad hinge-lines, and their long hinge-spines. Again, on the other side of the typical form we find one of the commonest variations presented by large elongate flattish shells, in which the umbones are very small, and the spinous markings are minute, short, multitudinous and quincuncially arranged (Pl. XXI, figs. 7, 9); in these the transverse wrinkles are very numerous and prominent, and sometimes produce with the spinous markings a zigzag appearance. At first sight this variety has a distinct appearance, but it is most probably only an aged or extreme form of the present shell. Lastly, in a few small shells we find the spinous markings very few, acicular, and confined to the more central parts of the shell, and the transverse ridges prominent and straight (Pl. XXI, fig. 11); these may be regarded as immature shells. While, however, the above variations may be noted, it must be added that they are not constant, as they are united by intermediate forms, and few shells are exactly alike. There seems, therefore, every reason to believe that they all belong to a single species.

The strong erect spines of the hinge of both valves sometimes reach a length of more than 10 mm. (Pl. XXI, fig. 9). Specimens occasionally occur in which the body-spines are seen to be elongate, crowded, and hair-like over the whole surface. A decayed specimen from Baggy retains them wherever the shell is not obliterated, both on the shoulders and the front portion of the valve (Pl. XXI, fig. 6). While the extreme elongation in shape of some specimens is largely due to contortion, it is probably not to be wholly accounted for by this cause.

Two other variations not occurring in the Barnstaple area must be noticed. At South Petherwyn the shells called by Phillips *Leptæna membranacea*,[1] but united by Davidson to this species, are common. These are small and flat; their spinous markings are very few and blunt, while their wrinkles are numerous, prominent, and zigzagged. All the specimens I have noticed are dorsal valves, but a ventral valve is figured by Davidson. Again, in the same beds occur equally

[1] 1841, Phillips, 'Pal. Foss.,' p. 60, pl. xxv, fig. 101.

small, rounded, ventral valves, with somewhat larger, scattered, blunt tubercles or spinous markings. These seem to have been referred by Phillips [1] to his *P. laxispina*,[2] but are included in this species by Davidson: *St. productoides*, Wenjukoff,[3] and *St. calvus*, Wenjukoff,[4] appear closely to correspond with them. It is remarkable that amid the numerous specimens from the Pilton Beds nothing like either of these two forms should have come under my notice, and I reserve for the present my opinion as to their specific identity.

3. *Genus*—Chonetes, *Fischer de Waldheim*, 1837.

1. Chonetes Hardrensis, *Phillips*, sp.? Plate XXII, fig. 4.

? 1841.	Orthis Hardrensis, *Phillips*.	Pal. Foss., p. 138, pl. lviii, figs. 104 *a*—*d*; and pl. lx, fig. 104*.
? 1855.	Leptæna (Chonetes) Hardrensis, *M'Coy*.	Brit. Pal. Foss., p. 454.
? 1861.	Chonetes Hardrensis, *Davidson*.	Brit. Foss. Brach., vol. ii, p. 186, pl. xlvii, figs. 12—18, 25?.
1865.	— — —	Ibid., vol. iii, p. 94, pl. xix, figs. 6—9.
? 1880.	— Laquessiana, *Davidson*.	Ibid., vol. iv, p. 312, pl. xxxiv, fig. 18.
1882.	— Hardrensis, *Davidson*.	Ibid., vol. v, p. 54, pl. iii, fig. 24.
? 1884.	— Laquessiana, *Davidson*.	Ibid., vol. v, p. 280, pl. xx, figs. 20—21 *a*.

Description.—Ventral valve small, moderately transverse, suboval. Hinge-line straight, as long as the width of the shell, bearing several obliquely-set spines. Umbo small, incurved, not extending above the hinge. Contour very gently convex. Front margin long, slightly convex. Side margins obliquely convex. Lateral angles rather less than right angles. Surface covered with very numerous, straight, divaricating rays, which are more or less nodulous. Dorsal valve concave; interior radially pitted.

Size.—Length 6 mm., width 9 mm.

Localities.—Top Orchard, Ashford Strand, Mainstone, Bradiford, Kingdon's Shirwell, Croyde, Laticosta Cave, Baggy, Upcott Arch Quarry, Wrafton Lane, Rock Hill Quarry, Ashhill Quarry.

[1] 1841, Phillips, 'Pal. Foss.,' p. 59, pl. xxv, fig. 99.

[2] 1861, Davidson, 'Brit. Foss. Brach.,' vol. ii, pt. 5, p. 166, pl. xxxiii, fig. 18 (under *P. aculeatus*).

[3] 1886, Wenjukoff, 'Faun. Dev. Syst. Russl.,' p. 45, pl. ii, figs. 5, 6.

[4] Ibid., p. 47, figs. 8—10.

Remarks.—This is undoubtedly the shell to which Davidson ultimately restricted the name *Ch. Hardrensis;* but its title to that name seems rather faulty.

Ch. Hardrensis, though described in Phillips's Devonian work, seems primarily to be a Carboniferous species, his two first and best figures being from Westleigh (Culm) and Yorkshire, though he also quotes it from Berry Pomeroy and Meadfoot. In 1852 M'Coy limited the name to the Carboniferous form, referring the Devonian shells to *Ch. sarcinulata* (Schlotheim). Davidson, in 1865, united under it both the Carboniferous and Devonian shells, quoting it as especially abundant from near Barnstaple, figuring "one of Phillips's original specimens" from North Devon, and uniting with it *Leptæna sordida*, Sowerby. In 1880, however, in deference to the opinion of de Koninck, he reluctantly separated the Carboniferous shell under the name *Ch. Laquessiana*, de Koninck, remarking at the same time that the Rev. W. Downes had found two good examples of *Ch. Laquessiana* at Westleigh, which is Phillips's first locality for his *Ch. Hardrensis*. In face of the latter fact, can Phillips's be superseded by a later name for the Carboniferous shell, if it is distinct from the Devonian form? But further, though possibly Davidson may have included more than one species among the numerous Carboniferous varieties which he records, some of them, including the typical Carboniferous shape, seem impossible to be distinguished from our Pilton shells (at all events in their present state of preservation). Lastly, it is also to be noted that the shell which in 1882 he figures from Hope's Nose seems also to coincide with them. On the whole it seems best to retain Phillips's name for these common Pilton shells, only remembering that, if the Carboniferous shell be ultimately proved distinct, it has a strong claim to retain the name *Hardrensis* for itself.

As seen in the Pilton Beds our species is very variable. Its diversity in shape is doubtless exaggerated by distortion, but its fine divaricating rays vary considerably in size and number, while they have a granular appearance, and sometimes show the characteristic arrangement of minute regular and close concentric striæ. The hinge-spines are only very imperfectly seen in any of our specimens, but the slight indications of them occasionally visible seem to have the same obliquity as in Phillips's type.

PLATE XVII.

LEPTODESMA, sp. (Page 121.)

FIG.

1. Specimen defective, but showing portions of the wings. Saunton Point (in a pebble). Hamling Collection.

AVICULOPECTEN NEXILIS, *Sowerby*, sp. (Page 129.)

2. Portion of the surface of a specimen, × 15. Laticosta Cave, Baggy. My Collection.
3. Slab, with moulds of the opposite valves, apparently of a single shell, × 3. Laticosta Cave, Baggy. My Collection.

PTERINOPECTEN SCABRIRADIANS, n. sp. (Page 135.)

4. Specimen of a right valve, showing ornament and anterior wing clearly, but defective below, × 3. Wrafton Lane. My Collection.

PERNOPECTEN INSPERATUS, n. sp. (Page 143.)

5. Specimen, showing the projecting wings, × $\frac{3}{2}$. Top Orchard. Barnstaple Athenæum.

PROTHYRIS, sp. (Page 144.)

6. Left valve, showing the anterior notch (which is fractured) and the radiating and transverse markings, × $\frac{3}{2}$. Sloly Quarry. My Collection.

RENSSELLÆRIA? FORMOSA, n. sp. (Page 145.)

7. Specimen, showing umbonal arrangements and texture, but so much distorted as to simulate *Leptæna laticosta* in shape, × $\frac{3}{2}$. 7 *a*. Portion of surface, × 40. Poleshill. Porter Collection.
8. Large specimen, showing the cast of the dental plates, &c., and the rounded shape of the ribs, × $\frac{3}{2}$. 8 *a*. Umbonal portion, × 3. Ashford Strand. My Collection.
9. Portion of the surface of a fragmental specimen, × 40, showing the pores and the shape of the ribs. Ashford Strand. My Collection.

ATHYRIS? sp. (Page 146.)

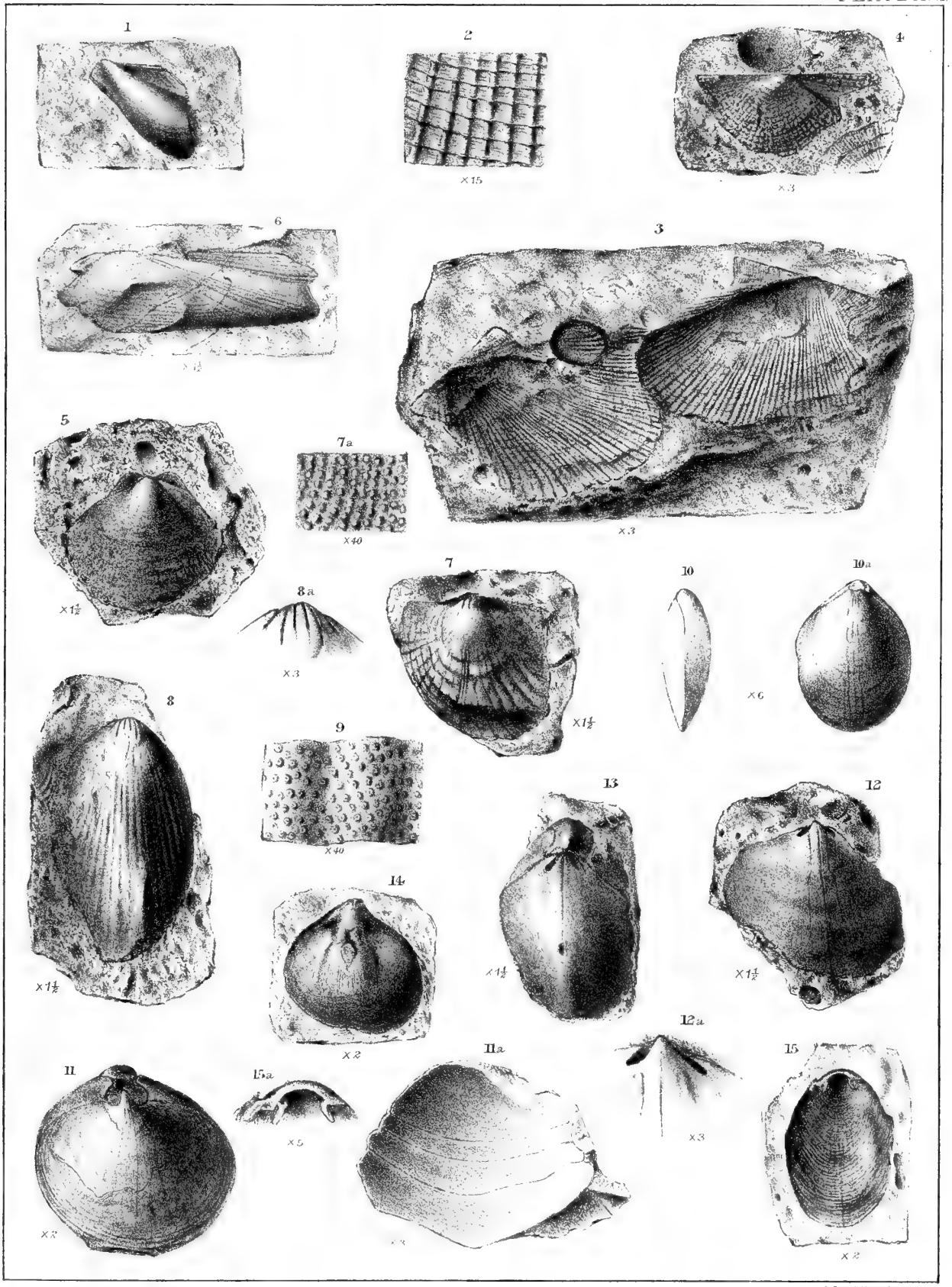
10, 10 *a*. Dorsal and lateral views of a minute undetermined species, × 6. Pilton. Porter Collection.

ATHYRIS (SEMINULA) OBLONGA, *Sowerby*, sp. (Page 147.)

11. Cast of the closed valves, showing the slight marginal fold and indications of the marks left by the vascular sinuses, × 2. 11 *a*. Portion of the mould of the same individual, showing its smooth surface, × 3. Ashford Strand. My Collection.
12. Cast of the dorsal valve of rather doubtful specimen, which has a stronger and wider fold than usual, × $\frac{3}{2}$. 12 *a*, umbonal part, × 3. Barnstaple. Woodwardian Museum.

ATHYRIS (CLEIOTHYRIS) ROYSSII, *Léveillé*, sp. (Page 148.)

13. Specimen figured by Davidson as *Terebratula elongata*, Schlotheim (?), but exactly corresponding with casts of this species, × $\frac{3}{2}$. Braunton. Museum of Practical Geology.
14. Cast of the ventral valve of a rather doubtful specimen, × 2. Roborough. Porter Collection.
15. Mould of the ventral valve of a small specimen, showing the surface and the beginnings of the crura, × 2. 15 *a*, Umbonal part, × 5. Pilton. Porter Collection.



Geo. West & Sons, lith. et imp.

PLATE XVIII.

ATHYRIS (CLEIOTHYRIS) ROYSSII, *Léveillé*, sp. (Page 148.)

FIG.

1. Dorsal view of the cast of a young specimen, showing the central septum and the muscle-scars, × 3. Croyde. Museum of Practical Geology.
2. Dorsal view of a similar specimen, showing the spire, × 3. 2 *a*, posterior view, showing the opening of the visceral canal, × 3. Croyde. Museum of Practical Geology.
3. Mould of another young specimen, showing the ornament, × 3. (*This figure is drawn out of the perpendicular.*) Poleshill. Porter Collection.
4. Mould of a large distorted specimen, showing the fold and the ornament, which becomes closer and more spiniferous near the margins, × 2. Pouch Bridge. Barnstaple Athenæum.
5. Distorted mould of another large specimen, with unusually numerous striæ, × 2. Pilton. Porter Collection.

SPECIES INDETER.

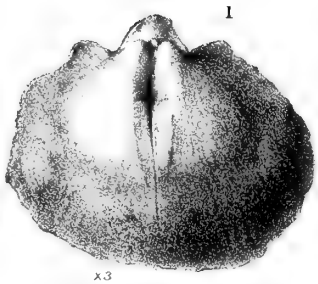
6. Cast of a ventral valve, showing muscular marks and signs of probable ribs, × 2. Poleshill. Porter Collection.

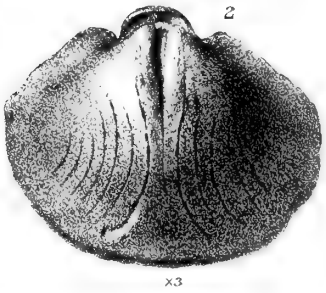
SPIRIFERA MICROGEMMA, *Phillips*. (Page 151.)

7. Cast taken from the mould of a valve, showing ornament, but distorted in the region of the sinus, × 2. 7 *a*. Portion, × 5. Pilton. Porter Collection.
8. A distorted dorsal valve, showing the fold, × $\frac{3}{2}$. Top Orchard. Barnstaple Athenæum.

SPIRIFERA VERNEUILII, *Murchison*. (Page 152.)

9. A crushed individual, showing the hinge, × $\frac{3}{2}$. Pilton. Porter Collection.
10. Portion of the cast of a specimen of the variety *Sp. Barumensis*, showing the spires.
11. Portion of the surface of a large specimen, showing the minor longitudinal ornament, × 10. Ashford Strand. Barnstaple Athenæum.
12. Portion of another specimen, in which the transverse ornament is strong and the minor longitudinal ornament invisible, × 10. Ashford Strand. Barnstaple Athenæum.
13. Ventral valve, seen from within, × $\frac{3}{2}$. 13 *a*, portion of surface, × 15, showing the arching lines of pores. Snapper Quarry. My Collection.


1
x3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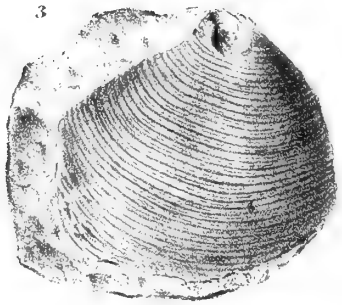
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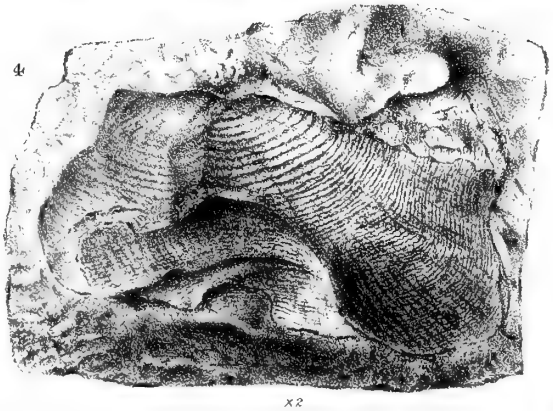
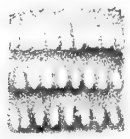
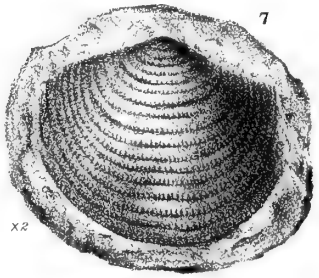
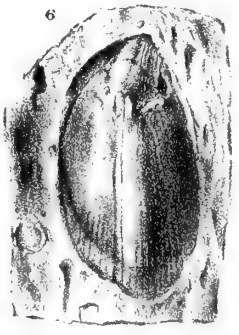
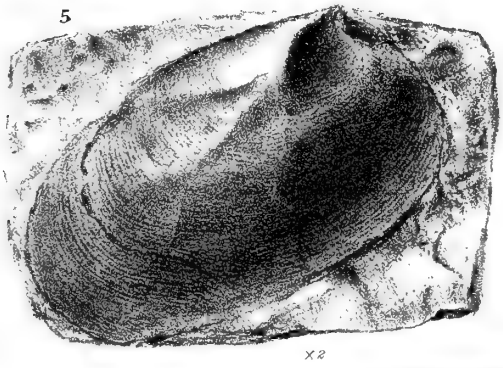

4
x2

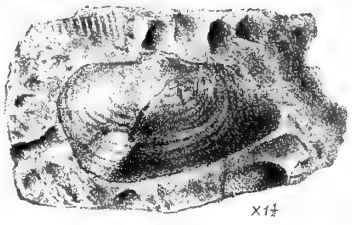

2a
x3

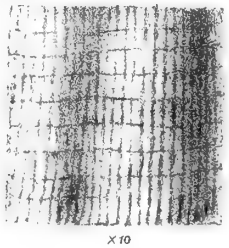

7a
x5

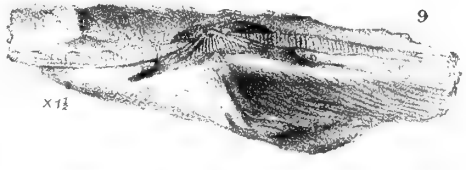

7
x2

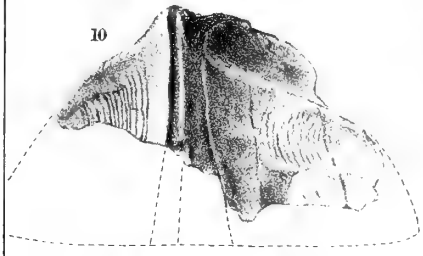

6
x2


5
x2


8
x1½


11
x10


9
x1½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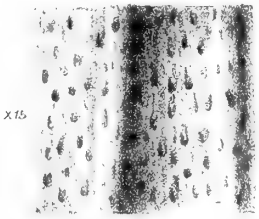
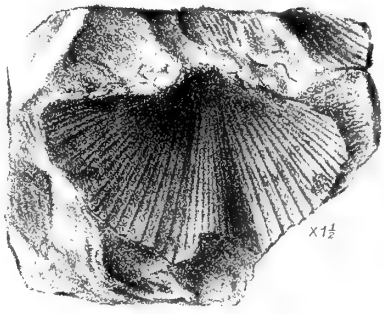

13a
x15


13
x1½

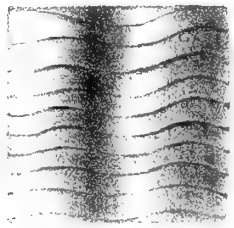

12
x10

PLATE XIX.

SPIRIFERA OBLITERATA, *Phillips*. (Page 156.)

FIG.

1. Phillips's type specimen, being a ventral valve, × ⅔. Brushford. Museum of Practical Geology.
2. Specimen of a dorsal valve, × ⅔. Top Orchard. Hamling Collection.
3. Another specimen with numerous ribs, × ⅔. Ashhill Quarry. My Collection.
4. A small specimen of the umbonal part of a dorsal valve, × 3. 4 *a*, umbo, × 6. Frankmarsh. My Collection.

SPIRIFERA URII, *Fleming*. (Page 157.)

5. An unusually large specimen of the ventral valve, × ⅔. Roborough. Porter Collection.
6. A ventral valve, apparently of a variety of this species, with an unusually small beak and a very deep angular sinus, × 2. Barnstaple. Woodwardian Museum.
7. A small specimen of the dorsal valve, × 3. Ashhill Quarry. My Collection.

SPIRIFERA MESOMALA, *Phillips*. (Page 158.)

8. A small defective ventral valve with well-preserved surface, showing the smooth median sinus, × 5. Saunton Hotel. My Collection.
9. A small and very badly preserved ventral valve, either of this species, or, more probably, of *Sp. Verneuilii*, × ⅔. 9 *a*, view of area. 9 *b*, side view. Sloly Quarry. Mr. Upfield Green's Collection.

SPIRIFERINA CRISTATA (*Schlotheim*), var. OCTOPLICATA, *Sowerby*. (Page 159.)

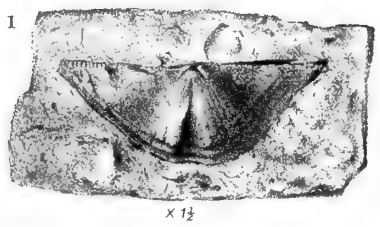
10. Specimen of a ventral valve, showing the plaited surface, × 3. Poleshill. Porter Collection.
11. A small ventral valve in the state of a cast, × 2. 11 *a*, portion, × 15, showing the puncta of the surface. Poleshill. Porter Collection.

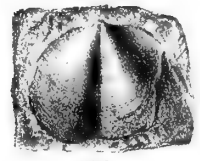
RHYNCHONELLA PARTRIDGIÆ, *Whidborne*. (Page 161.)

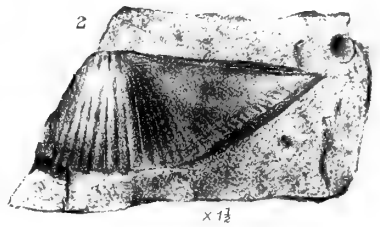
12. Cast of dorsal valve, showing the fold with four ribs, × ⅔. 12 *a*, umbonal portion, × 4, showing the hinge arrangement. Pilton. Porter Collection.
13. Ventral valve, showing the sinus with three ribs, the ridge bounding the muscular area, and the apical grooving of the ribs, × 2. Pilton. Porter Collection.
14. Another specimen, × ⅔. Roborough. Porter Collection.

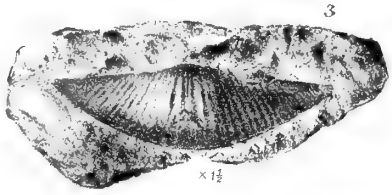
RHYNCHONELLA TOGATA, n. sp. (Page 163.)

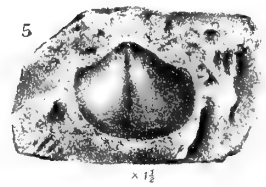
15. Ventral valve, showing the two ribs on the sinus, × ⅔. "North Devon." Museum of Practical Geology.
16. Another ventral valve, showing the coarse distant ribs and the muscular area. Marwood. Museum of Practical Geology.
17. Umbonal portion of another dorsal valve (which has three ribs on the fold). Pilton. Barnstaple Athenæum.
18. A very defective dorsal valve, with no indication of lateral ribs, × ⅔. Barnstaple. Museum of Practical Geology.

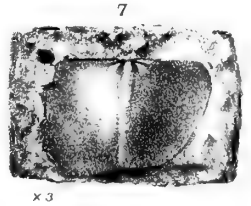

1
× 1½

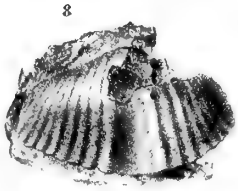

6
× 2

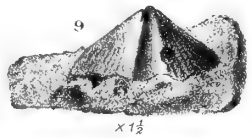

2
× 1½

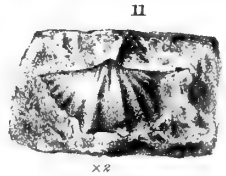

3
× 1½

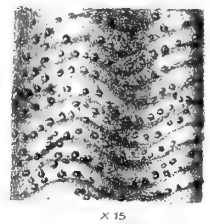

5
× 1½


7
× 3


8
× 5

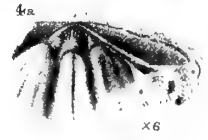

9
× 1½

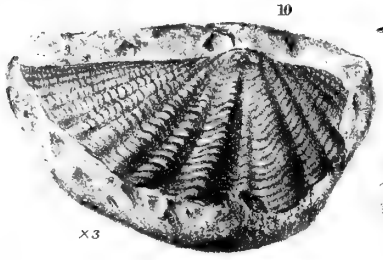

11
× 2

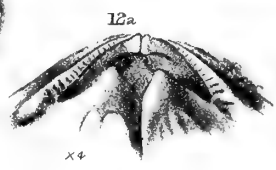

11a
× 15

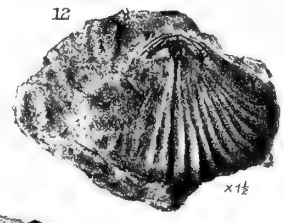

9a
× 1½


9b

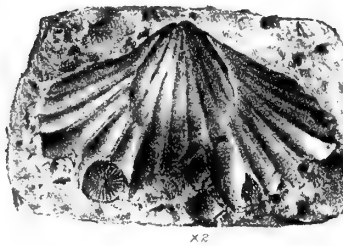

4a
× 6

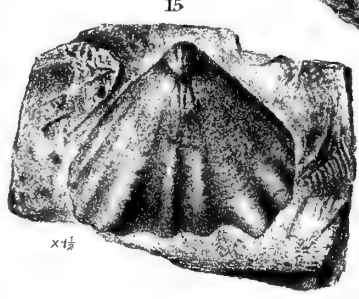

10
× 3

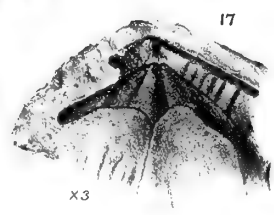

12a
× 4


12
× 1½

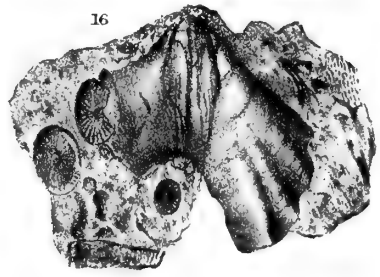

4
× 3


13
× 2


15
× 1½


17
× 3


14
× 1½


16


18

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PLATE XX.

ATHYRIS (CLEIOTHYRIS) ROYSSII, *Léveillé*, sp. (Page 148.)

FIG.

1. Portion of the mould of a specimen, showing the spines, × 8. Poleshill? Porter Collection.
2. Portion of the mould of another specimen, showing the transverse ridges and the commencement of the spines, × 8. Pilton. Porter Collection.

RHYNCHONELLA LATICOSTA, *Phillips*, sp. (Page 164.)

3. Large obliquely distorted specimen. 3 *a*. Another view. Laticosta Cave, Baggy. My Collection.
4. Cast of a smaller dorsal valve, showing the median septum. Laticosta Cave, Baggy. My Collection.

STROPHOMENA RHOMBOIDALIS, *Wilckens*, sp. (Page 168.)

5. Interior of a dorsal valve. Pilton. Porter Collection.

ORTHIS INTERLINEATA, *Sowerby*. (Page 165.)

6. Cast of a dorsal valve, × 2. Pilton. Porter Collection.
7. Cast of a ventral valve, × 2. Pilton. Porter Collection.

ORTHIS, sp. (Page 165.)

8. Specimen, drawn from a wax cast of a mould, × 6. 8 *a*, Portion of shell, × 30, showing markings, which may, however, be partly due to weathering. Saunton? Porter Collection.
9. Specimen, × 6. Saunton? Miss Partridge's Collection. (The slab on which this lies proves to be the reverse of the slab in the Porter Collection; it contains several small specimens, and the artist appears to have chosen the cast of the same shell as that in the last figure.)

ORTHOTETES CRENISTRIA (*Phillips*), var. ARACHNOIDEA, *Phillips*. (Page 166.)

10. Portion of a large variety, with very fine and numerous ribs, × 2. "Blagiford Paper Mills," Ilfracombe Road. Porter Collection.
11. Portion of another specimen, with few and coarse ribs, × 2. Saunton Down, south end of Croyde Bay. Hamling Collection.

PRODUCTUS PRÆLONGUS, *Sowerby*, sp. (Page 168.)

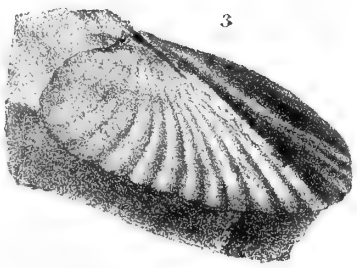
12. Dorsal valve, showing the median rib and the ears, × $\frac{3}{2}$. 12 *a*, side view, × $\frac{3}{2}$. Top Orchard, Barnstaple Athenæum.
13. Small ventral valve, showing the scars of spines in the sinus and on the ears, × 2. 13 *a*, side view, × 2. Pilton. Porter Collection.

PRODUCTUS PRÆLONGUS, var. SIMPLICIOR, n. var. (Page 169.)

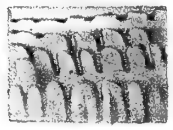
14. Specimen partially hid by matrix, showing the absence of a median sinus, and the presence of short scattered spines, × 2. 14 *a*, portion of shell enlarged. Poleshill. Porter Collection.
15. Another specimen, with smaller umbo, × 2. 15 *a*, side view, × 2. Barnstaple. Woodwardian Museum.

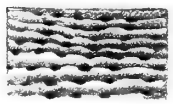
PRODUCTUS SCABRICULUS, *Martin*, sp. (Page 170.)

16. A transverse ventral valve, nat. size. Smoking House Lane. Porter Collection.
17. Another distorted specimen, with scars of spines on the ears. Woodwardian Museum.
18. Portion of mould of dorsal valve, × 10. Pilton. Porter Collection.

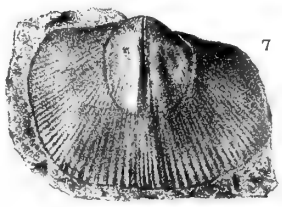

3

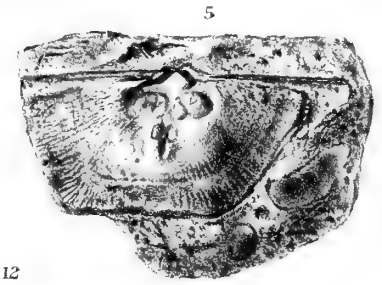

3a


1 X8


2 X8


4


7 X2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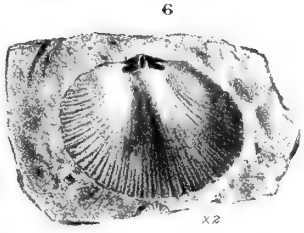
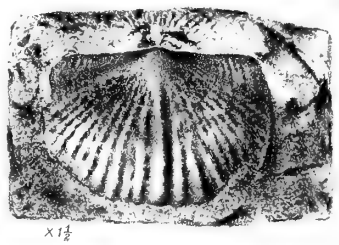
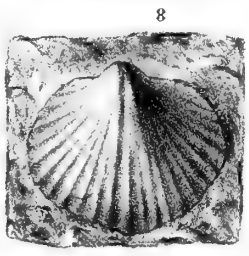
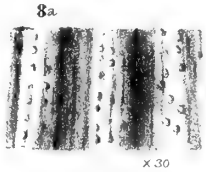
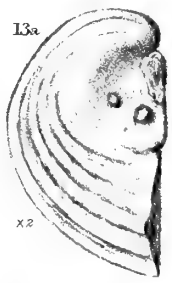

6 X2

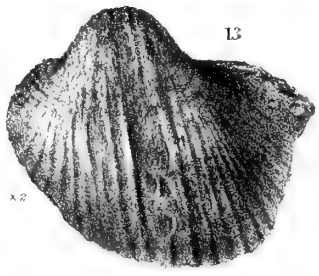

12a X1½


12 X1½


8 X6


8a X30


13a X2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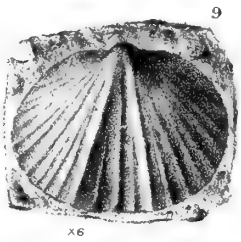
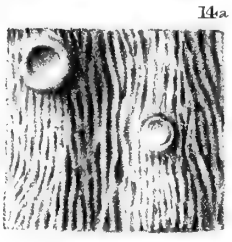
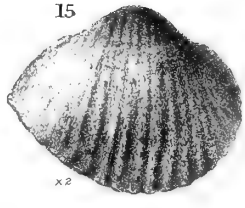

9 X6

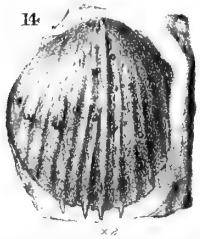

10 X2

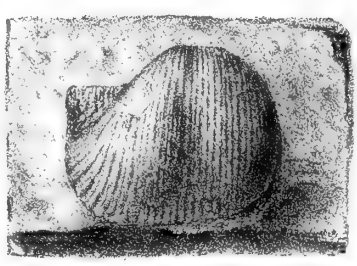

14a


15 X2

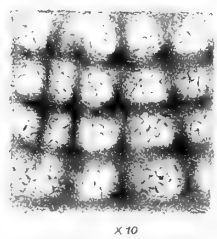

15a X2


11 X2


14 X2


16


17


18 X10

Geo. West & Sons lith et imp

PLATE XXI.

PRODUCTUS cf. P. SUBACULEATUS, *Murchison*. (Page 174.)

FIG.

1. Imperfect dorsal valve, with the casts of long spines of the ventral valve. Pilton. Porter Collection.
2. Fragment of the mould of a ventral valve, showing casts of long spines, × $\frac{3}{2}$. Fremington. Porter Collection.
3. Worn cast of a valve, showing the scars of spines in transverse rows, × $\frac{3}{2}$. Fremington. Porter Collection.

PRODUCTUS CORRUGATUS, *M'Coy*. (Page 173.)

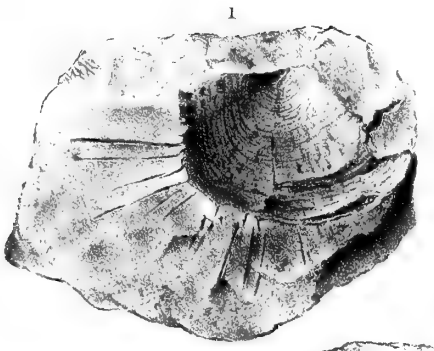
4. Oblique view of a worn specimen, with less flexuous ribs than usual. Fremington. Porter Collection.
5. Dorsal valve, most probably of this species, seen from within. Fremington. Porter Collection.

STROPHALOSIA PRODUCTOIDES, *Murchison*, sp. (Page 175.)

6. Posterior part of a decayed specimen, which is covered (wherever the surface is not totally obliterated) by crowded hair-like spines. Laticosta Cave, Baggy. My Collection.
7. Dorsal valve, showing hinge-area and hinge-spines; part of the centre being broken away, another specimen is disclosed, which shows the attachment of the spines, × $\frac{3}{2}$. 7 *a*. Portion of the latter specimen, × 8. Poleshill. Porter Collection.
8. Ventral valve, with very long ribs and hardly any signs of spines, except on the hinge. Poleshill. Porter Collection.
9. Specimen, showing the length of the hinge-spines, × $\frac{3}{2}$. Pilton. Porter Collection.
10. Transverse specimen, with short ribs, × $\frac{3}{2}$. Poleshill. Porter Collection.
11. Young specimen, with very few short ribs in the median parts, × 2. Poleshill. Porter Collection.

PRODUCTUS SCABRICULUS, *Martin*, sp. (Page 170.)

12. Large elongate dorsal valve, showing the hinge-area. Pilton. Porter Collection.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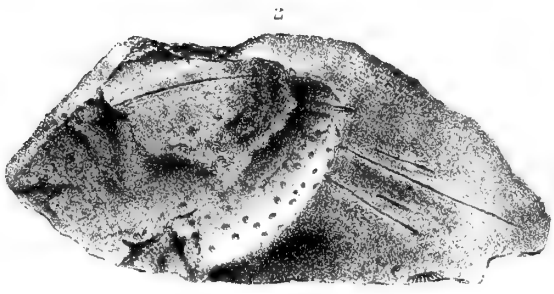
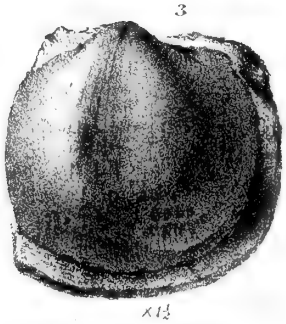

2

×1½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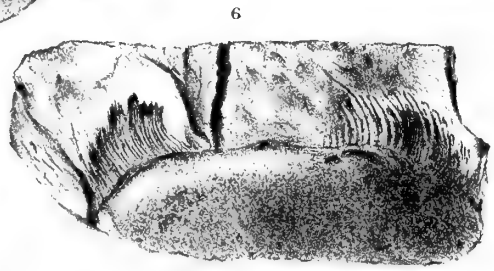
×1½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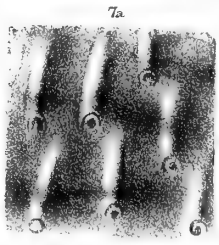
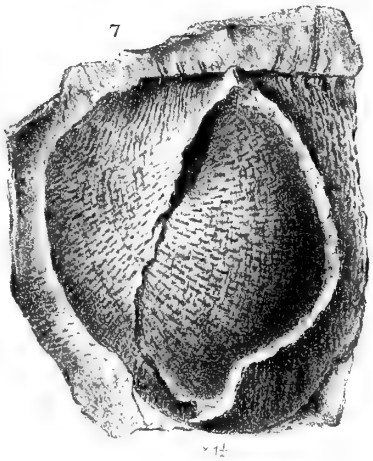

7a

×8


5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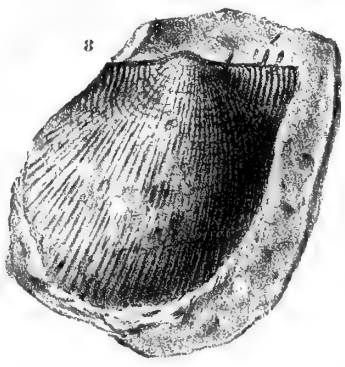
×1½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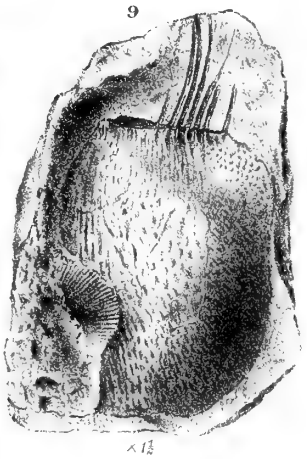
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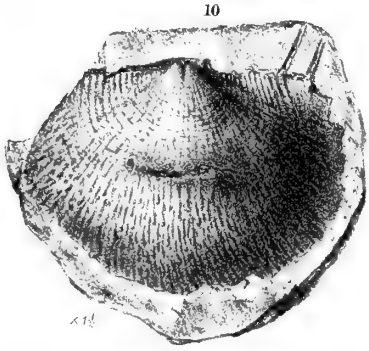
×1½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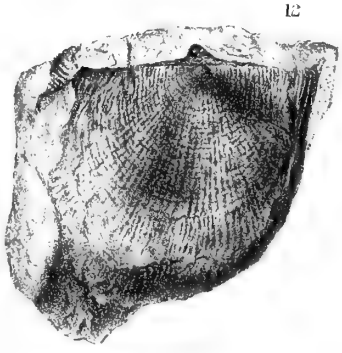
×1½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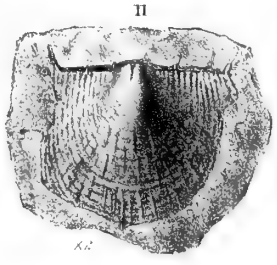
11

×2

Ge West & Son, lith. et imp.